DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

VELAGAPUDI RAMAKRISHNASIDDHARTHA ENGINEERING COLLEGE

SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME [VR17]

Syllabus for

Ist– VIIIth Semesters

VELAGAPUDI RAMAKRISHNASIDDHARTHA ENGINEERING COLLEGE

ELECTRONICS & INSTRUMENTATION ENGINEERING

Vision

- To impart excellent education to provide globally competent Electronics and Instrumentation Engineers.
- To establish Centre of Excellence and Research in Electronics and Instrumentation Engineering and allied fields.

Mission

- To prepare competent Electronics and Instrumentation Engineers who can pursue professional career and/or higher studies.
- To promote excellence in teaching with academically good ambiance that allows the learners to be socially responsible with professional ethics.

Program Educational Objectives(PEOs)

In alignment with the vision and mission of the department, the EIE graduates are expected to attain the PEOs listed below

1. Graduates excel in academic and professional career in Electronics and Instrumentation enabled industries or software industries or be an entrepreneur in the domain area.

2. Graduates pursue higher education in the core or allied areas of electronics and instrumentation engineering and actively contribute to academic/R&D activities.

3. Graduates exhibit professional and ethical attitudes having all-round personality to work in multi-disciplinary allied areas to be of use to the society.

VELAGAPUDI RAMAKRISHNASIDDHARTHA ENGINEERING COLLEGE

ELECTRONICS & INSTRUMENTATION ENGINEERING

Program Outcomes

1. An ability to apply knowledge of mathematics, science and engineering fundamentals appropriate to the discipline.
2. An ability to identify, formulate and solve problems by applying the principles of electronic instrumentation and control systems.
3. An ability to design and implement instrumentation and control systems to meet desired needs with appropriate consideration for public health and safety, environment, society, economics and sustainability.
4. An ability to design and conduct experiments as well as to analyze and interpret data.
5. An ability to use the techniques, skills and modern engineering tools necessary for his engineering practice.
6. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
7. Knowledge of contemporary issues.
8. An understanding of professional, ethical, legal and social issues and consequent responsibility relevant to professional engineering practice.
9. An ability to function on multidisciplinary teams.
10. An ability to communicate effectively with a range of audience in his professional engineering practice.
11. A recognition of the need for and an ability to engage in lifelong learning.
12. An ability to use engineering and management principles to one's own work, as a member and leader in a team to manage projects

Program Specific Outcomes

PSO1: Use basic engineering principles, concepts of measurement, and sensor selection to design an industrial process.

PSO2: Apply basic knowledge related to circuits and devices for designing electronic systems to solve engineering problems.

PSO3. Demonstrate proficiency in the use of software and hardware required in industrial automation systems

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SIDDHARTHA ENGINEERING COLLEGE
SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME [VR17]
ELECTRONICS & INSTRUMENTATION ENGINEERING

Semester I **Contact Hours: 26**

S.No	Course Code	Title of the Course	L	T	P	Credits
1.	17MA1101	Matrices and Differential Calculus	3	1	0	4
2.	17PH1102	Engineering Physics	3	0	0	3
3.	17CS1103	Problem Solving Methods	2	1	0	3
4.	17EE1104	Basics of Electrical Engineering	3	0	0	3
5.	17HS1105	Technical English and Communication Skills	2	0	2	3
6.	17PH1151	Engineering Physics Lab	0	0	3	1.5
7.	17CS1152	Computing and Peripherals Lab	0	0	2	1
8.	17ME1153	Basic Workshop	0	0	3	1.5
		Total	**13**	**2**	**10**	**20**
9.	17MC1106A	Technology and Society	1	0	0	-
10.	17MC1107	Induction Program				-

Semester II **Contact Hours: 27**

S.No	Course Code	Course	L	T	P	Credits
1.	17MA1201	Laplace Transforms and Integral Calculus	3	1	0	4
2.	17CH1202	Engineering Chemistry	3	0	0	3
3.	17CS1203	Programming in C	3	0	0	3
4.	17EI1204	Electronic Devices and Circuits	3	0	0	3
5.	17ME1205	Engineering Graphics	2	0	4	4
6.	17CH1251	Engineering Chemistry Lab	0	0	3	1.5
7.	17CS1252	Computer Programming Lab	0	0	3	1.5
		Total	**14**	**1**	**10**	**20**
8.	17MC1206B	Professional Ethics& Human Values	2	0	0	-

Semester III **Contact Hours: 28**

S.No	Course Code	Course	L	T	P	Credits
1.	17MA1301	Complex Analysis & Numerical Methods	3	1	0	4
2.	17EI3302	Network Theory	3	1	0	4
3.	17EI3303	Analog Electronic Circuits	3	1	0	4
4.	17EI3304	Sensors and Transducers	3	0	0	3
5.	17HS2305	Humanities Elective	1	0	0	1
6.	17TP1306	Logic & Reasoning	0	0	2	1
7.	17EI3351	Electronic Circuits Lab	0	0	3	1.5
8.	17EI3352	Transducers Lab	0	0	3	1.5
9.	17HS1353	Communication Skills Lab	0	0	2	1
Total			**13**	**3**	**10**	**21**
10.	17MC1307B	Indian Constitution	2	0	0	-

List of Humanities Electives

A	Yoga & Meditation	G	Film Appreciation
B	Music	H	Sanskrit Bhasa
C	Human Rights and Legislative Procedures	I	Foreign Languages (German/French)
D	Philosophy	J	Law for Engineers
E	Development of societies	K	Psychology
F	Visual Communication		

Semester IV **Contact Hours: 27**

S.No	Course Code	Course	L	T	P	Credits
1.	17EI3401	Analytical Instrumentation	3	0	0	3
2.	17EI3402	Integrated Circuits and Applications	3	1	0	4
3.	17EI3403	Industrial Instrumentation	3	1	0	4
4.	17EI3404	Electrical and Electronic Measurements	3	0	0	3
5.	17TP1405	English for Professionals	0	0	2	1
6.	17EI3406	Digital Circuits and Systems	3	0	0	3
7.	17EI3451	Analog and Digital Integrated Circuits Lab	0	0	3	1.5
8.	17EI3452	Measurements Lab	0	0	3	1.5
Total			**15**	**2**	**8**	**21**
9.	17MC1407A	Environmental Studies	2	0	0	-

Semester V **Contact Hours: 25**

S.No	Course Code	Course	L	T	P	Credits
1.	17EI3501	Control Systems	3	1	0	4
2.	17EI3502	Digital Signal Processing	3	1	0	4
3.	17EI3503	Microcontrollers and Embedded Systems	3	0	0	3
4.	17EI2504	Open Elective – I	3	0	0	3
5.	17EI2505	Open Elective –II (Inter Disciplinary Elective)	3	0	0	3
6.	17EI2506	Open Elective-III (Self-Learning Elective Course)*	0	0	0	2
7.	17HS1507	Personality Development	0	0	2	1
8.	17EI3551	Simulations Lab	0	0	3	1.5
9.	17EI3552	Microcontrollers and Embedded Systems Lab	0	0	3	1.5
Total			**15**	**2**	**8**	**23**
10.	17MC1508	Biology for Engineers	2	0	0	-

S.No	Course Code	Open Elective – I	L	T	P	Credits
1.	17EI2504/A	Biomedical Electronics	3	0	0	3
2.	17EI2504/B	Control System Components	3	0	0	3

S.No	Course Code	Open Elective – II (Inter Disciplinary Elective)	L	T	P	Credits
1.	17EI2505/A	Instrumentation Engineering	3	0	0	3
2.	17EI2505/B	Fundamentals of Industrial Automation	3	0	0	3

S.No	Course Code	Open Elective – III (Self-Learning Elective Course)	L	T	P	Credits
1.	17EI2506/A	MOOCS	0	0	0	2
2.	17EI2506/B	MOOCS	0	0	0	2

*Students can opt any one of the self-learning courses prescribed by the Department. Students register and complete the opted course in approved MOOCS platform on or before the Last Instruction Day of V semester. They have to submit the certificate before the Last Instruction Day of V semester

Semester VI **Contact Hours: 27**

S.No	Course Code	Course	L	T	P	Credits
1.	17EI3601	Process Control	3	1	0	4
2.	17EI3602	Computer Control of Processes	3	1	0	4
3.	17EI4603	Programme Elective-1	3	0	0	3
4.	17EI4604	Programme Elective -2	3	0	0	3
5.	17EI2605	Open Elective-IV	3	0	0	3
6.	17TP1606	Quantitative Aptitude	1	0	0	1
7.	17EI3651	Process Control Lab	0	0	3	1.5
8.	17EI3652	Virtual Instrumentation Lab	0	0	3	1.5
9.	17EI5653	Engineering Project for Community services*	0	1	2	2
Total			**16**	**3**	**8**	**23**

S.No	Course Code	Program Elective – I	L	T	P	Credits
1.	17EI4603/A	Fiber Optic Sensors	3	0	0	3
2.	17EI4603/B	VLSI Design	3	0	0	3
3.	17EI4603/C	Robotics and Control	3	0	0	3
4.	17EI4603/D	Industrial Communication Networks	3	0	0	3

S.No	Course Code	Program Elective – II	L	T	P	Credits
1.	17EI4604/A	Renewable Energy	3	0	0	3
2.	17EI4604/B	Industrial Electronics	3	0	0	3
3.	17EI4604/C	Process Modeling and Simulation	3	0	0	3
4.	17EI4604/D	Biomedical Signal Processing	3	0	0	3

S.No	Course Code	Open Elective – IV	L	T	P	Credits
1.	17EI2605/A	Virtual Instrumentation	3	0	0	3
2.	17EI2605/B	Intelligent Instrumentation Principles and Application	3	0	0	3

* Students will go to the society (Villages/ Hospitals / Towns etc,.) to identify the problem and survey the literature for a feasible solution. The work will be carried out during summer vacation after IV Semester. The student is encouraged to take up real life problems leading to innovative model building

Semester VII **Contact Hours: 25**

S.No	Course Code	Course	L	T	P	Credits
1.	17EI3701	Industrial Automation	3	1	0	4
2.	17EI4702	Programme Elective -3	3	0	0	3
3.	17EI4703	Programme Elective -4	3	0	0	3
4.	17EI4704	Programme Elective -5	3	0	0	3
5.	17HS1705	Engineering Economics and Finance	2	0	0	2
6.	17EI3751	Industrial Automation Lab	0	0	3	1.5
7.	17EI3752	Advanced Instrumentation Lab	0	0	3	1.5
8.	17EI5753	Mini Project *	0	0	4	2
9.	17EI6754	A Internship B Industry offered Course C Global Professional Certification				2
Total			**14**	**1**	**10**	**22**

S.No	Course Code	Program Elective – III	L	T	P	Credits
1.	17EI4702/A	Power Plant Instrumentation	3	0	0	3
2.	17EI4702/B	Industrial Internet of Things	3	0	0	3
3.	17EI4702/C	Wireless Sensor Networks	3	0	0	3
4.	17EI4702/D	Drives and Control for Industrial Automation	3	0	0	3

S.No	Course Code	Program Elective – IV	L	T	P	Credits
1.	17EI4703/A	Fundamentals of Petrochemical Engineering	3	0	0	3
2.	17EI4703/B	Database Management Systems	3	0	0	3
3.	17EI4703/C	Intelligent Systems and Control	3	0	0	3
4.	17EI4703/D	Digital Image Processing	3	0	0	3

S.No	Course Code	Program Elective – V	L	T	P	Credits
1.	17EI4704/A	Instrumentation and Control in Paper Industries	3	0	0	3
2.	17EI4704/B	Computer Networks	3	0	0	3
3.	17EI4704/C	Sensor Signal Conditioning	3	0	0	3
4.	17EI4704/D	Machine Learning	3	0	0	3

* Could be done in a group of students; involves working under a faculty member and carrying out a detailed feasibility study, literature survey and preparing a work plan for major project.

Semester VIII **Contact Hours: 19**

S.No	Course Code	Course	L	T	P	Credits
1.	17EI4801	Programme Elective – 6	3	0	0	3
2.	17EI2802	Open Elective –V*	3	0	0	3
3.	17EI5851	Major Project**	0	5	8	9
Total			**6**	**5**	**8**	**15**

S.No	Course Code	Program Elective – VI	L	T	P	Credits
1.	17EI4801/A	Measurement and Control in Food Processing	3	0	0	3
2.	17EI4801/B	Biomedical Instrumentation	3	0	0	3
3.	17EI4801/C	System Identification	3	0	0	3
4.	17EI4801/D	Real World Instrumentation with Python	3	0	0	3

S.No	Course Code	Open Elective – V	L	T	P	Credits
1.	17EI2802/A	MOOCS	3	0	0	3
2.	17EI2802/B	MOOCS	3	0	0	3

*Open Elective- V may also opt as self-learning course. Students register and complete the opted course in approved MOOCS platform on or before Last Instruction Day of VIII Semester. They have to submit the certificate before the last Instruction Day of VIII Semester. Students who have not opted as a self-learning are required to attend for the class work and internal assessment as per the regular theory course.

**Major project involves continuation of Mini Project. The objective is to complete the work as per the prepared work plan and prepare a detailed project report.

First Year
(I Semester)

17MA1101 - Matrices and Differential Calculus

Course Category:	Institutional Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Fundamentals of Matrices, Fundamentals of Calculus, Integration, Differentiation	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Determine Eigen values, Eigen vectors of a matrix													
	CO2	Estimate maxima and minima of multi variable functions													
	CO3	Solve the linear differential equations with constant coefficients													
	CO4	Solve the linear differential equations with variable coefficients													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3				1										
	CO2	3				1										
	CO3	3				1										
	CO4	3				1										

Course Content

UNIT- I

Matrices: Rank of a matrix, Elementary transformations, Inverse of a matrix (Gauss Jordan Method), Consistency of linear system of equations, Linear transformations, Vectors, Eigen values, Properties of Eigen values, Finding inverse and powers of a matrix by Cayley-Hamilton theorem. Reduction to diagonal form, Reduction of quadratic form to canonical form, Nature of a quadratic form, Complex matrices.

UNIT II

Differential Calculus: Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's theorem, Malaren's series.
Application: Curvature, Radius of curvature.

Functions of two or more Variables: Partial derivatives, Change of variables, Jacobians, Taylor's theorem for function of two variables, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers.

UNIT III

Differential Equations of First Order: Formation of a differential equation, Solution of a differential equation, Linear equations, Bernoulli's equation, Exact differential equations, Equations reducible to exact equations.

Applications: Orthogonal trajectories, Newton's law of cooling.

Linear Differential Equations of Higher Order: Definitions, Operator D, Rules for finding the complementary function, Inverse operator, Rules for finding

	farticular integral, Working procedure to solve the equation. **UNIT IV** Linear dependence of solutions, Method of variation of parameters, Method of undetermined coefficients, Equations reducible to linear equations with constant coefficients: Cauchy's homogeneous linear equation, Legendre's linear equation, Simultaneous linear differential equations with constant coefficients. **Applications:** L-C-R Circuits
Text books and Reference books	**Text Book:** [T1] B.S.Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Ed., 2014. **Reference Books:** [R1] Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Ed., John Wiley & Sons, 2015. [R2] B.V.Ramana, "Higher Engineering Mathematics", 1st Ed., Tata MC Graw Hill, 2007 [R3] N.P.Bali, Dr. Manish Goyal, "A Text Book of Engineering Mathematics", 9th Ed., Lakshmi Publications, 2014.
E-resources and other digital material	1. https://nptel.ac.in/courses/122104017/ 2. https://www.nptel.ac.in/courses/111105035/ 3. https://plus.maths.org/content/open-learning-foundation-mathematics-working-group

17PH1102–Engineering Physics

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 – 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the importance of quantum mechanics													
	CO2	Analyze and understand various types of lasers and their applications													
	CO3	Elaborate different types of optical fibers and understand holography													
	CO4	Understand the fabrication of nonmaterial's and carbon nanotubes													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3														
	CO2	3														
	CO3	3								2						
	CO4	3								2						

Course Content

UNIT- I

Quantum Mechanics: Dual nature of light, Matter waves and Debroglie's hypothesis, G. P. Thomson experiment, Heisenberg's uncertainty principle and its applications (Non existence of electron in nucleus, Finite width of spectral lines), One dimensional time independent Schrödinger's wave equation, Physical significance of wave function, Particle in a box (One dimension).

UNIT II

Lasers: Introduction, Characteristics of laser, Absorption, Spontaneous emission, Stimulated Emission, Pumping, Population inversion, Cavity resonance, Einstein's coefficients,

Different types of lasers: Solid-state lasers (Ruby, Neodymium), gas lasers (He-Ne, CO_2), Dye lasers, Applications of lasers in science, engineering and medicine.

UNIT III

Fibre Optics: Introduction, Fundamental of optic fibre, Propagation of light through optical fiber, Types of optical fibers, Numerical aperture, Fractional refractive index change, V- number and cut-off Parameters of fibres, Fibre attenuation (losses), Fiber optics in communication and its advantages.

Holography: Basic principle of Holography, Construction of the hologram, Reconstruction of the image, Applications of holography

UNIT IV

Nanotechnology: Basic concepts of Nanotechnology, Nano scale, Introduction to

	nano materials, Surface to volume ratio, General properties of Nano materials **Fabrication of nano materials**: Plasma Arcing, Chemical vapour deposition **Characterization of nano materials**: AFM, SEM, TEM, STM, Carbon nano tubes: SWNT, MWNT, Formation of carbon nanotubes: Arc discharge, Laser ablation, Properties of carbon nano tubes, Applications of CNT's & Nanotechnology.
Text books and Reference books	**Text Book:** [T1] M.N. Avadhanulu& P.G. Kshirsagar, "Engineering Physics", S. Chand Publications, Revised Edition, 2014 [T2] P.K. Palanisamy, "Applied Physics", Vth Ed., Scitech Publications (INDIA) Pvt. Ltd., 2008. **Reference Books:** [R1] B. K. Pandey and S. Chaturvedi, 'Engineering Physics' Cengage Learning', Delhi, 2012. [R2] O. Svelto, Principles of Lasers, VthEd., Springer, London, 2010. [R3] M.R. Srinivasan, "Engineering Physics", New Age International Publishers, IstEd., 2011.
E-resources and other digital material	1. https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/lecture-videos/ 2. https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/laser-fundamentals-i/ 3. https://nptel.ac.in/courses/112106198/19 4. https://www.peterindia.net/NanoTechnologyResources.html

17CS1103 – Problem Solving Methods

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 1 - 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the computer problem solving approaches, efficiency and analysis of algorithms													
	CO2	Apply the factoring methods to solve the given problem													
	CO3	Apply the array techniques to find the solution for the given problem													
	CO4	Solve the problems using MATLAB													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	2													
	CO2	1		3												
	CO3	1		3												
	CO4	1	1							3						

Course Content

UNIT- I

Introduction to Computer Problem Solving: Programs and algorithms, Characteristics of an algorithm, Requirements for solving problems by computer; Flowchart, Pseudo-code

The Problem– Solving Aspect: Problem definition phase, Getting started on a problem, Similarities among problems, Working backwards from the solution, General problemsolving strategies;

Top-Down design: Breaking a problem into sub-problems, Construction of loops, Establishing initial conditions for loops, Finding the iterative construct, Termination of loops;

The Efficiency of Algorithms: Redundant Computations, Referencing array elements, Inefficiency due to late termination, Early detection of desired output conditions, Trading storage for efficiency gains;

Analysis of Algorithms: Computational complexity, The order notation, Worst and average case behavior.

UNIT II

Fundamental Algorithms: Problem, Algorithm development, Algorithm description - Exchanging values of two variables, Counting, Summation of a set of numbers, Factorial computation, Generation of Fibonacci sequence, Reversing the digits of an Integer. Using pseudo-codes and flowcharts to represent fundamental

	algorithms. **Factoring Methods**: Finding the square root of a number: Smallest divisor of an Integer, GCD of two integers, Generating prime numbers, Computing the prime factors of an integer, Raising a number to a large power, Pseudo random number generation, Computing n^{th} Fibonacci number **UNIT III** **Array Techniques**: Introduction, Array order reversal, Array counting, Finding the maximum number in a set, Removal of duplicates from an ordered array, Partitioning an array, Finding The K^{th} Smallest Element. **Merging, Sorting and Searching**: Sorting by selection, Sorting by exchange, Linear search, Binary search **UNIT IV** **MATLAB Environment**: User interface, Syntax and Semantics operators, Variables and constants: Simple arithmetic calculations. Data types, Control structures: if…then, loops, Functions, Matrices and vectors: Matrix manipulations and operations. **MATLAB Programming**: Reading and writing data, File handling, MATLAB Graphic functions.
Text books and Reference books	**Text Book:** [T1]R.G.Dromey , "How to solve it by Computer", Prentice-Hall International Series in Computer Science,1982 [T2] Bansal.R.K, Goel.A.K, Sharma.M.K, "MATLAB and its Applications in Engineering", Pearson Education, 2012 **Reference Books:** [R1] Michael Schneider, Steven W. Weingart, David M. Perlman, "An Introduction to Programming and Problem Solving with Pascal", John Wiley and Sons Inc ,1984 [R2] David Gries, "The Science of Programming", SpringerVerlag, 1981 [R3] ReemaThareja, "Computer Fundamentals and C Programming", Oxford, 2012
E-resources and other digital material	1. https://www.mathworks.com

17EE1104 – Basics of Electrical Engineering

Course Category:	Engineering Sciences	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0– 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Analyze electric circuit fundamentals													
	CO2	Understand the basic concepts of alternating quantities and magnetic circuits													
	CO3	Analyze the basic concepts of electric machines													
	CO4	Understand measuring instruments and solar photo voltaic system concepts													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	1			2										
	CO2	3	1													
	CO3	2				2										
	CO4	2														

Course Content

UNIT- I

Introduction to Electrical Engineering: Electric current, Electromotive force, Electric power and energy, Basic circuit components- Resistors – Inductors- Capacitors. Electromagnetic phenomenon and related laws, Kirchhoff's laws.

Network Analysis: Network sources-Ideal independent voltage source, Ideal independent current source, Dependent sources, Practical voltage and current sources, Source conversion, Voltage and current division rule, Series and parallel connection of R, L and C, Star-Delta or, Delta- Star transformation. Mesh and nodal Analysis (with independent sources only).

UNIT II

Alternating Quantities: Introduction; Generation of a.c. voltages, Waveforms and basic definitions, Relationship between frequency, speed and number of poles, Root mean square and average values of alternating current and voltages, Form factor and peak factor, Phasor representation of alternating quantities.

Magnetic Circuits: Introduction, Magnetic circuits, Magnetic field strength (H), Magneto motive force, Permeability, Reluctance, Analogy between electric and magnetic circuits, Magnetic potential drop, Magnetic circuit computations, Self and mutual inductance, Energy in linear magnetic systems

UNIT III

DC Machines: Introduction, Construction of dc machines, Armature windings, Generation of dc voltage and torque production in a dc machine,Torque production in a dc Machine, Operation of a dc machine as a generator, Operation of dc machine

	as a motor. **Induction Motors:** Introduction, Constructional features of three-phase induction motors, Principle of operation of three-phase induction motor- Slip and rotor frequency, Voltage and current equations and equivalent circuit of an induction motor **UNIT IV** **Interface Measuring Instruments:** Introduction, Classification of instruments, Operating principles, Essential features of measuring instruments, Ammeters and voltmeters, Measurement of power. **Solar photovoltaic Systems**: Solar cell fundamentals, Characteristics, Classification, Module, Panel and array construction, Maximizing the solar PV output and load matching, Maximum Power Point Tracker(MPPT), Balance of system components, solar PV systems and solar PV applications.
Text books and Reference books	**Text Book:** [T1]T.K.Nagasarkar and M.S. Sukhja, "Basic Electric Engineering", 2nd Ed., Oxford University press 2011 **Reference Books:** [R1] B.H.Khan, "Non Conventional Energy Resources", 2nd Ed., Mc.Graw Hill Education PvtLtd.,New Delhi,2013 [R2] AshfaqHusain , Haroon Ashfaq, "Fundamentals of Electrical Engineering", 4th Ed., Dhanpat Rai & Co , 2014 [R3] I.J.Nagrath and Kothari , "Theory and problems of Basic Electrical Engineering", 2nd Ed., Prentice-Hall of India Pvt.Ltd.,2016
E-resources and other digital material	1. https://nptel.ac.in/courses/108108076/

17HS1105 – Technical English & Communication Skills

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0–2
Prerequisites:	Basic understanding of the language skills, viz Listening, Speaking, Reading and writing, including sentence construction abilities	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Develop administrative and professional compilations including web related(online) communication with felicity of expression													
	CO2	Demonstrate proficiency in interpersonal communication, in addition to standard patterns of pronunciation													
	CO3	Apply the elements of functional English with sustained understanding for authentic use of language in any given academic and/or professional environment													
	CO4	Execute tasks in technical communication with competence													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1				2	3	3	3	3		2					
	CO2				3	3	3	3	3		2					
	CO3	2			3	3	3	3	3		2					
	CO4	1	1	2	3	2	3	3	3		2					
Course Content	**UNIT- I** **Professional Writing Skills** ➢ Professional Letter- Business, Complaint and Transmittal ➢ Essay Writing- Descriptive and Analytical ➢ Administrative and On-line drafting skills –Minutes and Web notes including e-mail **UNIT II** **Interpersonal Communication Skills** ➢ Communicative Facet- Speech acts- Extending Invitation, Reciprocation, Acceptance, Concurrence, Disagreeing without being disagreeable ➢ Articulation-oriented Facet- Transcription using International Phonetic Alphabet, Primary Stress **UNIT III** **Vocabulary and Functional English** ➢ A basic List of 500 words – Overview ➢ Verbal analogies, Confusables, Idiomatic expressions and Phrasal Collocations ➢ Exposure through Reading Comprehension- Skimming, Scanning and														

	Understanding the textual patterns for tackling different kinds of questions ➢ Functional Grammar with special reference to Concord, Prepositions, use of Gerund and Parallelism **UNIT IV** **Technical Communication skills**: ➢ Technical Proposal writing ➢ Technical Vocabulary- a representative collection will be handled ➢ Introduction to Executive Summary ➢ Technical Report writing(Informational Reports and Feasibility Report
Text books and Reference books	**Text Book:** [T1] Martin Cutts, "Oxford Guide to Plain English", Oxford University Press, 7th Ed., 2011 [T2] TM Farhathullah, "Communication Skills for Technical Students", Orient Longman, Ist Ed., 2002 [T3] John Langan, "College Writing Skills", McGraw Hill, IXth Ed., 2014. "Eclectric Learning materials offered by the Department **Reference Books:** [R1] Randolph Quirk, "Use of English", Longman, Ist Ed., (1968) Reprinted 2004 [R2] Thomson A.J & A.V, Martinet, "Practical English Grammar", Oxford University Press, IIIrd Ed., 2001 [R3] V.Sethi and P.V. Dhamija, "A Course in Phonetics and Spoken English", PHI, IInd Ed., 2006
E-resources and other digital material	1. https://www.britishcouncil.org/english

17PH1151 – Engineering Physics Lab

Course Category:	Institutional Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0 –3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Use function generator, spectrometer and travelling microscope in various experiments													
	CO2	Test optical components using principles of interference and diffraction of light													
	CO3	Determine the V-I characteristics of solar cell and photo cell and appreciate the accuracy in measurements													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1		3	1												
	CO2		3	1												
	CO3		3	1												
Course Content	**Course Content** 1. Photo cell-Study of V-I characteristics, Determination of work function 2. Newton's rings-Radius of curvature of plano convex lens. 3. Compound pendulum-Measurement of 'g' 4. LCR circuit - Study resonance 5. AC Sonometer - Verification of vibrating laws 6. Solar cell - Determination of Fill Factor 7. Diffraction grating-Wavelength of laser light 8. Optical fiber- Study of attenuation and propagation characteristics 9. Diffraction grating-Measurement of wavelength of mercury source 10. Hall effect - Hall coefficient measurement 11. Figure of merit of a galvanometer 12. Variation of magnetic field along the axis of current-carrying circular coil														
Text books and Reference books	**Text Book:** [T1] Madhusudhan Rao, "Engineering Physics Lab Manual", 1st Ed., Scitech Publications, 2015 [T2] Ramarao Sri, ChoudaryNityanand and Prasad Daruka, "Lab Manual of Engineering Physics", 5th Ed., Excell Books, 2010														
E-resources and other digital material	1. http://vlab.amrita.edu/?sub=1&brch=201&sim=366&cnt=1 2. http://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1														

17CS1152 – Computing and Peripherals Lab

Course Category:	Institutional Core	**Credits:**	1
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0 – 2
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand and apply MS office tools													
	CO2	Configure the components on the motherboard and install different operating systems													
	CO3	Understand and configure different storage media													
	CO4	Perform networking, troubleshooting and system administration tasks													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3								2		1				
	CO2		1							2						
	CO3	3														
	CO4		2							2						

Course Content

CYCLE - I:

Word Processing, Presentations and Spread Sheets

1. **Word Processing**

a) Create personal letter using MS word.

b) Create a resume using MS word.

c) Creating project abstract: Features to be covered:- Table of content, List of tables, Formatting styles, Inserting table, Bullets and numbering, Changing text direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell check,Track changes.

d) Creating a newsletter: Features to be covered:- Table of content, List of figures, Newspaper columns, Images from files and clipart, Drawing toolbar and word art, Formatting images, Textboxes, Paragraphs and mail merge in word.

2. **Spread Sheets**

a) Create a worksheet containing pay details of the employees.

b) Creating a scheduler: Features to be covered:- Gridlines, Format cells, Summation, Auto fill,Formatting Text

c) Create a worksheet which contains student results: Features to be covered:- Cell referencing, Formulae in excel - average, Charts, Renaming and inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP, Sorting, Conditional formatting

d) Create a worksheet importing data from database and calculate sum of all the columns.

3. Presentations

a) Create a presentation using themes.
b) Save, edit, print and import images/videos to a presentation.
c) Create a power point presentation on business by using master layouts, adding animation to a presentation and see the presentation in different views

4. MS Access:

a) Create simple table in MS access for results processing.
b) Create a query table for the results processing table.
c) Create a form to update/modify the results processing table.
d) Create a report to print the result sheet and marks card for the result

CYCLE - II:

Hardware Experiments:

1) Identification of system layout: Front panel indicators & switches and front side & rear side connectors. Familiarize the computer system Layout: Marking positions of SMPS, Motherboard, FDD,HDD, CD, DVD and add on cards. Install hard disk. Configure CMOS- Setup. Partition and format hard disk.
2) Install and configure a DVD writer or a Blue - ray disc writer.
3) Install windows operating system and check if all the device (graphics, sound, network etc.) drivers are installed.
4) Install Linux operating system and check the working of all devices (graphics, sound, network etc.) in the computer.
5) Assemble a Pentium IV or Pentium Dual Core Pentium Core2 Duo system with necessary peripherals and check the working condition of the PC.
6) PC system layout: Draw a computer system layout and mark the positions of SMPS, Mother Board, FDD, HDD, and CD-Drive/DVDDrive add on cards in table top / tower model systems.
7) Mother board layout: Draw the layout of Pentium IV or Pentium Dual core or Pentium Core2 DUO mother board and mark processor, Chip set ICs. RAM, cache, Cooling fan, I/O slots and I/O ports and various jumper settings.
8) Configure BIOS setup program to change standard and advanced settings to troubleshoot typical problems.
9) Install and configure Printer/Scanner/Webcam/Cell phone/bio-metric device with system. Troubleshoot the problems

CYCLE – III : Networking

1) Prepare an Ethernet/UTP cable to connect a computer to network switch. Crimp the 4 pair cable with RJ45 connector and with appropriate color code.
2) Manually configure TCP/IP parameters (Host IP, Subnet mask and default gateway) for a computer and verify them using IPCONFIG command. Test connectivity to a server system using PING command.
3) Creating a shared folder in the computer and connecting to that folder using Universal Naming Convention (UNC) format. (Ex: computernamesharename)
4) Connects computers together via Switch/ Hub
5) Connect different devices via Switch/Hub
6) Statically configure IP address and subnet mask for each computer
7) Examine non-existent IP address and subnet conflicts
8) Configure a computer to connect to internet (using college internetsettings) and troubleshoot the problems using PING, TRACERT and NETSTAT commands.

	9) Using scan disk, disk cleanup, disk Defragmenter, Virus Detection and Rectifying Software to troubleshoot typical computer problems. 10) Configure DNS to establish interconnection between systems and describe how a name is mapped to IP Address. 11) Remote desktop connections and file sharing. 12) Installation antivirus and configure the antivirus. 13) Introducing Ethereal , a packet capture tool
Text books and Reference books	
E-resources and other digital material	1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00sc-introduction-to-computer-science-and-programming-spring-2011/

17ME1153 – Basic Workshop

Course Category:	Engineering Sciences	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0 – 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Model and develop various basic prototypes in the carpentry trade													
	CO2	Develop various basic prototypes in the trade of welding													
	CO3	Model and develop various basic prototypes in the trade of tin smithy													
	CO4	Familiarize with various fundamental aspects of house wiring.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1		2						1			3	2			
	CO2		2						1			3	2			
	CO3		2						1			3	2			
	CO4						1									

Course Content

UNIT I
Carpentry:

a. Study of tools & operations and various carpentry joints.
b. Practice of open bridle joint, Cross half lap joint, Half LapT Joint, and Dove tail joint
c. Simple group exercise like preparation of single widow frame.

UNIT II
Welding:

a. Study of tools and operations of Gas welding and arc welding.
b. Practice of various joints like weld layer practice, V- Butt Joint, Double parallel fillet joint, T-Joint, and Corner Joint**.**

UNIT III
Tin Smithy:

a. Study of tools & operations
b. Practice of various joints like Saw Edge, Wired Edge, Lap Seam, and Grooved Seam.
c. Simple exercise like Fabrication of square tray**.**

UNIT IV
House Wiring:

a. To connect one lamp with one switch.
b. To connect two lamps with one switch.
c. To connect a fluorescent Tube.
d. Stair case wiring.

	e. Godown wiring. f. Study of single phase wiring for a office room. g. Nomenclature & measurement of wire gauges and cables. h. Estimation of cost of indoor wiring for a wiring diagram (plan of a building). i. Test procedure for continuity of wiring in a electric installation. j. Measurement of electric energy by using meter.
Text books and Reference books	**Text Book:** [T1] Kannaiah P. & Narayana K. C., "Manual on Workshop Practice", Scitech Publications, Chennai, 1999 [T2] Venkatachalapathy, V. S., "First year Engineering Workshop Practice", RamalingaPublications, Madurai, 1999 **Reference Books:** [R1] Gopal, T.V., Kumar, T., and Murali, G., "A first course on workshop practice – Theory, Practice and Work Book", Suma Publications, Chennai, 2005.
E-resources and other digital material	

17MC1106A – Technology and Society

Course Category:	Institutional Core	**Credits:**	0
Course Type:	Theory	**Lecture - Tutorial - Practice:**	1 - 0 – 0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	0
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the origins of technology and its role in the history of human progress													
	CO2	Know the industrial revolution and its impact on society													
	CO3	Interpret the developments in various fields of technology till twentieth century.													
	CO4	Distinguish the impacts of technology on the environment and achievements of great scientists													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3										1				
	CO2	3					2									
	CO3	3										1				
	CO4	3					2									
Course Content	**UNIT- I** **Introduction:** Origins of technology, The agriculture revolution, Technological contributions of ancient civilizations-Mesopotamian, Egyptians, Greeks, Romans, Indians and Chinese. **UNIT II** **Industrial Revolution:**The social and political background, The technical background, Steam: The power behind the industrial revolution, The revolution in textile Industry, The impact of industrial revolution on society **UNIT III** **The Flowering of Modern Technology**: Manufacturing technologies, Prime movers, Internal combustion engines, Production of metals and alloys, The birth of electrical technology, Twentieth century: The flowering of modern technology **UNIT IV** **Technology, Science and Society:** Impact of technology on society, The impacts of technology on the environment, Sustainable development. **Achievements of famous scientists:** **(World):**Einestein, Newton, Faraday, Graham Bell, Edison, S.Hawking. **(India):** CV Raman, S.Chandrasekhar, Aryabhatta, Homi J Bhabha, Vikram														

	Sarabhai, APJ Abdulkalam, S.Ramanujan, M.Visweswarayya
Text books and Reference books	**Text Book:** [T1] Dr. R.V.G Menon, "Technology and Society", Pearson Education, 2011 **Reference Books:** [R1] Quan-Haase, A., "Technology and Society: Inequality, Power, and Social Networks", Oxford University Press, 2013.
E-resources and other digital material	

17MC1107 – Induction Program

Course Category:	Institutional Core	**Credits:**	0
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 0 – 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	0 0 0

First Year
(II Semester)

17MA1201 - Laplace Transforms and Integral Calculus

Course Category:	Institutional Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 – 0
Prerequisites:	Vectors, Curve Tracing	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Solve linear differential equations using Laplace transforms													
	CO2	Examine the nature of the infinite series.													
	CO3	Evaluate areas and volumes using double, triple integrals													
	CO4	Convert line integrals to area integrals and surface integrals to volume integrals													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3				1										
	CO2	3				1										
	CO3	3				1										
	CO4	3				1										

Course Content

UNIT- I

Laplace Transforms: Introduction, Definition, Conditions for existence, Transforms of elementary functions, Properties of Laplace transforms, Transforms of periodic functions, Transforms of derivatives, Transforms of integrals, Multiplication by ‘t’, Division by ‘t’, Inverse transforms, Method of partial fractions, Other methods of finding inverse transform, Convolution theorem, Unit step and Unit impulse functions.

Applications: Evaluation of improper integrals, Solving differential equations by Laplace transform

UNIT II

Partial Differential Equations: Introduction, Formation of partial differential equations, Solutions of partial differential equations, Equations solvable by direct integration, Linear equations of first order.

Sequence and Series: Convergence of series, Comparison test, Integral test, D’Alembert’s ratio test, Cauchy’s root test, Alternating series test, Absolute and conditional convergence.

UNIT III

Integral Calculus: Double integrals, Change of order of integration, Double integrals in polar coordinates, Triple integrals, Change of variables. Applications: Area enclosed by plane curves, Volumes of solids.

	Special Functions: Beta function, Gamma function, Relation between Beta and Gamma function, Error function. **UNIT IV** **Vector Calculus:** Scalar and vector point functions, Del applied to scalar point functions, Del applied to vector point functions, Physical interpretation of divergence, Del applied twice to point functions, Del applied to products of point functions. Integration of vectors, Line integral, Surface integral, Green's theorem in a plane, Stokes'stheorem, Volume integral, Gauss divergence theorem, Irrotationalfield
Text books and Reference books	**Text Book:** [T1] B.S.Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Ed., 2014. **Reference Books:** [R1] Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Ed., John Wiley & Sons, 2015. [R2] B.V.Ramana, "Higher Engineering Mathematics", 1st Ed., Tata MC Graw Hill, 2007 [R3] N.P.Bali, Dr. Manish Goyal, "A Text Book of Engineering Mathematics", 9th Ed., Lakshmi Publications, 2014.
E-resources and other digital material	1. https://nptel.ac.in/courses/122104017/ 2. https://www.nptel.ac.in/courses/111105035/ 3. https://plus.maths.org/content/open-learning-foundation-mathematics-working-group

17CH1202 – Engineering Chemistry

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Knowledge of chemistry at intermediate level	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Analyze various water treatment methods and boiler troubles													
	CO2	Apply the principles of spectroscopic techniques to analyze different materials and apply the knowledge of conventional fuels for their effective utilization.													
	CO3	Apply the knowledge of working principles of conducting polymers, electrodes and batteries for their application in various technological fields													
	CO4	Evaluate corrosion processes as well as protection methods													
Contribution of Course Outcomes towards achievement of Program Outcome **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O 2	PSO 3
	CO1		3													
	CO2	2														
	CO3											3				
	CO4			2												
Course Content	**UNIT- I** **Water Technology-I:** WHO standards - Water treatment for drinking purpose - Sedimentation, Coagulation, Filtration, Disinfection by chlorination, Breakpoint chlorination and its significance - Desalination of brackish water - Principle and process of electrodialysis and reverse osmosis, Advantages and disadvantages. **Water technology-II:** Boiler troubles - Scales formation, Disadvantages and internal conditioning methods - Phosphate conditioning, Calgon conditioning and sodium aluminate, Caustic embrittlement-reasons, Mechanism and its control, Boiler corrosion - Causes and control. **UNIT II** **Spectroscopic Techniques and Applications**: Interaction of electromagnetic radiation with matter - Ultraviolet-visible spectroscopy: Frank-Condon principle, Types of electronic transitions, Lambert-Beer's law – Definition and numerical problems, Problems on interpretation of UV-visible spectra of simple molecules of arenes, aldehydes and ketones. **Infrared (IR) spectroscopy**: Principle, Types of vibrations, Problems on interpretation of IR spectra of simple molecules of amines, Alcohols, Aldehydes and ketones.														

	Fuel Technology: Fuel- Definition, Calorific value - Lower and higher calorific values, Analysis of coal - Proximate analysis and ultimate analysis, Refining of petroleum, Fue gas analysis by Orsat's apparatus, Numericals based on calculation of air required for combustion **UNIT III** **Conducting Polymers:** Definition, Examples, Classification - Intrinsically conducting polymers and extrinsically conducting polymers - Mechanism of conduction of undopedpolyacetylene, Doping of conducting polymers - Mechanism of conduction of p-doped and n-doped polyacetylenes - Applications of conducting polymers. **Electrochemistry**: Construction and working of Calomel electrode, Silver-silver chloride electrode and principle, Construction and working of glass electrode, Determination of pH using glass electrode - Chemistry of modern batteries -Li/SOCl2 battery and LixC/LiCoO2 battery - Construction, Working and advantages, Chemistry of H2-O2 fuel cell - Advantages. **UNIT IV** **Corrosion Principles:** Introduction, Definition, Reason for corrosion, Examples - Electrochemical theory of corrosion, Types of electrochemical corrosion - Hydrogen evolution and oxygen absorption - Corrosion due to dissimilar metals, Galvanic series - Differential aeration corrosion - Pitting corrosion and concept of passivity. **Corrosion Control Methods**: Cathodic protection - Principle and types - Impressed current method and sacrificial anode method, Anodic protection - Principle and method, Corrosioninhibitors - Types and mechanism of inhibition - Principle, Process, Advantages of electroplating and electroless plating.
Text books and Reference books	**Text Book:** [T1] Shikha Agarwal, "Engineering Chemistry – Fundamentals and Applications", Cambridge University Press, New Delhi, 1st Ed., 2015. **Reference Books:** [R1] Sunita Rattan, "A Textbook of Engineering Chemistry", S.K. Kataria& Sons, New Delhi, 1st Ed., 2012. [R2] P.C. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Limited, New Delhi, 15th Ed. [R3] B.S. Bahl, G. D. Tuli and ArunBahl, "Essentials of Physical Chemistry", S. Chand and Company Limited, New Delhi. [R4] O. G. Palanna, "Engineering Chemistry", Tata McGraw Hill Education Pvt. Ltd., New Delhi. [R5] Y.Anjaneyulu, K. Chandrasekhar and ValliManickam, "Text book of AnalyticalChemistry", Pharma Book Syndicate, Hyderabad. [R6] H. Kaur, Spectroscopy, 1st Ed., 2001, PragatiPrakashan, Meerut
E-resources and other digital material	1. C:\Users\BANNULUCKY\paruc\Downloads\VR17 03-02-2020.docxhttp://www.cip.ukcentre.com/steam.htm 2. http://nopr.niscair.res.in/bitstream/123456789/5475/1/JSIR%2063%289%29%20715728.pdf 3. https://www.khanacademy.org/test-prep/mcat/physical-processes/infrared-andultraviolet-visible-spectroscopy/e/infrared-and-ultraviolet-visible-spectroscopyquestions 4. NPTEL online course, "Analytical Chemistry", offered by MHRD and instructed by Prof.Debashis Ray of IIT Kharagpur. 5. NPTEL online course, "Corrosion Part-I" offered by MHRD and instructed by Prof.KallolMondal of IIT Kanpur

17CS1203 – Programming in C

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Problem Solving Methods	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the fundamentals and structure of a C programming language													
	CO2	Apply the loops, arrays, functions and string concepts in C to solve the given problem													
	CO3	Apply the pointers and text input output files concept to find the solution for the given applications													
	CO4	Use the enumerated, datatypes, structures and unions													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3														
	CO2		1	3												
	CO3		1	3												
	CO4	3	1													
Course Content	**UNIT- I** **Introduction to the C Language**: Background, C programs, Identifiers, Types, Variables, Constants, Input/Output, Programming examples. **Structure of a C Program:** Expressions, Precedence and associatively, Evaluating expressions, Type conversion, Statements, Sample programs. **Selection:** Storage class,Logical data and operators, Two-Way selection, Multi-way selection, More standard functions **UNIT II** **Repetition:** Concept of a loop, Loops in C, Loop examples, Recursion, The calculator program. **Arrays:** Concepts, Using array in C, Inter-function communication, Array applications, Two dimensional arrays, Multi dimensional arrays. **Functions:** Functions in C, User defined functions, Inter function communication, Standard functions, Scope.														

	Strings: String concepts, C Strings, String Input/Output functions, Arrays of strings, String manipulation functions, String - Data conversion **UNIT III** **Pointers:** Introduction, Pointers for inter function communications, Pointers to pointers, Compatibility, Lvalue and Rvlaue. **Pointer Applications:** Arrays and pointers, Pointer Arithmetic and arrays, Passing an array to a function, Memory allocations functions, Array of pointers. **Text Input/output:** Files, Streams, Standard library Input/Output functions, Formatting Input/output functions and character Input/Output Functions, Command-line arguments. **UNIT IV** **Enumerations:** The type definition(Typedef), Enumerated types: Declaring an enumerated Type, Operations on enumerated types, Enumeration type conversion, Initializing enumerated constants, Anonymous enumeration:Constants, Input/Outputoperators. **Structures:**Structure type declaration, Initialization, Accessing structures, Operations on structures, Complex structures, Structures and functions, Sending the whole structure, Passing structures through pointers. **Unions:** Referencing Unions, Initializers, Unions and structures, Internet address, Programming applications.
Text books and Reference books	**Text Book:** [T1] Behrouz A. Forouzan& Richard F. Gilberg , "Computer Science A Structured Programming Approach using C" , 3rd Ed., Cengage Learning. **Reference Books:** [R1] Kernighan and Ritchie, "The C programming language", 2nd Ed., PHI. [R2] YashwantKanetkar , "Let us C" , BPB Publications, , 2nd Ed., 2001. [R3] Paul J. Dietel and Dr. Harvey M. Deitel, "C: How to Program", Prentice Hall, 7th Ed., 2012. [R4] Herbert Schildt, "C: The Complete reference", McGraw Hill, 4th Ed., 2002. [R5] K.R.Venugopal, Sundeep R Prasad, "Mastering C", McGraw Hill,2nd Ed., 2015.
E-resources and other digital material	

17EI1204 – Electronic Devices and Circuits

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Engineering Physics	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply modern physics concepts to determine the concentration and resistivity of semiconductor materials.													
	CO2	Analyze basic diode circuits for various applications													
	CO3	Analyze the operation of BJTs and FETs													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PSO 2	PSO 3
	CO1	2													2	
	CO2		3												2	
	CO3		3												2	
Course Content	**UNIT- I** **Conduction in Semiconductors:** Conductivity of a semiconductor, Carrier Concentrations in an intrinsic semiconductor, Donor and acceptor impurities, Charge densities in a semiconductor, Diffusion, **Semiconductor Diode Characteristics :** Qualitative theory of P-N junction, P-N junction as a diode, The volt ampere characteristics, The temperature dependence of P-N characteristics, Diode resistance, Space charge or transition capacitance, Diffusion capacitances. Breakdown diodes. **UNIT II** **Diode Applications:** Diode approximations, Series diode configurations with DC inputs, Parallel and series - Parallel configurations with DC inputs, Clippers, Clampers. **Rectifiers**: Diode as a rectifier, Half wave, Full wave - Centre-tapped, Bridge rectifiers without filter and with filters - Inductor filter, Capacitor filter, L section, Zener regulator **UNIT III** **Transistor Characteristics:** The junction transistor, Characteristics of common base, Common emitter and common collector configuration. **Transistor Biasing and Thermal Stabilization:** The operating point, Bias stability, Collector to base bias, Self bias, Bias compensation, Thermistor and sensistorcompensation, Thermal runaway and thermal stability														

	UNIT IV **Field Effect Transistors:** Construction and characteristics of JFETs, Transfer characteristics, Specification sheets (JFETs), Depletion-type MOSFET and enhancementtype MOSFET **FET Biasing:** Introduction, Fixed bias configuration, Self bias configuration, Voltage divider biasing, Depletion type MOSFET and Enhancementtype MOSFET
Text books and Reference books	**Text Book:** [T1] Jacob Millman, Christos C Halkias&Satyabrata JIT, "Millman'sElectronic Devices and Circuits", 4th Ed., TMH, 2015. (Unit I, II& III). [T2] Robert L Boylested and Louis Nashelsky, "Electronic Devices and Circuit Theory", 10th Ed., Pearson India, 2009. (UNIT IV). **Reference Books:** [R1] Nandita Das Gupta and AmitavaDas Gupta, "Semiconductor Devices Modelling and Technology", PHI Learning Pvt. Ltd., 2013 [R2] DavidA Bell., "Electronic Devices and Circuits", 5th Ed., Oxford University Press, 2008
E-resources and other digital material	1. http://www.nptelvideos.in/2012/12/basic-electronics-drchitralekha-mahanta.html 2. http://nptel.ac.in/courses/117103063/ 3. http://nptel.ac.in/courses/117106033/ 4. http://nptel.ac.in/courses/117102061/

17ME1205 – Engineering Graphics

Course Category:	Institutional Core	**Credits:**	4
Course Type:	Theory and Practice	**Lecture - Tutorial - Practice:**	2 - 0 - 4
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the scales, conics and cycloidal curves.													
	CO2	Draw orthographic projections of points, lines, planes and solids													
	CO3	Understand sectional views of solids, development of surfaces and their representation													
	CO4	Construct isometric scale, isometric projections, isometric views and convert pictorial views to orthographic projections													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3				3				3						
	CO2	2				3				3						
	CO3	2				3				3						
	CO4	1				3				3						

Course Content

UNIT- I

Introduction to Engineering Drawing: Principles of engineering graphics and their significance

Scales: Construction of plain and diagonal scales

Conic Sections: Construction of ellipse, Parabola and hyperbola (Treatment is limited to eccentricity or general method only)

Engineering Curves: Cycloidal curves - Cycloid, Epicycloid and Hypocycloid

UNIT II

Orthographic Projections: Principles of orthographic projections - Projections of points, Lines (Treatment is limited to first angle projection) and Projections of plane regular geometric figures (upto plane inclined to both of the reference planes)

UNIT III

Projections of Solids: Projections of simple solids such as cubes, prisms, pyramids, cylinders and cones with varying positions (limited to solid inclined to one of the reference planes)

Sections of Solids: Sections of solids such as cubes, prisms, pyramids, cylinders and cones. True shapes of sections (limited tothe solids perpendicular to one of the principal

	planes) **UNIT IV** **Development of Surfaces:** Lateral development of cut sections of cubes, prisms, pyramids, cylinders and cones **Isometric Projections:** Isometric Projection and conversion of isometric views into Orthographic Projections (Treatment is limited to simple objects only) **Conventions Auto CAD:** Basic principles only (Internal assessment only)
Text books and Reference books	**Text Book:** [T1]N.D. Bhatt & V.M. Panchal, "Elementary Engineering Drawing", Charotar Publishing House, Anand. 49th Ed., 2006. [T2] Basanth Agrawal & C M Agrawal," Engineering Drawing", McGraw Hill Education Private Limited, New Delhi **Reference Books:** [R1] K. L. Narayana & P. Kannaiah, "Text Book on Engineering Drawing", Scitech publications (India) Pvt. Ltd.,Chennai, 2nd Ed., fifth reprint 2006 [R2] K. Venugopal, "Engineering Drawing and Graphics + Auto CAD", New Age International, New Delhi [R3] D M Kulkarni, AP Rastogi, AK Sarkar, "Engineering Graphics with Auto CAD", PHI Learning Private Limited, Delhi Edition – 2013
E-resources and other digital material	1. https://www.slideshare.net/ 2. http://edpstuff.blogspot.com/

17CH1251 – Engineering Chemistry Lab

Course Category:	Institutional Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0 – 3
Prerequisites:	Knowledge of chemistry practical's at intermediate level	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Analyze quality parameters of water samples from different sources													
	CO2	Perform quantitative analysis using instrumental methods													
	CO3	Apply the knowledge of mechanism of corrosion inhibition, metallic coatings and photochemical reactions													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1				3											
	CO2					2										
	CO3		2													

Course Content

List of Experiments:

1. Determination of total alkalinity of water sample
2. Determination of chlorides in water sample
3. Determination of hardness of water sample
4. Determination of available chlorine in bleaching powder
5. Determination of copper in a given sample
6. Determination of Mohr's salt - Dichrometry
7. Determination of Mohr's salt - Permanganometry
8. Determination of purity of boric acid sample
9. Conductometric determination of a strong acid using a strong base
10. pH metric titration of a strong acid vs. a strong base
11. Determination of corrosion inhibition efficiency of an inhibitor for mild steel
12. Chemistry of blue printings
13. Preparation of urea-formaldehyde resin

Text books and Reference books

Reference Books:

[R1] K. Bhasin and Sudha Rani, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Company, 2nd Ed., New Delhi.

[R2] Sunitha Rattan, "Experiments in Applied Chemistry", 2nd Ed., S.K. Kataria& Sons, New Delhi.

E-resources and other digital material

17CS1252 – Computer Programming Lab

Course Category:	Institutional Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Implement the use of programming constructs in a structured oriented programming language														
	CO2	Analyze and implement user defined functions to solve real time problems														
	CO3	Implement the usage of pointers and file operations on data														
	CO4	Implement the user defined data types via structures and unions to solve real life problems														
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3														
	CO2								1	3						
	CO3								1	3						
	CO4	3							1							

Course Content

CYCLE - I:

1. **Introduction to C Programming:**
   a) Use of Turbo C IDE
   b) The structure of C Program with sample program
2. **Data Types and Variables:**
   a) Programs to usage of keywords and identifiers in c
   b) Programs on declaration of variables, rules for naming a variable, constants and different type of constants, data types
   c) Programs to perform on various operators in C
3. **Branching and Selection:**
   a) To specify the conditions under which a statement or group of statements should be executed.
   b) To choose exactly one out of two statements (possibly compound statements) to be executed; specifies the conditions under which the first statement is to be executed and provides an alternative statement to execute if these conditions are not met.
   c) To choose one statement (possibly compound) to be executed from among a group of statements (possibly compound); specifies the conditions under which each statement may be executed and may contain a default statement (in an else clause at the end) to be executed if none of these conditions are met. Note that in the absence of a final else clause, it may be the case that none of the statements are executed

	4. Unconditional control Transfer statements in C: a) Design and develop programs that use of gotostatement b) Design and develop programs that use break statement c) Design and develop programs that use continue statement **5. Looping constructs:** Design and develop programs based on a) Iterative loops using While, Do While, For, Nested For b) Selection statement using the switch-case statement c) Multiple way selections that will branch into different code segments based on the value of a variable or expression **6. Arrays:** a) Design and develop programs which illustrates the implementation of singledimensional arrays and multi dimensional arrays **7. Strings:** a) Create programs to initialize strings and usage of them for various input, output operations. b) Design and develop programs to handle string functions **CYCLE - II:** **Advanced Programming Constructs** **1. Concept of user defined functions** a) Design and develop programs depending on functions both user defined and standard library functions in C with different approaches **2. File handling operations** a) FILE structure b) Opening and closing a file, file open modes c) Reading and writing operations performed on a file d) File Pointers: stdin, stdout and stderr **e)** FILE handling functions: fgetc(), fputc(), fgets() and fputs() Functions **3. Pointers:** a) Programs on declaration of pointers and their usage in C b) Programs to relate between arrays and pointers and use them efficiently in a program c) To pass pointers as an argument to a function, and use it efficiently in program **4. Command Line Arguments** a) Design and develop programs that accept arguments from command line to perform different kinds of operations **5. Structures and Unions** a) Programs to define, declare and access structure and union variables b) Design and develop programs to work with pointers to access data within a structure programs to pass structure as an argument to a function
Text books and Reference books	**Text Books:** [T1] Ashok N Kamthane, "C And Data Structures", Pearson Education; 1st Ed., 2008. **Reference Books:** [R1] Brain W Kernighan and Dennis Ritchie, "The C Programming language", Pearson Education India,2015 [R2] David Griffiths and Dawn Griffiths, "Head First C:A Brain Friendly Guide", O:Reilly media, 2012

E-resources and other digital material	1. https://nptel.ac.in/courses/106104128/ 2. https://www.youtube.com/watch?v=S47aSEqm_0I&list=PLeCxvb23g7hrw27XlekHtfygUTQ0TmFfP 3. https://www.youtube.com/watch?v=zjyR9e-N1D4&

17MC1206B – Professional Ethics & Human Values

Course Category:	Mandatory Learning	**Credits:**	0
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0 - 0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	00
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Know the moral autonomy and uses of ethical theories													
	CO2	Understand morals, honesty and character													
	CO3	Understand about safety, risk and professional rights													
	CO4	Know the ethics regarding global issues related to environment, computers and weapon's development													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2														
	CO2								2							
	CO3						3									
	CO4											2				
Course Content	**UNIT- I** **Engineering Ethics:** Senses of engineering ethics - Variety of moral issues- Types of inquiry - Moral dilemmas - Moral autonomy - Kohlberg's theory -Gilligan's theory - Consensus and controversy - Models of professional roles - Theories about right action –Selfinterest - Customs and religion- Uses of ethical theories. **UNIT II** **Human Values**:Morals, Values and ethics - Integrity- Work ethic - Service learning - Civic virtue - Respect for others - Living peacefully - Caring - Sharing - Honesty - Courage - Valuing time - Co-operation - Commitment – Empathy - Self confidence - Character - Spirituality. **UNIT III** **Projections Engineering as Social Experimentation:** Engineering as experimentation - Engineers as responsible experimenters - Codes of ethics - A balanced outlook on law - The challenger case study, Safety, Responsibilities and Rights: Safety and risk - Assessment of safety and risk - Risk benefit analysis and reducing risk - The three mile island and chernobyl case studies. Collegiality and loyalty - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights - Intellectual Property Rights (IPR) - Discrimination. **UNIT IV** **Global Issues:** Multinational corporations - Environmental ethics - Computer ethics - Weapons development - Engineers as managers - Consulting engineers - Engineers														

	as expert witnesses and advisors - Moral leadership - Sample code of ethics (specific to a particular engineering discipline).
Text books and Reference books	**Text Book:** [T1] Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York 1996. [T2] Govindarajan M, Natarajan S, Senthil Kumar V. S., "Engineering Ethics", Prentice Hall of India, New Delhi2004. **Reference Books:** [R1] K. Baum, R.J. and Flores, A., "Ethical Problems in Engineering, Center for the studyof the Human Dimensions of Science and Technology", Rensellae Polytechnic Institute,Troy, New York, 1978. [R2] Beabout, G.R., Wennemann, D.J. "Applied Professional Ethics: A Developmental Approach for use with Case Studies", University Press of America Lanham, MD,1994.
E-resources and other digital material	

Second Year
(III Semester)

17MA1301 – Complex Analysis and Numerical Methods

Course Category:	Basic Sciences	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 -1- 0
Prerequisites:	Algebra of complex numbers, Convergence of infinite series, Theory of equations	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Determine analytic and non analytic functions and understand the concept of complex integration													
	CO2	Analyze Taylor and Laurent series and evaluation of real definite integrals using residue theorem and understand the concept of transformations													
	CO3	Solve algebraic and transcendental, system of equations and understand the concept of polynomial interpolation													
	CO4	Understand the concept of numerical differentiation and integration. Solve initial and boundary value problems numerically													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3						1								
	CO2	3						1								
	CO3	3			2	2		1								
	CO4	3			2	2		1								

Course Content

UNIT- I

Complex Analysis: Introduction, Continuity, Cauchy-Riemann equations, Analytic functions, Harmonic functions, Orthogonal systems, Complex integration, Cauchy's integral theorem, Cauchy's integral formula

UNIT II:

Taylor's series, Laurent's series, Zeros and singularities. Residue theorem, Calculation of residues, Evaluation of real definite integrals (by applying the residue theorem).
Standard transformations: Translation - Magnification and rotation - Invertion and reflection - Bilinear transformation.

UNIT III:

Numerical Methods: Solution of algebraic and transcendental equations: Introduction, Newton - Raphson method, Solution of simultaneous linear equations - Gauss elimination method - Gauss - Seidel iterative method.

Interpolation: Introduction, Finite differences - Forward, Backward, Central differences, Symbolic relations, Differences of a polynomial, Newton's formulae for interpolation, Central difference interpolation formulae - Gauss's, Sterling's, Bessel's formulae interpolation with unequal intervals - Lagrange's and Newton's interpolation formulae.

	UNIT – IV **Numerical Differentiation and Integration**: Finding first and second order differentials using Newton's formulae, Trapezoidal rule and Simpsons 1/3 rule **Numerical Solutions of Differential Equations**: Taylor's series method, Picard's method, Euler's method, Runge - Kutta method of 4th order, Boundary value problems, Solution of Laplace's and Poisson's equations by iteration
Text books and Reference books	**Text Book:** [T1] B.S.Grewal,"Higher Engineering Mathematics",42nd Ed., Khanna Publishers, 2012. **Reference Books:** [R1] Krezig, "Advanced Engineering Mathematics", 8th Ed., JohnWiley& Sons.2007. [R2] R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", 3rd Ed., Narosa Publishers [R3] N.P.Bali, Manish Goyal, "A Text book of Engineering Mathematics", 1st Ed., Lakshmi Publications (P) Limited, 2011. [R4] H.K.Das, Er. RajnishVerma, "Higher Engineering Mathematics", 1st Ed., S.Chand& Co., 2011 [R5] S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 2005.
E-resources and other digital material	

17EI3302 – Network Theory

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1– 0
Prerequisites:	Calculus, Basics of Electrical Engineering	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes

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

CO1	Apply the basic network concepts to solve electric circuit problems.
CO2	Analyse DC and AC electrical circuits using various network problems.
CO3	Analyse the Transient behaviour and Resonant condition of electrical circuits.
CO4	Derive the two port network parameters and their relationship.

Contribution of Course Outcomes towards achievement of Program Outcomes

(1 – Low, 2 - Medium, 3– High

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2														
CO2		3												3	
CO3		2												2	
CO4			1												

Course Content

UNIT- I

Introduction of Circuit Elements: Circuit concepts, Active and passive circuit elements; Ideal, Practical and dependent sources and their V-I characteristics, Source transformation, Voltage and current division; V-I characteristics of passive elements and their series / parallel combination; Star Delta transformations and problems. Energy stored in inductors and capacitors,

UNIT - II

Network Theorems: Mesh and nodal analysis having independent and dependent sources with problems; Application of theorems to DC circuits. Superposition theorem, Thevenin's and Norton's theorems, Reciprocity, Maximum power transfer theorems.

UNIT - III

Sinusoidal Steady State Analysis: 'j' notation and concept of phasor, Phasor notation of voltage, Current and circuit elements in single phase and three phase circuits, Mesh and nodal analysis of obtaining steady state response of R,L,C circuits with problems, Application of network theorems such as superposition theorem, Thevenin's and Norton's theorems, Maximum power transfer theorems to AC circuits. Computation of active power, Power factor.

UNIT - IV

Resonance and Transients: Series and parallel resonance, Selectivity, Bandwidth and Q factor, Series and parallel RLC circuits. Transient analysis of RL, RC, RLC circuits with DC using Laplace transforms.

	Two-port networks: Calculation ofZ, Y and h parameters and their conversions.
Text books and Reference books	**Text Book:** [T1] A Sudhakar and S.P.Shyam Mohan, "Circuits and Networks: Analysis and Synthesis", 2nd Ed., TMH, 2002 **Reference Books:** [R1] FraklinF.Kuo, "Network Analysis and Synthesis", 2nd Ed., John Wiley & Sons, 2003 [R2] William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", 6thEd., TMH, 2002
E-resources and other digital material	

17EI3303 – Analog Electronic Circuits

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3- 1- 0
Prerequisites:	Electronic Devices and Circuits	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Determine the parameters of BJT and FET amplifiers at low frequencies.													
	CO2	Analyze various feedback amplifiers.													
	CO3	Analyze different oscillator circuits.													
	CO4	Analyze various types of power amplifiers used in electronic applications with respect to efficiency.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3				2									3	1
	CO2		2			2									2	1
	CO3		3												3	
	CO4		2			2									2	1

Course Content

UNIT- I

Transistor Amplifiers at Low frequencies

BJT Amplifiers: Hybrid parameter model of transistor, Analysis of transistor amplifier using hparameter model, Simplified CE hybrid model, Simplified calculations for CC & CB configurations, Cascaded stage(CE-CE),Cascode(CE-CB),Darlington Pair(CC-CC).

FET Amplifiers: FET small signal model, Analysis of FET amplifiers at low frequencies - CS/CD/CG configurations

UNIT- II

Feedback Amplifiers: Feedback concepts, General characteristics of negative feedback amplifiers, Input resistance & output resistance, Method of analysis of feedback amplifiers - Voltage series, Current series, Voltage shunt, Current shunt feedback amplifiers.

UNIT- III

Oscillators: Classification of oscillators, Sinusoidal oscillators, Barkhausen criteria, RC phase shift oscillator using BJT, Wein bridge oscillator, LC oscillators - Hartley and Colpitts Oscillator

UNIT- IV

Power Amplifiers: Classification of power amplifiers, Class A series fed and transformer coupled, Second harmonic distortion, Class B transformer coupled push-

	pull and complementary symmetry push-pull, Cross over distortion
Text books and Reference books	**Text Book:** [T1]JacobMillman and Christos C Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems", 12th Ed., TMH, 1991. (UNIT I,II& III) [T2] A.Anandkumar , "Pulse and Digital Circuits", 2nd Ed., PHI,2010. (UNIT IV) **Reference Books:** [R1] G.KMithal, "Electronic Devices and Circuits", 23rd Ed., Khanna Publishers 2010. [R2]RobertBoylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 6th Ed., PHI 2000
E-resources and other digital material	1. http://nptel.iitm.ac.in/courses.php?branch=Ece

17EI3304 – Sensors and Transducers

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Analyze the various performance characteristics of instrument														
	CO2	Apply transduction principles in parameter measurement.														
	CO3	Select the relevant transducer for measurement of displacement, velocity and acceleration														
	CO4	Illustrate the additional attributes in sensors advancement.														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1		3											3		
	CO2	2												2		
	CO3		2											2		
	CO4	2												2		

Course Content

UNIT- I

Instrument Characteristics: Block diagram of generalized instrument system, Static characteristics - Desirable & Undesirable characteristics; Dynamic characteristics - Transfer function, Dynamic response of zero order, First order and second order instruments to step input.

Measurement Errors and Statistical Analysis: Definition of parameters, Combination of limiting error, Statistical treatment, Curve fitting methods.

UNIT- II

Transducers: Classification of transducers, Characteristics of transducers.

Passive Transducer Principles: Variable resistance - Change in length and area;Variable inductance - Change in self inductance, Change in mutual inductance, Production of eddy currents, Variable capacitance - Change in area, Distance and dielectric**.**

Active Transducer Principles: Thermoelectric, Piezoelectric and Photoelectric effects.

UNIT- III

Displacement Measurement: Introduction, Pneumatic transducers - Flapper Nozzle transducer; Electrical transducers - Resistive, inductive and capacitive; Digital displacement transducer.

Velocity, Acceleration and Vibration Measurement: Electromagnetic tachometer,

	Digital Methods- Photo electric and toothed rotor variable reluctance tachometers, Principles of accelerometers, Types of accelerometers - LVDT, Strain guage and piezo electric accelerometers. **UNIT- IV** **Developments in Sensor Technology:** Introduction, Smart sensors, Micro sensors, IR radiation sensors, Ultrasonic sensors, Fiber optic sensors, Chemical sensors and Bio sensors.
Text books and Reference books	**Text Book:** [T1] A.K.Ghosh, "Introduction to Measurements & Instrumentation",3rdEd., PHI, 2009. (UNIT I) [T2] A.K.Sawhney&PuneetSawhney,"A Course in Mechanical Measurements & Instrumentation", 12thEd., Dhanapat Rai & Co., 2012. (UNIT II & III) [T3] D.V.S.Murty, "Transducers & Instrumentation", 2nd, Ed., PHI. (UNIT IV) **Reference Books:** [R1] Raman Pallas-Arney& John G.Webster, "Sensors & Signal Conditioning", 2ndEd., J. Wiley,2012. [R2] D.Patranabis, "Sensors and Transducers" 2nd Ed., PHI, 2013
E-resources and other digital material	1. http://nptel.ac.in/courses/112103174/4 2. http://nptel.ac.in/courses/112103174/3

17HS2305 – Humanities Elective

Course Category:	Humanities and Social Sciences	**Credits:**	1
Course Type:	Theory	**Lecture - Tutorial - Practice:**	1 - 0- 0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	00
		Total Marks:	100

List of Humanities Electives

A	Yoga & Meditation	G	Film Appreciation
B	Music	H	Sanskrit Bhasa
C	Human Rights and Legislative Procedures	I	Foreign Languages (German/French)
D	Philosophy	J	Law for Engineers
E	Development of societies	K	Psychology
F	Visual Communication		

17HS2305A –Yoga and Meditation

Course Category:	Humanities Elective	**Credits:**	1
Course Type:	Practical	**Lecture - Tutorial - Practice:**	1 - 0- 0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Equip better attitude and behaviour														
	CO2	Imbibe set of values enabling a balanced life focused on an ethical material														
	CO3	Develop levels of concentration through mediation														
	CO4	Apply conscience for the missions of life.														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1						2									
	CO2						2									
	CO3						2									
	CO4						2									

Course Content

UNIT- I

Understanding Yoga: Orientation, Introduction to values, The positive impact of yoga, Application of values in real life, Universal values**.**

(**Lec-demo pattern with illustrations representing Yogic Postures and value system related pictorial will be followed**)

UNIT- II

Yogic Practices: Yoga, Self and Ultimate goal of yoga, Introduction to various types of yoga, Integration of values in Yoga.

(Activity based processes with Assasanas and Pranayama will be implemented)

UNIT- III

Practice of Meditation: Art of meditation, Observation, Introspection, Contemplation, Meditation and concentration

(Activity based processes involving Mediation sessions followed by demonstrations will be implemented)

UNIT- IV

Towards Professional Excellence through Yoga and Meditation: Stress management, Choices we make, Excellence and integration.

(Lec-demo pattern will be followed)

Text books and Reference

Text Book:

[T1] Common Yoga protocol, Ministry of Ayush, Govt of India

[T2] Journey of the Soul- Michael Newton, 2003, Llewellyn

books	**Reference Books:** [R1]Lectures from Colombo to Almora, Swami Vivekakanada, 2010 Ramakrishna Mission. [R2] Essays of Ralph Waldo Emerson, 1982, Eastern press [R2] Eclectic materials offered by English Dept.
E-resources and other digital material	1. www.heartfulness.org 2. www. ayush.gov.in 3. www. belurmath.org

17HS2305D – Philosophy

Course Category:	Humanities Elective	**Credits:**	1
Course Type:	Practical	**Lecture - Tutorial - Practice:**	1 - 0- 0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand major philosophical issues													
	CO2	Appreciate the philosophical doctrines of western thinkers													
	CO3	Understand the eminence of Indian classical thought													
	CO4	Appreciate relation between science and values													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2															
	CO3															
	CO4															
Course Content	**UNIT- I** What's Philosophy: Definition, Nature, Scope and branches. **UNIT- II** Introduction to western philosophy: Ancient Greek and modern philosophy **UNIT- III** Introduction to Indian thought: Six systems - Modern philosophers **UNIT- IV** Philosophy of science&technology: Human values and professional ethics														
Text books and Reference books	**Text Book:** [T1] "The Story of Philosophy",Will Durant, Simon & Schuster 1926 [T2] "An Introduction to Philosophy",O.O.Fletcher, Word Public Library,2010 **Reference Books:** [R1] Six Systems of Indian Philosophy, DH Dutta [R2] The Pleasures of Philosophy, Will Duran, Simon & Schuster,1929														
E-resources and other digital material															

17HS2305I – Foreign Language (German)

Course Category:	Humanities Elective	**Credits:**	1
Course Type:	Practical	**Lecture - Tutorial - Practice:**	1 - 0- 0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Learn basics of German language													
	CO2	Write German writing													
	CO3	Understand German hearing													
	CO4	Form sentence in present, past and future tense													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1										2					
	CO2										2					
	CO3											2				
	CO4											2				
Course Content	**UNIT- I** Alphabets, Numbers, Exact articles and not exact Articles **UNIT- II** Prepositions, Present tense **UNIT- III** Past Tense and about family **UNIT- IV** Future tenses														
Text books and Reference books	**Text Book:** [T1] Studio d A1Cornelsen Goyalaas Publications New Delhi.														
E-resources and other digital material															

17HS2305K – Psychology

Course Category:	Humanities Elective	**Credits:**	1
Course Type:	Practical	**Lecture - Tutorial - Practice:**	1 - 0- 0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Relate biological and socio-cultural factors in understanding human behaviour													
	CO2	Understand the nature of sensory processes, types of attentions													
	CO3	Explain different types of learning and the procedures, distinguishes between different types of memory													
	CO4	Demonstrate an understanding of some cognitive processes involved in problem solving and decision-making													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1						2									
	CO2						2									
	CO3						2									
	CO4						2									
Course Content	**UNIT- I** Introduction: Psychology as a scientific study of behaviour. Biological and socio-cultural bases of behaviour, Fields of psychology **UNIT- II** Sensory and perceptual processes: Sensation, Attention and perception **UNIT- III** Cognition and affect: Learning and memory. Emotion and motivation **UNIT- IV** Thinking, Problem solving and decision making, Personality and intelligence														
Text books and Reference books	**Text Book:** [T1] Zimbardo, P. G. "Psychology and Life" 20th Ed., Pearson Education, 2013. **Reference Books:** [R1] Baron, R. A. "Psychology" 5th Ed., New Delhi: Pearson Education, 2006 [R2] Coon, D., &Mitterer, J. O. "Introduction to Psychology: Gateway to Mind and Behaviour" New Delhi: Cengage, 2007. [R3] Feldman, R. S. "Psychology and your Life" 2nd Ed., McGraw Hill, 2013														
E-resources															

17TP1306 – Logic & Reasoning

Course Category:	Humanities and Social Sciences	**Credits:**	1
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 0- 2
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	0
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Think reason logically in any critical situation.													
	CO2	Analyze given information to find correct solution													
	CO3	To reduce the mistakes in day to day activities in practical life.													
	CO4	Develop time-management skills by approaching different shortcut methods													
	CO5	Use mathematical based reasoning to make decisions													
	CO6	Apply logical thinking to solve problems and puzzles in qualifying exams in any competitive exam													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2-Medium,3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1						2									
	CO2		2													
	CO3								2							
	CO4									2						
	CO5	2														
	CO6	1														
Course Content	**UNIT- I** 1. Series completion, 2. Coding-Decoding, 3. Blood relation blood, 4. Puzzles test **UNIT- II** 1. Direction sense test, 2. Logical Venn diagrams, 3. Number test, Ranking test, 4. Mathematical operations **UNIT- III** 1. Arithmetical reasoning, 2. Inserting missing character, 3. Syllogism														

	UNIT- IV 1. Water images, 2. Mirror images, 3. Paper folding, 4. Paper cutting, 5. Embedded figures, 6. Dot situation, 7. Cubes & dice
Text books and Reference books	**Text Book:** [T1] R. S. Aggarwal, "Verbal and Non-verbal Reasoning", RevisedEdition, S Chand publication, 2017 ISBN:81-219-0551-6
E-resources and other digital material	

17EI3351 – Electronic Circuits Lab

Course Category:	Program Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Analyze and design basic diode circuits related to various applications													
	CO2	Understand the working of BJT,FET and its application as an amplifier experimentally and infer their salient parameters													
	CO3	Analyze the working of BJT, FET and its application as an amplifier virtually and infer their salient parameters													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3– High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3	3		3	3				2	2	1			2	2
	CO2		3		3	3				2	2	1			3	2
	CO3	3	1		1	3				2	2	1			3	2
Course Content	**List of Experiments** **A. Electronic Devices Module:** 1. Characteristics of transistor in common emitter configuration 2. Design of transistor self-bias circuit. 3. Drain and transfer characteristics of junction field effect transistor 4. Design of clippers with reference voltage. 5. Design of unbiased clampers. 6. Design of CE amplifier. 7. Design of voltage series feedback amplifier 8. Design of RC phase shift oscillator 9. Design of class A power amplifier. **B. P-Spice Module:** 1. Characteristics of PN junction diode and Zener diode 2. Design voltage regulator using Zener. 3. Verification of half-wave rectifier operation with and without filter. 4. Verification of full-wave rectifier operation with and without filter. 5. Frequency response of CE amplifier. 6. Frequency response of CS Amplifier 7. Design of voltage shunt feedback amplifier 8. Design of Wien oscillator														
Text books &Reference books															
E-resources															

17EI3352 – Transducers Lab

Course Category:	Program Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:	-	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Apply the transduction principles to measure the displacement and velocity parameters.														
	CO2	Analyze the characteristics of level, flow, pressure and miscellaneous transducers.														
	CO3	Analyze the dynamic characteristics of first and second order systems.														
	CO4	Compare the characteristics of different temperature transducers.														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2-Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3								2	2	1				
	CO2				3					2	2	1		3		
	CO3				3	3				2	2	1		3		3
	CO4									2	2	1				
Course Content	**List of Experiments** 1.Temperature measurement using RTD and thermistor 2.Temperature measurement using thermocouple and IC temperature sensor 3.Characteristics of LDR, photodiode and phototransistor 4.Measurement of magnetic flux density using Hall transducer 5.Humidity measurement using dry wet hygrometer 6.Study of various pressure measuring devices 7.Speed measurement using magnetic pick-up and photoelectric pick-up 8.Torque measurement using strain gauge load cells 9.Characteristics of level transmitter 10. Calibration of pressure gauges using dead weight tester. 11.Characteristics of synchro transmitter and receiver 12.Flow measurement using ultrasonic flow meter 13.Displacement measurement using LVDT 14.Angular displacement measurement using capacitive pick-up 15.Dynamic Characteristics of first order and second order systems															
Text books and Reference books																
E-resources																

17HS1353 – Communication Skills Lab

Course Category:	Humanities and Social Sciences	**Credits:**	1
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0 - 2
Prerequisites:	Technical English & Communication skills	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Execute rational pronunciation of speech sounds including accentuation.													
	CO2	Apply elements of listening comprehension in professional environments													
	CO3	Develop the abilities of rational argumentation and skills of public speaking.													
	CO4	Demonstrate proficiency in the elements of professional communication including the competitive examination .													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1						3			3	3	2	1			
	CO2			2	2		3	3	2	3	3	2	2			
	CO3	3		2	3	1	2	3	3	3	3	2	3			
	CO4	2	1	2	2	1	3	3	3	3	3	3	3			
Course Content	**UNIT- I** **Elements of Spoken Expression and processes of Listening Comprehension:** ➢ Speech mechanism ➢ Articulation of vowels and consonants ➢ Patterns of accentuation ➢ Types and processes of listening comprehension **UNIT - II** **Patterns of Substantiation and Refutation in Public Speaking:** ➢ Group discussion ➢ Pyramid discussion ➢ PNI ➢ Seminar talk and power point presentation **UNIT - III** **Professional Communication:** ➢ Self-affirmation ➢ Advanced composition including memo and e-mail ➢ Résumé preparation ➢ Corporate ethic of non-verbal communication **UNIT - IV** **Life Skills and Vocabulary for Competitive Examinations:** ➢ Select life skills (50)														

	➢ Select logies, Isms, phobias and manias (25 each) ➢ Sentence completion and double unit verbal analogies (50 items) ➢ Fundamentals of syllogisms(Descriptive and pictorial)
Text books and Reference books	**Text Book:** [T1] Martin Cutts, Oxford Guide to Plain English, 7th Impression, OUP, 2011 [T2]LlewellynExercises in Spoken English, Prepared by Department of Phonetics and Spoken English, CIEFL, OUP, 21stImpression, 2003 **Reference Books:** [R1]Stephen R Covey, The 7 Habits of Highly Effective people, 2nd Ed., (Pocket Books) Simon & Schuster UK Ltd, 2004 [R2] Eclectic Materials offered by English Dept.
E-resources and other digital material	1. ODll Language Learner's Software, 27-6-2012 Orell Techno Systems 2. Visionet Spears Digital Language Lab software Advance Pro, 28-01-2015 3. www.natcorp.ox.ac.uk

17MC1307B – Indian Constitution

Course Category:	Humanities Elective	**Credits:**	0
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0- 0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	0
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Know the fundamental law of the land													
	CO2	Understand how fundamental rights are protected													
	CO3	Perceive the structure and formation of the Indian government system													
	CO4	Explain when and how an emergency can be imposed and what are the consequences													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1						2									
	CO2						2									
	CO3						2									
	CO4						2									
Course Content	**UNIT- I** **Introduction to Constitution of India:** Meaning of the constitution law and constitutionalism, Historical perspective of constitution of India, Salient features of constitution of India. **UNIT- II** **Fundamental rights:** Scheme of the fundamental rights, Scheme of the fundamental right to equality, Scheme of the fundamental right to certain freedoms under Article 19, Scope of the right of life and personal liberty under Article 21, writs jurisdiction **UNIT- III** **Nature of the Indian constitution:** Federal structure and distribution of legislative and financial powers between the union and states **Parliamentary form of Government in India:** The constitution powers and status of the President of India, Amendment of the constitutional powers and procedure, Historical perspectives of the constitutional amendments in India **Local Self Government:** Constitutional scheme in India **UNIT- IV** **Emergency Provisions:** National emergency, President rule, Financial emergency														
Text books	**Text Book:**														

and Reference books	[T1] Dr. J.N. Pandey, "Constitutional Law of India" published by Central law Agency, Allahabad, Edition 2018 **Reference Books:** [R1] V.N Shukla's, "Constitution of India" Eastern Book Company, Lucknow. [R2] M.P. Jain, "Indian Constitution Law", Wadhwa and Company, Nagpur. [R3] D.D. Basu, "Constitution of India", Wadhwa and Company, Nagpur
E-resources and other digital material	

Second Year
(IV Semester)

17EI3401 –Analytical Instrumentation

Course Category:	ProgramCore	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Engineering Chemistry	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Illustrate the operation of various spectrophotometers based on the application.
	CO2	Select suitable spectrometer for a given application.
	CO3	Describe the operation of various radiation detectors and X-ray spectroscopic instruments.
	CO4	Illustrate the use of chromatography and gas analyzers in real time industrial environments.

Contribution of Course Outcomes towards achievement of Program Outcomes

(1 – Low, 2 - Medium, 3– High

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3											3		
CO2	3												3		
CO3		3					2						3		
CO4		3					2						3		

Course Content

UNIT- I

Spectrophotometers: Introduction to analytical instruments - Radiation sources, Filters, Monochro mators and detectors, Flame photometer - Basic and clinical types, UV-VIS Spectrophotometers - Single beam null type, Double beam ratio recording, Microprocessor based, FTIR spectrophotometer, Applications

UNIT II

Mass Spectroscopy: Principle, Types of mass spectrometers - Magnetic deflection, The time of flight, Applications.

NMR and ESR Spectroscopy: Principle of NMR spectroscopy, Types of NMR spectrometers - Continuous wave and FT NMR, Principle of ESR spectroscopy, ESR spectrometer, Applications

UNIT III

Radiation Detectors: Ionization chamber, Geiger Muller Counter, Proportional Counter, Scintillation Counter, Semiconductor Detectors

X-Ray Spectroscopy: Production of X-Rays and X-Ray spectra, Instrumentation, X-Ray diffractometer, X-Ray absorption meter, X-Ray fluorescent spectrometer, Applications.

	UNIT IV **Chromatography:** Basic definitions, Classification of chromatographic methods, Gas chromatography - Introduction, Basic parts of chromatograph, Liquid chromatography - Introduction, Types, High performance liquid chromatograph - Detection systems, Applications. **Industrial Gas Analysers:** Types, Paramagnetic oxygen analyser, Infrared gas analyser, Thermal conductivity analyser, Analysers based on gas density
Text books and Reference books	**Text Book:** [T1]R.S.Khandpur, " Handbook of Analytical Instruments", 2nd Ed., TMH, 2006 [T2]Willard H.H, Merrit L.L, Dean J.A,"Instrumental Methods of Analysis", 7th Ed., CBS publishers and Distributors, 1988 **Reference Books:** [R1] D.A.Skoog and James J.Leary, "Principles of Instrumental Analysis", 5thEd., Holt-Saunders, 1997 [R2] James W.Robinson, Eileen M.SkellyFrame,GeorgeM.Frame, "Undergraduate Instrumental Analysis", 7thEd., CRC Press, 2014
E-resources and other digital material	1. http://nptel.ac.in/courses/103108100 2. http://instruct.uwo.ca/chemistry/532/lectures.htm

17EI3402 – Integrated Circuits and Applications

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Electronic Devices and Circuits, Analog Electronic Circuits, Network Theory	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply the concepts of 741IC to implement various linear applications.													
	CO2	Apply the concepts of 741IC to implement various non-linear applications.													
	CO3	Illustrate the operation of various converters and design aspects of active filters.													
	CO4	Illustrate the operation of Special purpose ICs and their applications.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3– High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3													3	
	CO2	2													2	
	CO3		3												3	
	CO4	2													2	

Course Content

UNIT- I

Operational Amplifiers: Integrated circuits - Types, Classification, Package types and temperature ranges, Power supplies; Op-amp block diagram, Ideal and practical Op-amp specifications, 741 Op-amp features and specifications. Op-amp characteristics - DC and AC characteristics.

Linear Applications of Op-Amps:

Negative feedback concept in Op-Amps, Inverting and non-inverting amplifier, Voltage follower, Differential amplifier, The summing amplifier, Instrumentation amplifier, V-I, I-V converters, Integrator and differentiator

UNIT II

Non Linear Applications of Op-Amps: Sample and hold circuit, Log and antilog amplifiers, Precision diode, Applications - Precision rectifier, Peak value detector, Clipper and clamper circuit.

Comparators and Wave Form Generators: Introduction to comparator, Basic comparator, Applications – Zerocrossing detector, Window detector, Voltage limiters; Waveform generators - Oscillators, Schmitt trigger, Squarewavegenerator, Triangular wave generator, Saw tooth wave generator.

UNIT III

Active Filters: Active LP and HP filters, Sallen key LP and HP filters, Band pass filters - Wide band pass and multiple feedback band pass filters; Band stop filters -

	Wide band stop and notch filter; All pass filters. **D/A and A/D Converters:** Introduction, Basic DAC techniques - Weighted resistor DAC, R-2R ladder D/A converter; A/D conversion - Parallel comparator type ADC, Tracking type A/D converters, Successive approximation ADC and dual slope ADC; DAC and ADC specifications. . **UNIT IV** **Applications of Special ICs:** The 555 timer - 555 as monostable and astable multivibrator and applications; Voltage controlled oscillator; Phase locked loops - Operating principles, Monolithic PLLs, 565 PLL Applications; IC voltage regulators, 723 IC voltage regulator.
Text books and Reference books	**Text Book:** [T1] Royand Chowdhary, "Linear Integrated Circuits", 4th Ed., New Age International, 2003 [T2] Rama Kant A. Gayakwad, "Op-Amps and Linear Integrated Circuits",3rdEd., PHI, 1997 **Reference Books:** [R1] Jacob, "Applications and Design with Analog Integrated Circuits", 2nd Ed., PHI, 1996 [R2] Denton J Dailey, "Operational Amplifiers and Linear Integrated Circuits Theory and Applications", Mc Graw Hill Ltd, 1989
E-resources and other digital material	1. www.analog.com 2. https://nptel.ac.in/courses/108106068/ 3. https://www.allaboutcircuits.com/ 4. https://www.linkwitzlab.com/filters.htm

17EI3403 – Industrial Instrumentation

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Sensors and Transducers	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Outline the operation of various transducers for temperature measurement.														
	CO2	Illustrate the operation of pressure measuring transducers.														
	CO3	Select a relevant flow transducer based on the given requirements														
	CO4	Illustrate the operation of miscellaneous transducers														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3– High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1		3											3		
	CO2	3												3		
	CO3	2												2		
	CO4		2											2		

Course Content

UNIT- I

Temperature Measurement: Introduction, Classification of temperature sensors based on change in dimensions - Bimetals &Liquid in glass thermometers; Change in electrical properties - RTD, Thermistor; Thermo electricity - Thermocouples & IC sensors; Radiation pyrometers, Fibre-optic sensors.

UNIT-II

Pressure Measurement: Introduction, Manometers, Force summing devices - Diaphragms, Bellows & Bourdon tubes; Secondary transducers - Resistive, Inductive, Capacitive, Piezoelectric; Low pressure measurement - Mcleod, Knudsen, Pirani & ionization gauges**;** Calibration of pressure gauges using dead weight tester.

UNIT- III

Flow Measurement: Introduction, Head type flow meters - Orifice plate, Venturi tube and Pitot tube; Variable area type flow meters - Rotameter; Velocity measurement type flow meters - Electromagentic, Turbine, Ultrasonic flow meters**,** Anemometers; Mass flow measurement type - Coriolis mass flow meter; Positive displacement flow meter - Nutating disc and lobed impeller; Open channel flow meters - Weirs, Flumes.

UNIT-IV

Level Measurement: Introduction, Mechanical level indicators - Differential pressure type; Optical - Laser sensors, IR and visible light sensors; Electrical type - Resistive, Inductive and capacitive; Radioactive methods - Ultrasonic, Gamma ray.

	Humidity, Density & Viscosity Measurement: Electrolytic hygrometers, Wet and dry bulb hygrometers; Moisture analyzer, Ultrasonic and gamma ray densitometers, Saybolt Viscometer, Float viscometers
Text books and Reference books	**Text Book:** [T1] A.K.Ghosh, "Introduction to Measurements & Instrumentation", 3rd Ed., PHI, 2009 [T2] A.K.Sawhney & Puneet Sawhney, "A Course in Mechanical Measurements & Instrumentation", 12thEd., Dhanpat Rai & Co, 2012 **Reference Books:** [R1] Ernest O Doebelin/Dhanesh, N Manik, "Measurement systems", 6thEd., Tata Mc Grawhill [R2] C.S.Rangan, G.R.Sarma & V.S.V.Mani "Instrumentation Devices & Systems", 2nd Ed., TMH, 2011
E-resources and other digital material	1. https://nptel.ac.in/courses/108/105/108105064/

17EI3404 – Electrical and Electronic Measurements

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Circuit analysis	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply suitable null or deflection type technique to measure prescribed electrical parameter.													
	CO2	Select a suitable digital instrument to measure physical and electrical parameters.													
	CO3	Compare the operation of various oscilloscopes and probes.													
	CO4	Explain the principles of various signal generators and wave analyzers.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3														
	CO2		3												3	
	CO3		3												3	
	CO4				3										3	
Course Content	**UNIT- I** **Electromechanical Indicating Instruments**: Suspension galvanometer; Torque and deflection of the galvanometer - Steady state deflection, Dynamic behavior, Damping mechanisms; Permanent magnet moving coil mechanism - D'Arsonval movement, Temperature compensation. **Electrical Measurements**: DC ammeters - Shunt resistor, Ayrton shunt, Multirange ammeters, The Ayrton shunt, DC voltmeters - Multiplier resistor, Multirange voltmeter, Voltmeter sensitivity - Ohms per volt rating, Loading effect, Series type ohmmeter, Shunt type ohmmeter, Calibration of dc instrument, Alternating current indicating instruments - Electrodynamometer, Rectifier type instruments, Typical multimeter circuits; Thermo Instruments, Electrodynamometers in power measurements, Watt hour meter, Power factor meters. **UNIT – II** **Bridges:** Wheatstone's bridge (Measurement of resistance), Kelvin's bridge, Practical Kelvin's double bridge, Maxwell's bridge, Hay's bridge, Schering bridge, Wien's bridge, Wagner's ground connection. **Electronic Instruments**: AC Voltmeter using rectifiers, True RMS voltmeter, Digital voltmeters - Ramp technique, Dual slope integrating type DVM, Staircase ramp DVM, Successive approximation type DVM, Q Meter - Impedance measurement using Q Meter.														

	UNIT – III **Oscilloscopes**: Block diagram of oscilloscope, Vertical amplifier, Horizontal deflecting system, Delay line in triggered sweep, Typical CRT connections, High frequency CRT, Dual beam CRO, Dual trace oscilloscope (basic block diagram), Sampling oscilloscope, Storage oscilloscope, Probes for CRO - Direct probes, Passive voltage probe, Active probes, Attenuators - Uncompensated attenuators, Simple compensated attenuator. **UNIT – IV** **Signal Generators:** Basic standard sine wave generator, Standard signal generator, Function generator, Laboratory square wave and pulse generator. **Wave Analyzers:** Basic wave analyzer, Frequency selective wave analyzer, Heterodyne wave analyzer, Spectrum analyzer. **Frequency Counters And Time Interval Measurements:** Digital frequency meter - Principle of operation, Basic circuit of a digital frequency meter, Digital measurement of time - Principle of operation, Time base selector, Period measurement
Text books and Reference books	**Text Book:** [T1] W D Cooper & A D Helfrick, "Electronic Instrumentation and Measurement Techniques", PHI, 1998 (Unit-I) [T2] H.S.Kalsi, "Electronic Instrumentation", 2nd Ed., TMH. (Units-II, III and IV) **Reference Books:** [R1] A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation",Dhanpat Rai & Co [R2] Oliver & Cage, "Electronic Measurements and Instrumentation", Mc Graw Hill, 1975
E-resources and other digital material	https://www.youtube.com/watch?v=3eYmFjHnQjY&list=PLbRMhDVUMngcoKrA4sH-zvbNVSE6IpEio

17TP1405 – English for Professionals

Course Category:	Humanities and Social Sciences	**Credits:**	1
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 0- 2
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 0 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Present themselves effectively in the professional world													
	CO2	Introduce themselves as well as others appropriately													
	CO3	Use vocabulary to form sentences and narrate stories by using creative thinking skills													
	CO4	Involve in practical activity oriented sessions													
	CO5	Learn about various expressions to be used in different situations													
	CO6	Respond positively by developing their analytical thinking skills													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1										3	3				
	CO2											3				
	CO3											3				
	CO4										3	3				
	CO5															
	CO6															
Course Content	**UNIT- I** 1. Beginners, Functional, Situational conversations 2. Practicing on functional conversations **UNIT – II** 1. Errors in usage of parts of speech with a thrust on verbs, adjectives and conjunctions, idioms/phrases. 2. Introducing basic grammar 3. Practicing on functional conversations **UNIT – II** 1. Introducing self & others 2. Structures and forming sentences 3. Telephonic etiquette, Social etiquette and Table manners 4. Practicing on functional conversations														

	UNIT – IV 1.Direct, Indirect/Reporting speech 2. Public speaking basics 3. Versant test preparation 4. Practicing on situational conversations
Text books and Reference books	**Text Book:** [T1] Swaroopa Polineni, "Strengthen your Communication Skills", 1st Ed., Maruthi Publications, 2013 **Reference Books:** [R1] Mamta Bhatnagar & Nitin Bhatnagar, "Communicative English", 1st Ed., Pearson India, 2010
E-resources and other digital material	

17EI3406 – Digital Circuits and Systems

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Electronic Devices and Circuits	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply various number systems to arithmetic operations													
	CO2	Explain the characteristics of different logic families													
	CO3	Apply Boolean algebra and K-map method to simplify logical functions													
	CO4	Design combinational logic circuits and realize using logic gates													
	CO5	Design sequential logic circuits using flip flops													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2													2	
	CO2															
	CO3	3													3	
	CO4			2											2	
	CO5			2											2	
Course Content	**UNIT- I** **Number Systems and Codes:** Decimal, Binary, Octal and hexadecimal number systems and their conversion. Binary addition, Subtraction, Multiplication, Division. Sign magnitude representation, 1's & 2's complement representations, 2's complement arithmetic - Addition/Subtraction; Codes - Excess-3 code, Gray code, Octal code, Hexadecimal code. **Logic Gates & Logic Families:** Logic gates, Characteristics of digital IC's, Direct coupled transistor logic, Resistor transistor logic, Diode Transistor logic, Transistor transistor logic, Schottky TTL, Emitter coupled logic, MOS Inverter, MOSFET NAND and NOR Gates, CMOS inverter, CMOS NAND and NOR gates **UNIT- II** **Boolean Algebra:** Boolean algebra laws & theorems, Simplification of Boolean expression, Implementation of Boolean expressions using logic gates, Standard forms of Boolean expression. **Minimization of Switching Functions:** Simplification of logical functions using Karnaugh map method (two, three and four variable), Don't-Care conditions. **UNIT- III** **Combinational Logic Design:** Half-Adder, Full-Adder, Half-Subtractor, Full-														

	Subtractor, BCD to 7 segment decoder, Design of a binary to gray and gray to binary code converters. **Combinational Logic Design Using MSI Circuits:** Multiplexer, Combinational logic design using multiplexers, Demultiplexers / Decoders and their use in combinational logic design. **UNIT- IV** **Flip-Flops:** Clocked S-R flip-flop, Preset and Clear, J-K flip-flop, Race around condition, Master slave J-K flip-flop, D flip-flop, T flip-flop, Excitation table of flip-flop. **Sequential Logic Design:** Shift register, Bi-directional shift register, Applications of shift resisters, Ring counter, Twisted Ring counter, Sequence generator. Asynchronous counters - UP/DOWN counters, Modulus of the counter, Design of Synchronous counters.
Text books and Reference books	**Text Book:** [T1] R P Jain "Modern Digital Electronics", 4thEd., TMH. **Reference Books:** [R1] A.Anand Kumar, "Fundamentals of Digital Circuits", PHI, 2006 [R2] M.Morris Mano, "Digital Logic and Computer Design", PHI,2003
E-resources and other digital material	

17EI3451 – Analog and Digital Integrated Circuits Lab

Course Category:	Program Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Design various applications using Analog ICs													
	CO2	Design combinational and sequential logic circuits using digital ICs													
	CO3	Conduct experiments as an individual or team using Analog and digital ICs													
	CO4	Prepare an effective report based on experiments													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1				3										3	
	CO2				3										3	
	CO3				3					2		1				1
	CO4										2					
Course Content	**List of Experiments** **<u>Analog ICs</u>** 1. Measurement of Op-amp parameters 2. Design of integrator, differentiator using 741I 3. Design of instrumentation amplifier using 741IC 4. Waveform generation using 741IC (square, triangular) 5. Design of Wein bridge oscillator using 741IC 6. Design of active filters using 741IC (LPF & HPE-first order) 7. Design of IC 555 timer astable circuit 8. Design of a voltage regulator using IC 723 **<u>Digital ICs</u>** 1. Realization of logic gates using discrete components and universal gates. 2. Adders/ Subtractor using IC 7483 3. Verification of flip flops using gates 4. Design of synchronous and asynchronous counters using flip flops and IC 74163 5. UP/DOWN counters using IC 74193 6. Design of MUX and DEMUX 7. Design of code convertors (binary to gray and gray to binary code conversion) 8. Design of ring and Johnson counters using flip-flops.														
Text books and Reference books	**Text Book:** [T1] Roy and Chowdhary, "Principles of Integrated Circuits", 2nd Ed., New Age International,2003 [T2] Rama Kant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 3rd Ed., PHI, 1997														

E-resources and other digital material	1. www.allaboutcircuits.com.

17EI3452 – Measurements Lab

Course Category:	Program Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply the basic measurement techniques to measure the electrical parameters													
	CO2	Analyze the outputs and interpret the data generated from the null and deflection techniques.													
	CO3	Conduct various experiments as an individual or team.													
	CO4	Prepare an effective report based on experimental outcome.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3												3		
	CO2				3									3		
	CO3				3					2		1		3		
	CO4										2					
Course Content	**List of Experiments** 1. DC meters using D'Arsonval galvanometer and their range extension. 2. AC meters using D'Arsonval galvanometer and their range extension. 3. Measurement of voltage, frequency, phase angle and phase shift using a CRO. 4. Measurement of resistance using Wheatstone bridge 5. Measurement of resistance of small resistors using Kelvin double bridge. 6. Measurement of inductance using Maxwell bridge. 7. Measurement of capacitance using Shearing bridge. 8. Measurement of harmonics using a Spectrum analyzer. 9. Measurement of resistance, inductance, capacitance and quality factor using a Q meter. 10. Measurement of amplitude and frequency of different types of waveforms using a function generator. 11. Measurement of amplitudes of different types of waveforms using a true RMS voltmeter. 12. Measurement of inductance of high Q coils using Hay bridge. 13. Measurement of frequency using a Wien bridge. 14. Calibration of voltmeter using potentiometer. 15.Calibration of ammeter using potentiometer														
Text books and Reference books															
E-resources															

17MC1407A - Environmental Studies

Course Category:	Mandatory Course	**Credits:**	0
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0 - 0
Prerequisites:	Concern on conservation and preservation of environment	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the various natural resources, analyze and explore degradation management													
	CO2	Understand the ecosystems and need of biodiversity													
	CO3	Realize and explore the problems related to environmental pollution and management													
	CO4	Apply the role of information technology and analyze social issues, Acts associated with environment													
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	1														
	CO2			3					3							
	CO3						3		3							
	CO4		1	3								3				

Course Content

UNIT- I

The Multidisciplinary Nature of Environmental Studies: Definition, Scope and importance. Need for public awareness.

Natural Resources

Renewable and Non-renewable Resources: Natural resources and associated problems.

(a) Forest resources: Use and over-exploitation, Deforestation. Timber extraction, mining, dams and their effects on forests and tribal people.
(b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
(c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.
(d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.
(e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.
(f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT- II

Ecosystems: Concept of an ecosystem.
Structure and function of an ecosystem.
Producers, consumers and decomposers.
Energy flow in the ecosystem.
Ecological succession.
Food chains, food webs and ecological pyramids.
Introduction, types, characteristic features, structure and function of the following ecosystem:

(a) Forest ecosystem
(b) Grassland ecosystem
(c) Desert ecosystem
(d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its Conservation:
Introduction, Definition: Genetic, Species and ecosystem diversity.
Biogeographically classification of India.
Value of biodiversity: Consumptive use, Productive use, Social, Ethical, Aesthetic and option values.
Biodiversity at global, National and local levels.
India as a mega-diversity nation.
Hot-spots of biodiversity.
Threats to biodiversity: Habitat loss, Poaching of wildlife, Man-wildlife conflicts.
Endangered and Endemic species of India.
Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT- III

Environmental Pollution: Definition, Causes, effects and control measures of

(a)Air pollution (b) Water pollution
(c)Soil pollution (d) Marine pollution
(e)Noise pollution (f) Thermal pollution
(g)Nuclear hazards

Solid Waste Management: Causes, Effects and control measures of urban and industrial wastes.
Role of an individual in prevention of pollution.

Disaster Management: Floods, Earthquake, Cyclone and landslides.

UNIT- IV

Social Issues and the Environment:
From unsustainable to sustainable development.
Urban problems related to energy.
Water conservation, Rain water harvesting, Watershed management.
Resettlement and rehabilitation of people; Its problems and concerns.
Environmental ethics: Issues and possible solutions.
Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear accidents and holocaust.
Wasteland reclamation.
Consumerism and waste products.

Environment Protection Act;
Air (Prevention and Control of Pollution) act.

	Water (Prevention and Control of Pollution) act. Wildlife protection act. Forest conservation act. Issues involved in enforcement of environmental legislation. Public awareness. **Human Population and the Environment:** Population growth, Variation among nations. Population explosion—Family welfare programme Environment and human health, Human rights, Value education. HIV/AIDS, Women and child welfare. Role of information technology in environment and human health. **Field Work/Case Studies: {<u>NOT TO BE INCLUDED IN SEMESTER END EXAMS</u>}** Visit to a local area to document environmental assets—river/forest/grassland/hill/ mountain. Visit to a local polluted site—Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.
Text books and Reference books	**Text Book:** [T1] ErachBharucha, "Text book for Environmental Studies', for under graduate courses of all branches of higher education" University Grants Commission **Reference Books:** [R1] AnjaneyuluY "Introduction to Environmental Sciences", B S Publications PVT Ltd
E-resources and other digital material	

Third Year
(V Semester)

17EI3501 – Control Systems

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Linear algebra and differential equations, Network theory	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the control systems terminology.													
	CO2	Model various physical systems using block diagram and signal flow graph approaches.													
	CO3	Analyze the time response of first order and second order systems for standard input test signals.													
	CO4	Analyze the frequency response and stability of the given control system using various techniques.													
	CO5	Model SISO and MIMO systems using state space approaches.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2	3												3		
	CO3		2											2		2
	CO4		2											3		3
	CO5	3	2											2		2
Course Content	**UNIT- I** **Introduction:** Control system terminology, Examples of simple control systems - Open loop and closed loop control systems, Effect of feedback on overall gain, Stability, Sensitivity and external noise. **Mathematical Models of Physical Systems:** Formulation of differential equations for electrical, mechanical and electromechanical systems, Analogous systems, Block diagram representation of control systems, Signal flow graphs and Mason's gain formula. **UNIT – II** **Time Domain Analysis:** Standard test signals - Step, ramp, parabolic and impulse, Time response of first-order system to standard test signals, Step response of second order systems, Time domain specifications, Steady state error and error constants. **Stability Analysis in Complex Plane**: Stability definitions - Bounded Input and Bounded Output (BIBO) stability, Stability study based on poles of closed-loop transfer function, Absolute and relative stability, Routh–Hurwitz criterion.														

	UNIT – III **Root Locus Technique:** The root locus concept, Magnitude and angle conditions, Properties and construction of the root loci (For positive K only). **Frequency Domain Analysis:** Frequency domain specifications, Correlation between time and frequency response, Bode plot - Magnitude plot, Phase plot, Determination of phase margin and gain margin, Stability analysis from bode plots, Polar plots, Nyquist stability criterion, Nyquist Plot. **UNIT – IV** **State Space Analysis:** Concepts of state, State variables, State model of linear systems, State variable representation using phase variables, Derivation of transfer function from state model, Characteristic equation, Eigen values, Eigenvectors, Solution of state equations (derivations only), State transition matrix and its properties, Computation of state transition matrix by Laplace transform method, Controllability and observability
Text books and Reference books	**Text Book:** [T1]A.Anand Kumar, "Control Systems", 2nd Ed., PHI, 2014 [T2] I J Nagrath& M Gopal, "Control Systems Engineering", 5th Ed., New Age International, 2008 **Reference Books:** [R1] Katsuhiko Ogata, "Modern Control Engineering", 4th Ed., Pearson Education, 2003 [R2] A.NagoorKani, "Control Systems", 2nd Ed., RBA Publications, 2006
E-resources and other digital material	1 http://www.nptelvideos.com/control_systems/ 2 https://nptel.ac.in/courses/108101037/

17EI3502 – Digital Signal Processing

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Matrices and differential calculus, Laplace transforms and integral calculus, Complex analysis and numerical methods	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Analyze the signals and systems using Fourier transform and Z- transform													
	CO2	Apply Fast Fourier Transform algorithms to compute DFT.													
	CO3	Model digital infinite impulse response filters (Butterworth and Chebyshev) using bilinear transformation and impulse invariance transformation methods													
	CO4	Model the digital finite impulse response filters using windowing techniques													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1			3											3	
	CO2			3	3	2									3	
	CO3			3	3	2									3	
	CO4			3	3	2									3	

Course Content

UNIT- I

Discrete-Time Signals and Systems: Basic elements of digital signal processing system, Classification of signals, Sampling of analog signals, Sampling theorem, Classification of systems.

Fourier Transform: Fourier transform, Fourier transform of basic signals, Properties of Fourier transforms, Analysis of discrete-time linear-time-invariant systems, Correlation of discrete-time signals.

Z-Transform: The Z-transform, Properties of Z-transform, Inversion of the Z-transform, The one sided Z-transform, Solution of linear constant-coefficient difference equations.

UNIT – II

Discrete Fourier Transform (DFT): Introduction to DFT, Properties of DFT, Linear convolution using DFT, Circular convolution, Fast Fourier Transforms (FFT): Radix-2 decimation in time algorithm, Radix-2 decimation in frequency algorithms, Inverse FFT

UNIT – III

IIR Filter Design:

Analog Filter Approximations: Butter worth and Chebyshev, Design of IIR digital filters from analog filters - Impulse invariance method, Bilinear transformation method, Design examples, Frequency transformations, Basic structures for IIR

	systems: Direct-form structures, Cascade-form structures and Parallel-form structures. **UNIT – IV** **FIR Filter Design:** FIR filters: Design of linear phase FIR filters using windows, Design of linear phase FIR filters by the frequency sampling method, Comparison of FIR and IIR filters, Basic structures for FIR systems: Direct-form structures and Cascade-form structures.
Text books and Reference books	**Text Book:** [T1] John G. Proakis& Dimitris G. Manolakis, "Digital Signal Processing-Principles, Algorithms, and Applications", 4th Ed., Pearson Education, 2007 [T2] Emmanuel C. Ifeachor& Barrie W. Jervis, "Digital Signal Processing a Practical Approach", 2nd Ed., Pearson Education, 2004 **Reference Books:** [R1] Alan V. Oppenheim, Ronald W. Schafer, Jhon R. Buck, "Discrete-Time Signal Processing", 2nd Ed., Pearson Education, 2004 [R2] Sanjit K. Mitra, "Digital Signal Processing-A Computer Based Approach", 4th Ed., McGraw Hill Education, 2013
E-resources and other digital material	1 https://nptel.ac.in/courses/117102060/ 2. https://www.dspguide.com 3. https://www.coursera.org/learn/dsp 4. https://www.mathworks.com/solutions/dsp.html

17EI3503 – Microcontrollers and Embedded Systems

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the basic concepts of an embedded system and its design.													
	CO2	Select the hardware components and software for embedded system design.													
	CO3	Illustrate the architecture of 8051, its instruction set and various peripheral interfacing.													
	CO4	Illustrate the ARM architecture and its instruction set.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2	3													2	
	CO3		2												2	
	CO4	2													2	
Course Content	**UNIT- I** **Introduction:** Embedded system - Definition, History of embedded systems, Classification of embedded systems, Major application areas of embedded systems, Purpose of embedded systems, The typical embedded system - Core of the embedded system, Memory, Sensors and actuators, Communication interface, Embedded firmware, Characteristics of an embedded system **UNIT- II** **8051 Microcontrollers:** Architecture, Timers and counters, Interrupts, Serial communication, Addressing modes, Instruction set, Jumps, Loops, Interrupts and returns, Timers and interrupts, I/O programming. **UNIT- III** **Hardware interfacing:** Interfacing with LEDs, Seven segment, Sensors, Basic concepts of LCD, ADC, DAC, Relays etc. and their interfacing to 8051 microcontrollers. **UNIT- IV** **ARM Processor Fundamentals:** Registers, Current program status register, Pipeline, Exceptions, Interrupts and the vector table, Core extensions, ARM processor families. **ARM Instruction Set:** Data processing instructions, Branch instructions, Load - store instructions, Software interrupt instruction, Program status register instruction, Loading constants, Conditional execution.														
Text books and Reference	**Text Book:** [T1] M.N.Avadhanulu& P.G. Kshirsagar, “Engineering Physics”, S. Chand Publications,														

books	Revised Edition, 2014 [T2] Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay "The 8051 Microcontroller and Embedded Systems using assembly and C", 2nd Ed., Pearson.(Unit II, III & IV). **Reference Books:** [R1] Raj Kamal, "Microcontrollers Architecture, Programming, interfacing and system design" 2nd Ed., Pearson Education, 2012.
E-resources and other digital material	1. http://nptel.iitg.ernet.in

17EI2504/A – Biomedical Electronics

Course Category:	Open Elective I	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Select suitable electrodes and transducers used for bioelectric potential measurement.													
	CO2	Outline various amplifiers used in the acquisition and amplification of the bioelectric signals.													
	CO3	Illustrate different systems used to record the bioelectric signals.													
	CO4	Illustrate on electrical safety, hazards, protection against shock and testing of medical equipment.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1		3											2		
	CO2		2												2	
	CO3	3													2	
	CO4	2													2	
Course Content	**UNIT- I** **Biomedical Electronic System:** Introduction, Human machine interface system configuration, Problems encountered while making measurements on a human body. **Bio-electric potentials**: Resting and action potentials, Propagation of action potentials, Bio electrodes, Transducers **UNIT- II** **Bio-signal Acquisition:** Introduction, Physiological signal amplifiers, Isolation amplifiers, Medical preamplifier, Bridge amplifiers, Line driving amplifier, Current amplifier, Chopper amplifier, Signal recovery and data acquisition, Drift compensation in operational amplifiers, Pattern recognition. **UNIT- III** **Display Systems and Recorders:** Oscilloscopes for biomedical measurements, CRO used in medical equipment - Cardioscope, Bedside and central monitoring systems, Instrumentation tape recorders, ECG, EEG, EMG recorders. **UNIT- IV** **Electrical Safety:** Physiological effects of electricity, Important susceptibility parameters, Macro shock hazards, Micro shock hazards, Electrical safety codes and standards, Basic approaches to protection against shock, Protection: Power														

	distribution and equipment design, Electrical safety analyzers, Tests of the grounding system in patient-care areas, Tests of electric appliances.
Text books and Reference books	**Text Books:** [T1] Amshed F. Khan, "Biomedical Electronics", Chintan Publications, 2008. [T2] Dr. M. Arumugam, "Biomedical Instrumentation", Anuradha Publications, 2nd Ed., 2006. [T3] John G. Webster, "Medical Instrumentation-Application and Design", John Wiley & Sons Inc., 3rd Ed., 1998. **Reference Books:** [R1] Khandpur R.S, "Hand-book of Biomedical Instrumentation", McGraw Hill Education, 3rd Ed., 2014. [R2] Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice-Hall India, 2nd Ed., 2007.
E-resources and other digital material	

17EI2504/B – Control System Components

Course Category:	Open Elective I	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Differential equations, Network theory	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Model the basic electrical systems and servomechanisms.														
	CO2	Use the basic switching components for functioning of electrical systems.														
	CO3	Illustrate the operation of various actuators.														
	CO4	Explain the basics of PLCs.														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3														
	CO2	2														
	CO3		3													
	CO4															

Course Content

UNIT- I

Motors: Types, Working principle, Characteristics and mathematical modeling of: AC/DC motors, Stepper motor, Servo motor, Synchros, Resolver, Generators and Alternators.

UNIT- II

Switches: Toggle switches, Push-Button switches, Limit switch, DIP switch, Rotary switch, Thumbwheel switch, Membrane switch.

Relays: Electromechanical relays, Solid-State relays.

Trigger Devices: UJTs, Diac.

UNIT- III

Electric Actuators: Electric linear actuators, Leadscrew linear actuators, Solenoids, Electric linear motors

Hydraulic Actuators: Hydraulic systems, Basic principles of hydraulics, Hydraulic pumps, Hydraulic actuators, Pressure control valves, Accumulators, Directional control valves.

Pneumatic Actuators: Pneumatic systems, Compressors, Dryers and tanks, Pressure regulators.

UNIT- IV

Relay Logic, Programmable Logic and Motion Controllers: Relay logic control, Ladder diagrams, Timers, Counters and sequencers, Programmable logic controllers

	and motion controllers
Text books and Reference books	**Text Book:** [T1]Christopher T. Kilian "Modern Control Technology: Components and Systems", 2nd Edition, (UNIT I, II, III & IV) [T2] B. L. Theraja, "A text book of Electrical Technology", S. Chand & Company Ltd.,1st Ed., 1959. (UNIT I). **Reference Books:** [R1] James R. Carstens, "Automatic Control Systems and Components", Prentice Hall Englewood cliffs, New Jersey [R2] Hasebrink J P &Kobler R, "Fundamentals of Pneumatic Control Engineering", FestoDidactic: Esslinger (W Germany),1989 [R3] Meixner H & Sauer E, "Intro to Electro-Pneumatics", Festo didactic, 1st Ed., 1989.
E-resources and other digital material	-----

17EI2505/A – Instrumentation Engineering

Course Category:	Open Elective II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Explain various performance characteristics of an instrument														
	CO2	Illustrate the operating principles of various transducers														
	CO3	Select an appropriate transducer for pressure and temperature measurement in industry														
	CO4	Illustrate the operation of different transducers in level and flow measurement.														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3– High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2	3														
	CO3		2													
	CO4	3														

Course Content

UNIT- I

Instrumentation Characteristics: Introduction, Block diagram of generalized instrument system; Static characteristics - Desirable and undesirable characteristics, Dynamic characteristics.

Transduction Principles:

Passive Transducer Principles: Introduction - Classification of transducers - Active and passive transducers with examples; Variable resistance - Change in length, area and piezo resistive effect; Variable inductance - Change in self inductance, Change in mutual inductance, Variable reluctance; Variable capacitance - Change in area, Distance and dielectric;

Active Transducer Principles: Thermoelectric, Piezoelectric, Photovoltaic.

UNIT- II

Pressure Measurement: Introduction, Types of pressure measuring devices, Manometers - Types of manometers; Elastic pressure elements - Bourdon tubes, Bellows, Diaphragms; Measurement of high pressure, Low pressure measurements, Mcleodguage, Knudsen guage, Viscosity gauge, Thermal conductivity gauge, Ionization guage.

UNIT- III

Temperature Measurement: Introduction, Classification of temperature sensors based on change in dimensions - Bimetals and Liquid-in-Glass thermometers;

	Change in electrical properties - RTD; Thermistors - NTC and PTC types; Thermo electricity - Thermocouple; Cold junction compensation and IC sensors - LM335, and AD592; Radiation pyrometers - Classification of radiation pyrometers - Broad band, Ratio and fiber optic pyrometers; Fibre-optic sensors - Micro bending type. **UNIT- IV** **Level Measurement:** Introduction, Mechanical level indicators - Differential pressure type; Optical - Laser sensors, IR and visible light sensors; Electrical type - Resistive, Inductive and capacitive; Radioactive methods - Ultrasonic, Gamma ray. **Flow Measurement:**Introduction, Variable head flow meters for incompressible fluids; Variable head flow meters for compressible fluids; Rota meter, Electromagnetic flow meters; Laser Doppler Anemometer
Text books and Reference books	**Text Book:** [T1] A.K. Ghosh, "Introduction to Measurements & Instrumentation",3rdEd., PHI, 2009. (UNIT I) [T2] A.K.Sawhney & Puneet Sawhney,"A course in Mechanical Measurements & Instrumentation", 12thEd., Dhanapat Rai & Co., 2012. (UNIT II & III) **Reference Books:** [R1] D.Patranabis " Sensors and Transducers", 2nd Ed., PHI, 2013 [R2]D.S.Kumar, "Mechanical Measurement & Control", 5th Ed., Metropolitan Book. Co
E-resources and other digital material	1. http://nptel.ac.in/courses/112103174/4 2. http://nptel.ac.in/courses/108106074

17EI2505/B – Fundamentals of Industrial Automation

Course Category:	Open Elective II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the basic concepts of programmable logic controllers and programming language													
	CO2	Illustrate the fundamentals of Distributed Control System (DCS).													
	CO3	Demonstrate the protocols used in industrial automation													
	CO4	Select appropriate DCS for industrial applications													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1		3													
	CO2		3													
	CO3			3												
	CO4				3											
Course Content	**UNIT- I** **Programmable Controllers**: Programmable Logic Controllers (PLC), Parts of PLC, Basic principles of operation, Input/output system, Programmable devices, Programming languages, Ladder diagram instructions, Boolean mnemonics, Software, Configuration. **UNIT- II** **Distributed Control System:** Introduction and historical background, Distributed control sub systems, Local field station, Presentation and monitoring device, Communication options in Distributed Control Systems, Configuration. **UNIT- III** **PLC and DCS Protocols:**TCP/IP protocol introduction, Protocol Architecture, Communication hierarchy in factory automation, I/O bus networks,Field architectural progress, Field bus architecture types, HART protocol introduction. **UNIT- IV** **Case Study:** Distributed control system for cement plant, Distributedcontrol system for water treatment plant, distributed control system for irrigation canal automation and distributed control system for thermal power plant														
Text books and Reference books	**Text Book:** [T1]KrishnaKanth, "Computer-Based Industrial Control", 1st Ed., Eastern Economy Edition 2010 [T2] Frank D. Petruzella, "Programmable Logic Controller", 3rd Ed., Tata McGraw-														

	Hill Edition 2010. [T3] Gary A. Dunning, "Introduction to Programmable Logic Controllers", 3rd Ed., Thomson Delmar learning 2010. [T4] Michael P. Lucas, "Distributed Control Systems", Their Evaluation and Design", Van Nostrand Reinhold Co., 1986. [T5] Popovic D. and Bhatkar V.P., "Distributed Computer Control for industrial automation", Marcel Dekkar Inc., 1990 **Reference Books:** [R1] Madhu Chandra MithraSamarithSen,"PLC & Industrial automation", 1st Ed., 2009. [R2] R. Bliesener, F.Ebel, C.Löffler, B. Plagemann, H.Regber, E.v.Terzi, A. Winter "Programmable Logic Controllers Basic Level", fetto, 2002
E-resources and other digital material	1. http://www.mikroe.com/old/books/plcbook/plcbook.htm 2.https://www.youtube.com/results?search_query=plc 3. https://www.youtube.com/watch?v=PLYosK87D8E 4.https://www.youtube.com/watch?v=-8DVa3SBu38

17EI2506/A – MOOCS

Course Category:	Open Elective III	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 00 100

17EI2506/B – MOOCS

Course Category:	Open Elective III	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 00 100

17HS1507 – Personality Development

Course Category:	Institutional Core	**Credits:**	1
Course Type:	Practice	**Lecture - Tutorial - Practice:**	0 - 0- 2
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	00
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the corporate etiquette													
	CO2	Make presentations effectively with appropriate body language													
	CO3	Be composed with positive attitude.													
	CO4	Understand the core competencies to succeed in professional and personal life.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1								2	2	3					
	CO2										3					
	CO3										3					
	CO4									2	3					
Course Content	**UNIT- I** **Analytical Thinking:** Self-Introduction, Shaping young minds - A talk by Azim Premji (Listening Activity), Self - Analysis, Developing positive attitude, Perception. **Communication Skills:** Verbal communication, Non verbal communication (Body language). **UNIT- II** **Self-Management Skills:** Anger management, Stress management, Time management, Six thinking hats, Team building, Leadership qualities. **Etiquette:** Social etiquette, Business etiquette, Telephone etiquette, Dining etiquette. **UNIT- III** **Standard Operation Methods:** Note making, Note taking, Minutes preparation, Email & letter writing. **Verbal Ability:** Synonyms, Antonyms, One word substitutes - Correction of sentences - Analogies, Spotting errors, Sentence completion, Course of action - Sentences assumptions, Sentence arguments, Reading comprehension, Practice work.														

	UNIT- IV **Job-Oriented Skills-I:** Group discussion, Mock group discussions. **Job-Oriented Skills-II:** Resume preparation, Interview skills, Mock interviews.
Text books and Reference books	**Text Book:** [T1] Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press, 2011. [T2] S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010 [T3] R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand& Company Ltd., 2018. [T4] Raman, Meenakshi& Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011 **Reference Books:**
E-resources and other digital material	1. www. Indiabix.com 2. www.freshersworld.com

17EI3551 – Simulations Lab

Course Category:	Program Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Obtain the Mathematical modeling of physical systems and analyze the time, frequency response and stability of given control system.													
	CO2	Demonstrate the properties and compute Fourier transform and digital filter design as per the specification given.													
	CO3	Conduct experiment with an individual or team using MATLAB													
	CO4	Prepare an effective report based on experiment													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2- Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3												2		2
	CO2				3									3		2
	CO3				3	3				2		1		3		2
	CO4										2					

Course Content

List of Experiments

Control Systems:

1. Using MATLAB/SIMULINK for control systems

Part I: Introduction to MATLAB/SIMULINK.
Part II: Polynomials in MATLAB.
Part III: Scripts, Functions & flow control in MATLAB.

2. Mathematical modeling of physical systems using MATLAB.
3. Block diagram reduction techniques for determination of transfer function of a given system using MATLAB.
4. Simulation of standard test signals using MATLAB.
5. Time response of first order system for step and impulse inputs using MATLAB/SIMULINK.
6. Time response of second order system for step and ramp inputs using MATLAB/SIMULINK.
7. Root locus plot for a given transfer function using MATLAB.
8. Stability studies using Bode and Nyquist plots for a given transfer function using MATLAB.
9. Simulation of P, PD, PI and PID controllers using MATLAB/SIMULINK.

Digital Signal Processing

1. Graphical representation of discrete time signals and calculation of signal power.
2. Properties of Fourier transform.

	3. State and verify linear convolution 4. State and verify circular convolution 5. Evaluation of DFT & IDFT of a 8 sample sequence using DIT algorithm. 6. Evaluation of DFT & IDET of a 8 sample sequence using DIF algorithm 7. Design of digital IIR filters using impulse invariant transformation technique. 8. Design of digital IIR filters using bilinear transformation technique. 9. Design of FIR filter using windowing methods
Text books and Reference books	**Text Book:** [T1] A.Anand Kumar, "Control Systems", 2nd Ed., PHI, 2014 [T2] S.Salivahanan. "Digital Signal Processing" TMH, 2000 **Reference Books:** [R1] Simulations lab manual
E-resources and other digital material	1 www.umu.se/en/education/courses/linear-control-systems2/ 2 www.dsptutor.freeuk.com 3 http://nptel.iitm.ac.in/courses/Webcourse contents/IITKANPUR/Digi_Sign_Pro/ui/About-Faculty.html

17EI3552 – Microcontrollers and Embedded Systems Lab

Course Category:	Program Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Use the instruction sets of 8051 and ARM to solve the problems													
	CO2	Select and use various interfacing peripherals with 8051 microcontroller													
	CO3	Select and Use various interfacing peripherals with ARM Microcontroller													
	CO4	Develop coding in Embedded C													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1			3	3					2	2	1				3
	CO2			3	3					2	2	1				3
	CO3			3	3					2	2	1				3
	CO4			3	3	3				2	2	1				3
Course Content	**List of Experiments** **PART A: Experiments using 8051 Microcontroller** Programs on data transfer instructions Programs on arithmetic and logical instructions Programs on conditional instructions Program on serial data transmission Interfacing of LCD using assembly language Interfacing of LED using assembly language Interfacing of Stepper Motor using assembly language **PART B: Experiments using ARM LPC2148 Microcontroller** Interfacing of stepper motor Interfacing of DAC Interfacing of music tone generator Interfacing of LCD Interfacing of traffic signals Interfacing of keyboard Interfacing of DC motor Interfacing of DAC for ADC & temperature sensor **Note:** Any 10 experiments from the above list covering 5 experiments from each part														
Text book and Reference	**Text Book:** [T1] Shibu.K.V, "Embedded Systems" 3rd Ed., Tata McGraw Hill Education Private Ltd. 2013.														

books	[T2] Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay "The 8051 Microcontroller and Embedded Systems using assembly and C", 2nd Ed., Pearson [T3] Sloss Andrew N, Symes Dominic and Wright Chris, "ARM System Developers guide: Designing and Optimizing", Morgan Kaufman Publication, 2004 **Reference Books:** [R1]Raj Kamal, "Microcontrollers Architecture, Programming, interfacing and system design", 2nd Ed., Pearson Education, 2012.
E-resources and other digital material	1. http://nptel.iitg.ernet.in.

17MC1508 – Biology for Engineers

Course Category:	Humanities Elective	**Credits:**	0
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0- 0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	0
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the biological concepts from an engineering perspective and classification of living organisms													
	CO2	Demonstrate the fundamentals of biomolecules like structure, function and regulation of biological processes													
	CO3	Understand the basic principles of Mendelian genetics, gene interactions and transfer/inheritance of genetic factors/genes													
	CO4	Explain the process of cellular respiration and photosynthesis, and illustrate important diversified microorganisms and their classification													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1							2								
	CO2							2								
	CO3							2								
	CO4							2								

Course Content

UNIT- I

Introduction and Classification of Living organisms

Introduction: Fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Biology as an independent scientific discipline. Discuss how biological observations of 18th century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.

Classification: Classification of living organisms based on (a) Cellularity - Unicellular or multicellular (b) Ultra structure - Prokaryotes or eukaryotes. (c) Energy and Carbon utilization - Autotrophs, heterotrophs, lithotrophs (d) Ammonia excretion - Aminotelic, uricotelic, ureotelic (e)Habitat - Acquatic, terrestrial (f) Molecular taxonomy - Three major kingdoms of life.

UNIT- II

Biomolecules and Enzymes

Biomolecules: Biomolecules: Structures of sugars (Glucose and Fructose), Starch and cellulose. Nucleotides and DNA/RNA. Amino acids and lipids. Proteins - structure and functions - As enzymes, transporters, receptors and structural

	elements **Enzymes:** Enzyme classification. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters. **UNIT- III** **Genetics and Gene Information Transfer** **Genetics:** "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Concepts of recessiveness and dominance. Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. **Information Transfer:** DNA as a genetic material. Hierarchy of DNA structure - From single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination. **UNIT- IV** **Metabolism and Microbiology** **Metabolism:** Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. ATP as an energy currency. Breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. **Microbiology:** Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Growth kinetics. Ecological aspects of single celled organisms. Microscopy.
Text books and Reference books	**Text Book:** [T1] Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, "Biology: A global approach:", R. B. Pearson Education Ltd. [2] Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., "Outlines of Biochemistry", John Wiley and Sons. [3] Nelson, D. L.; and Cox, "Principles of Biochemistry", 5thEd., M. M.W.H. Freeman and Company [4] Stent, G. S.; and Calender, "Molecular Genetics", 2nd Ed., W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher. [5] Prescott. L.M, J.P. Harley and C.A. Klein, "Microbiology", 2nd Ed., Wm, C. Brown Publishers **Reference Books:**
E-resources and other digital material	

Third Year
(VI Semester)

17EI3601 – Process Control

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Mathematically model various physical systems.													
	CO2	Select appropriate controllers and final control elements for various processes.													
	CO3	Outline various control strategies and controller tuning procedures.													
	CO4	Understand the operation of complex processes in industrial applications.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3														1
	CO2		3													2
	CO3		3													2
	CO4															
Course Content	**UNIT- I** **Introduction to Physical Processes and Modeling:** Introduction to process control, Definition, Elements of process control, Characteristics of physical systems - Mathematical modeling of liquid, gas and thermal systems, Servo and regulatory operation. Process Identification - Step, frequency and pulse testing. **Basic Controller Modes:** Basic control actions - Characteristic of on-off, proportional, single speed floating, integral and derivative control modes, Comparison of PI, PD and PID control modes. **UNIT – II** **Controlling Elements:** Self-operated controllers, Pneumatic controllers, Hydraulic controllers, Electrical controllers and Electronic controllers. **Actuators:** Pneumatic actuators, Electro-pneumatic actuators, Hydraulic actuators, Electric motor actuators. **Control Valves**: Sliding stem control valves, Rotating shaft control valves, Control valve sizing. **UNIT – III** **Advanced Control Strategies:** Cascade control, Feed forward control, Ratio control, Smith predictor control, Internal model control, Model predictive control. **Controller Tuning**: Criteria for good control, Tuning methods - Ziegler-Nichols														

	method of tuning, Cohen-Coon method of tuning. **UNIT – IV** **Applications:** pH control, Mass transfer operations - Mathematical modeling and control of distillation column, Evaporation, Drying.
Text books and Reference books	**Text Book:** [T1] Donald P. Eckman, "Automatic process control", Wiley India Pvt. Ltd. (UNIT I & II) [T2] Donald R. Coughanowr, "Process Systems Analysis and Control", 2nd Ed., Mc Graw- Hill International edition. (UNIT III) [T3] Shinskey.F.G, "Process Control Systems - Application, Design and Tuning", 3rd Ed., Mc Graw-hill International edition. (UNIT IV) **Reference Books:** [R1] D Patranabis, "Principles of Process Control" 2nd Ed., TMH, 2007. [R2] Stephanopoulos G, "Chemical Process Control", 3rd Ed, PHI, 1994
E-resources and other digital material	1. www.freevideolectures.com /Course/3126/Process-Control-and-Instrumentation 2. www.nptel.ac.in/courses/103105064/

17EI3602 – Computer Control of Processes

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Control systems, Digital signal processing	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Explain the role of computers in industrial automation													
	CO2	Model the various processes in discrete time domain													
	CO3	Analyze the time response and stability of computer control system using pulse transfer function													
	CO4	Determine the appropriate digital control algorithm for industrial processes													
	CO5	Use the concepts of intelligent controllers in real time applications													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low,2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2	1														1
	CO3		3			3										3
	CO4	3				3										3
	CO5	2				2										2

Course Content

UNIT- I

Introduction to Computers in Process Control: Need of computer in a control system, Functional block diagram of a computer control system, Applications of computers in process industries - Data loggers, Supervisory control and direct digital control

Mathematical Modeling of Discrete Systems: Introduction to mathematical modeling, Pulse transfer functions, Mathematical model for processes in discrete domain - First order and second order processes without and with pure delay, Higher order systems

UNIT- II

Analysis of Discrete Time Systems using Pulse Transfer Functions: Mathematical representation of sampler and zero order hold, Modified Z transforms, Open loop and closed loop analysis of discrete data systems, Stability in Z- domain, Jury stability test

UNIT- III

Design of Digital Control Algorithms : General expression for digital control algorithm for set point changes, Dead beat algorithm, Dahlin's algorithm, Ringing effect, Kalman's algorithm, Design of digital control algorithm for load changes,

	Digital PID algorithms-position and velocity forms, Selection of sampling time. **UNIT- IV** **Intelligent Controllers:** Introduction, Model based controllers - Adaptive controller, Artificial intelligence AI) based systems, Expert control system, Introduction to fuzzy control, Fuzzy control system, Artificial neural networks - Introduction, Neural controllers and neuro fuzzy control system
Text books and Reference books	**Text Book:** [T1]Pradeep B.Deshpande and Raymond H Ash, "Elements of Computer Process Control with Advanced Applications", 2nd Ed., Instrument Society of America.,1981[Unit-I,II & III] [T2]Krishna Kant, "Computer-based Industrial Control", 2nd Ed., PHI, Delhi, 2010. [Unit-IV] **Reference Books:** [R1] C.D. Johnson, "Process Control Instrumentation Technology", 4th Ed., Prentice Hall Inc, 2000 [R2] M.Gopal, "Digital Control and State Variable Methods", 3rd Ed., TMH, New Delhi, 2009
E-resources and other digital material	1. http://nptel.ac.in/courses/112103174/4 2. http://nptel.ac.in/courses/112103174/3

17EI4603/A – Fiber Optic Sensors

Course Category:	Program Elective I	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Engineering physics, Electronic devices and circuits	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Demonstrate the basic concepts of fiber optic sensors													
	CO2	Select suitable wavelength modulated fiber optic sensors to measure physical parameters													
	CO3	Select suitable interferometric and frequency modulated fiber optic sensors to monitor physical parameters													
	CO4	Apply principles of fiber optic sensors for various applications													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3														
	CO2		2													
	CO3		3													
	CO4	1														
Course Content	**UNIT- I** **Optical Fiber Sensors:** Introduction, Advantages of optical fiber sensors, Generic optical fiber sensor, Classification, Modulation schemes, Fields of applications, Issues in optical fiber sensors. **Basic Fiber Optics:** Introduction, Light propagation in an optical fiber, Acceptance angle and Numerical Aperture (NA), Fiber characteristics, Types of optical fibers, Optical fibers for sensors, Fiber selection for sensors. **UNIT- II** **Wavelength Modulated Sensors:** Introduction, Luminescence, Displacement sensor, Temperature sensor, Humidity sensor, Glucose sensor, pH sensor, Oxygen sensor, Carbon dioxide sensor. **UNIT- III** **Interferometric Sensors:**Introduction, Interference phenomenon, Fiber optic interferometers magnetic field/electric current sensor, Electric field/voltage sensor, Acoustic sensor, Gyroscope, Temperature sensor, Hydrogen gas sensor, Strain sensor. **UNIT- IV** **Frequency Modulated Sensors:**Introduction, Doppler effect, Raman effect, Doppler effect based sensors, Raman scattering based sensors.														

	Applications: Displacement sensors, Flow measurement, Acoustic sensor, Detection of oil in water, Liquid level sensor, Hydrocarbons detection in water, Oxy-haemoglobin concentration measurements.
Text books and Reference books	**Text Book:** [T1] B.D. Gupta, "Fiber Optic Sensors Principles and Applications", 1st Ed., New India publishing agency, 2006. (UNIT I,II,III & IV) **Reference Books:** [R1] Eric Udd, William B. Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists", 2nd Ed., John Wiley & Sons, 2011
E-resources and other digital material	1. https://nptel.ac.in/courses/114106046/46

17EI4603/B – VLSI Design

Course Category:	Program Elective I	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Electronic devices and circuits, Digital circuits and systems	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes

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

CO1	Understand the different fabrication methods of integrated circuits
CO2	Analyze basic electrical properties of MOSFET
CO3	Apply the design rules for MOS and BiCMOS circuits
CO4	Outline the concepts of MOS circuits

Contribution of Course Outcomes towards achievement of Program Outcomes

(1 – Low, 2 - Medium, 3 – High

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		2													
CO2		3													
CO3	2														
CO4	3														

Course Content

UNIT- I

IC Fabrication: Introduction to IC technology, MOS and related VLSI technology, Basic MOS transistors, Enhancement and depletion modes of transistor action, IC production process, MOS and CMOS fabrication processes, BiCMOS technology, Comparison between CMOS and bipolar technologies.

UNIT- II

Basic Electrical Properties of MOS and BiCMOS Circuits: Ids versus Vds relationships, Aspects of MOS transistor threshold voltage, MOS transistor trans, Output conductance and figure of merit. The pass transistor, NMOS inverter, Pull-up to pull-down ratio for NMOS inverter driven by another NMOS inverter. Alternative forms of pull-up, The CMOS Inverter, MOS transistor circuit model, BiCMOS inverter, Latch-up in CMOS circuits and BiCMOS latch-up susceptibility.

UNIT- III

MOS and BiCMOS Circuit Design Processes: MOS layers, Stick diagrams, Design rules and layout, General observations on the design rules, 2μm Double metal, Double poly, CMOS/BiCMOS rules, 1.2μm Double Metal, Double Poly CMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter, Symbolic diagrams - Translation to mask form.

UNIT- IV

Basic Circuit Concepts: Sheet resistance, Sheet resistance concept applied to MOS transistors and inverters, Area capacitance of layers, Standard unit of capacitance, The delay unit, Inverter delays, Propagation delays, Wiring capacitances, Fan-in and fan-out characteristics, Choice of layers, Transistor switches, Realization of gates

	using NMOS, PMOS and CMOS technologies. **Scaling of MOS Circuits:** Scaling models, Scaling factors for device parameters, Limits due to sub threshold currents, current density limits on logic levels and supply voltage due to noise.
Text books and Reference books	**Text Book:** [T1] Kamran Eshraghian,DouglasandA.Pucknell and SholehEshraghian, "Essentials of VLSI Circuits and Systems", 1st Ed., Prentice-Hall of India Private Limited, 2005. (Unit I. II, III, IV) [T2] Wayne Wolf, "Modern VLSI Design", 4th Ed., Pearson Education. (UNIT I, II, III & IV) [T3] Neil H. E. Weste and David Money Harris,"CMOSVLSI Design", 4thEd.,Pearson Education. (UNIT I, II, III & IV) **Reference Books:** [R1] A.Albert Raj and T.Latha, "VLSI Design", PHI Learning Private Limited, 2010. [R2] A.Shanthi and A.Kavita, "VLSI Design", 1st Ed., New Age International Private Limited,2006
E-resources and other digital material	1. http://nptel.iitg.ernet.in

17EI4603/C – Robotics and Control

Course Category:	Program Elective I	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the fundamental concepts of robot anatomy													
	CO2	Illustrate the kinematics and inverse kinematics of manipulators.													
	CO3	Select various strategies to manipulator control.													
	CO4	Identify suitable robots for industrial applications													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2	3														3
	CO3		2													2
	CO4	2														2

Course Content

UNIT- I

Introduction to Robotics: Evolution of robots and robotics. Laws of robotics, Robot anatomy, Manipulators, Links, Types of joints, Degrees of freedom, Required DOF in a manipulator, Arm and wrist configuration, End effectors, Robot actuators, Sensors and vision.

UNIT- II

Robot Kinematics:

Coordinate Frames, Mapping and Transformations: Coordinate frames, Transformation of vectors, Homogeneous transformation matrices, Fundamentals of rotation matrices.

Direct Kinematic Model: Mechanical structure and notations, Description of links and joints, Kinematic modeling of the manipulator, Denavit Hartenberg (DH) notation. Kinematic relationship between adjacent links, Manipulator transformation matrix, Case study - 3DOF articulated arm kinematic model, Inverse kinematics, Manipulator work space, Solvability of inverse kinematic model, Solution techniques, Closed form solution, Case study - 3DOF articulated arm inverse kinematics.

UNIT- III

Control of Manipulators: Block diagram of manipulator control system, Open and closed loop control system, Manipulator control problem, Linear control schemes, Linear second order SISO model of a manipulator joint, Model of a DC motor, Partition PD and PID control schemes. Force control of robotic manipulator, Hybrid position/ force control, Impedance force/torque control.

	UNIT- IV **Applications of Robots:** Industrial applications: Material handling - Material transfer applications, Machine loading and unloading application, Picking and placing, Palletizing and depalletizing, Processing applications - Welding assembly applications, Peg in hole assembly, Inspection applications, An overview of non industrial applications, Work place design considerations for safety, Safety sensors and safety monitoring.
Text books and Reference books	**Text Book:** [T1] R.K.Mittal&, I.J.Nagarath, "Robotics and Control", Tata McGraw Hill Pvt. Ltd, 15th Ed., 2010 [T2] S.R.Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Pvt. Ltd., 2002 **Reference Books:** [R1] R.D.Klafter, T.A.Chimielewski& M. Negin, "Robotic Engineering - An IntegratedApproach", Prentice Hall of India, New Delhi, 1994 [R2] P.J.McKerrow, "Introduction to Robotics", Addison Wesley, USA, 1991
E-resources and other digital material	1. http://nptel.ac.in/courses/112103174/4 2. http://nptel.ac.in/courses/112103174/3

17EI4603/D – Industrial Communication Networks

Course Category:	Program Elective I	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Explain various industrial networks and reference network models.													
	CO2	Use HART communication protocol in process automation.													
	CO3	Outline the Foundation Fieldbus architecture.													
	CO4	Select appropriate PROFIBUS protocols in process automation.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2	2														2
	CO3		3													2
	CO4		2													2

Course Content

UNIT- I

Introduction to Data Communication and Industrial Networks: Introduction, Data communication, Data types, Data flow methods, Transmission modes, Transmission impairments, Data rate and bandwidth relationship.

Introduction to networks, Data communication standards and organizations, Network topology, Network components, Classification of networks, OSI model, TCP/IP reference model.

UNIT – II

Networks in Process Automation: Introduction, I/O bus networks, Networking at I/O & field levels, Control level, Enterprise/Management level.

Highway Addressable Remote Transducer (HART): Introduction to HART protocol, HART encoding and waveform, HART addressing, Arbitration, Communication modes, HART networks, HART communication layers.

UNIT – III

Foundation Field Bus: Introduction, Definition and features, Foundation field bus data types, Architecture, H1 benefits, HSE benefits, OSI model of foundation fieldbus, Physical Layer, Data link layer, Application Layer, Technology in Foundation Fieldbus, Redundancy.

UNIT – IV

PROFIBUS: Introduction, Transmission technology, Communication protocols, Device classes, OSI model of PROFIBUS protocol stack, PROFIBUS - DP

	Characteristics, Communication profile of PROFIBUS - DP, Physical layer, Data link layer, DDLM and user interface, PROFIBUS - PA characteristics, Redundancy, PROFIsafe, PROFIdrive, PROFInet, Foundation Fieldbus and PROFIBUS a comparison
Text books and Reference books	**Text Book:** [T1] S. Sunit Kumar " Fieldbus and Networking in Process Automation" CRC Press, Taylor and Francis Group, 1st Ed., 2014 [T2] S.Mackay, E.Wrijut, D.Reynders and J.Park, "Practical Industrial Data Networks Design, Installation and Troubleshooting", Newnes Publication, Elsevier, 1st Ed., 2004 **Reference Books:** [R1] S. Mackay, J. Park and E. Wright, "Practical Data Communication for Instrumentation and Control", Newnes Elsevier,2002 [R2]R. Bowden, 'HART application Guide', HART Communication Foundation,1999
E-resources and other digital material	1. https://www.youtube.com/watch?v=DgAwOJMN2N0 2. http://nptel.iitg.ernet.in/Elec_Engg/IIT 3. http://www.nptel.ac.in/courses/106105081

17EI4604/A – Renewable Energy

Course Category:	Program Elective II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Describe the role of Renewable energy sources on future energy demand.														
	CO2	Illustrate solar power generation and photovoltaics.														
	CO3	Illustrate wind energy generation and its applications.														
	CO4	Elucidate the role of tidal and geothermal energy resources in power generation.														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1						3	3								
	CO2	3					3	3								
	CO3	2					2	2								
	CO4						2	2								
Course Content	**UNIT- I** **Introduction:** Energy, Evolution of world energy demand, Greenhouse effect, Renewable energies, Global use of renewable energy sources, Future energy demand and climatic protection. **UNIT-II** **Solar Power:** Solar power, Energy balance of the earth, Earth-Sun motion, Insolation, Solar resource, Concentrating Solar Power: Power tower, Line or Linear focus, Dish/Engine system, Point focus, Solar pond. **Photovoltaics:** Photovoltaic basics, Performance, Design considerations, Installed capacity and production, Applications. **UNIT- III** **Wind Energy:** Introduction, Wind characteristics and resources, Power transfer to a turbine, Turbine types and terms, Controlling and optimizing wind turbine performance, Electrical aspects and grid integration, Small wind, Offshore wind, Environmental impacts, Applications. **UNIT-IV** **Tidal Energy:** Wave, Tidal and Ocean thermal power resources, Tidal power and the cause of tides, Ocean thermal energy conversion. **Geothermal Energy:** Introduction, Resource, Types of geothermal resources, Direct use, Geothermal heat pumps, Electricity.															

Text books and Reference books	**Text Book:** [T1] Volker Quaschning, "Understanding Renewable Energy Systems", Earthscan, 2005. [T2] Vaughn Nelson, "Introduction to Renewable Energy", CRC Press, 2011. [T3] Robert Ehrlich, Harold A. Geller, "Renewable Energy: A First Course" 2nd Ed., CRC Press Taylor & Francis Group, 2018. **Reference Books:** [R1] John Twidell and Tony Weir, "Renewable Energy Resources" 3rd Ed., Routledge, 2015. [R2] Dieter Seifried and Walter Witzel, "Renewable energy: the facts", Earthscan, 2010.
E-resources and other digital material	1. https://nptel.ac.in/courses/108105058/

17EI4604/B – Industrial Electronics

Course Category:	Program Elective II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Basics of Electrical Engineering, Electronic Devices and Circuits	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the principles and characteristics of different power electronic devices													
	CO2	Analyze the operation of SCR converters, Inverters and chopper circuits.													
	CO3	Outline the operation of DC amplifiers and voltage regulated power supplies for industrial applications													
	CO4	Illustrate various industrial applications of SCR													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2-Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3													2	
	CO2			3											2	
	CO3	2													2	
	CO4		2												2	
Course Content	**UNIT- I** **Thyristors:** SCR structure and operation, Characteristics of SCR: Static V-I characteristics, Switching characteristics and gate characteristics, SCR turn on methods, SCR commutation techniques. **Modern semi conductor Power Electronic Devices:** Asymmetrical SCR, RCT, GATT, DIAC and TRIAC characteristics. **UNIT- II** **Thyristor Converters:** Single phase converters: Half wave converters, Full wave converters, Bridge converters. **Thyristor Inverters and Choppers:** Single phase inverters, Mc Murray Inverter, Mc Murray Bedford Inverter, Principle of step down chopper, Principle of stepup chopper, Chopper configurations. **UNIT- III** **Amplifiers and Regulated Power supplies**: DC amplifier, Differential amplifier as a DC amplifier, Chopper stabilized DC amplifier, Regulated power supplies: Principle, DC voltage regulator, Un Interrupted Power Supply (UPS), Switched Mode Power Supplies (SMPS).														

	UNIT- IV **Industrial Applications:** Industrial timing circuits, Electric welding methods and types, Induction and dielectric heating: Principle, Theory and applications, Amplidyne servo mechanism, Ultrasonic generators and applications. Speed control of induction motor and Super synchronous motor drives.
Text books and Reference books	**Text Book:** [T1] G.K.Mithal and Dr.Maneesh Gupta, "Industrial and Power Electronics," Khanna Publications, 9th Ed., 2007 **Reference Books:** [R1] M.Ramamurthy, "Thyristors and their applications", East-West Press, 2nd Ed.,1998 [R2] M.H.Rashid, Power Electronics Devices, Circuits and Application, Prentice Hall of India, 2003 [R2] P.S.Bimbra, "Power Electronics," Khanna Publications, 4th Ed., 2010
E-resources and other digital material	1. www.nptel.ac.in/downloads/108105066/ 2. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-334-powernelectronics-spring-2007/lecture-notes/ 3. http://www.nptelvideos.in/2012/11/power-electronics.html 4. http://onlinevideolecture.com/?course_id=510

17EI4604/C - Process Modeling and Simulation

Course Category:	Program Elective II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Process Control	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	4703	Determine nonlinear and linear models for a given process.														
	CO2	Model PID controller for a given process with suitable tuning method.														
	CO3	Analyse closed loop performance of Internal Model Controller (IMC) for various processes.														
	CO4	Describe the basic concepts of SISO Model predictive controller (MPC).														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3														3
	CO2	2				2										2
	CO3		3			3										3
	CO4															

Course Content

UNIT – I

Introduction to Process Modeling: Definitions, Model representation, Types of modeling equations, Classification of mathematical models, Process models and dynamic behaviour, Reasons for modeling, Material balances, Material and energy balances, Form of dynamic models, Linearization of nonlinear models, Dynamic behaviour, Stability of linear state space models, Empirical models.

UNIT – II

PID Controller Tuning and Enhancements: Introduction, PID controller forms, Closed-loop oscillation based tuning, Tuning rules for first-order + dead time processes, Direct synthesis for minimum-phase and non-minimum phase processes, Antireset windup, Autotuning techniques.

UNIT – III

Internal Model Control: Introduction to model based control, Practical open-loop controller design, Generalization of the open-loop control design procedure, Model uncertainty and disturbances, The Internal Model Control (IMC) structure, The IMC design procedure, Effect of model uncertainty and disturbances, Improved disturbance rejection design, The equivalent feedback form to IMC, The IMC based PID control design procedure.

	UNIT – IV **Model Predictive Control:** Block diagram of Model Predictive Control (MPC),Basic concept of MPC, Least squares and absolute values objective functions, Finite step response and finite impulse response models, Steps involved in implementing Dynamic Matrix Control (DMC), Effect of tuning parameters.
Text books and Reference books	**Text Books** [T1] B.Wayne Bequette, Process Control - Modeling, Design and Simulation, Prentice Hall International Series in the Physical and Chemical Engineering Sciences, 1st Ed., 2003. [T2] Amiya K.Jana, Chemical Process Modeling and Computer Simulation, PHI, 2nd Ed., 2011. **Reference Book** [R1] B. Wayne Bequette, Process Dynamics -Modeling, Analysis, and Simulation**,** Prentice Hall International Series in the Physical and Chemical Engineering Sciences, 1st Ed., 1998.
E-resources and other digital material	[1] https://nptel.ac.in/courses/103103037/module4/lec7/3.html [2] https://nptel.ac.in/courses/103101003/26 [3] https://nptel.ac.in/courses/103103037/24

17EI4604/D – Biomedical Signal Processing

Course Category:	Program Elective II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Outline basic signal processing techniques suitable for various biological signals.														
	CO2	Use the relevant mathematical models for noise cancellation and compression.														
	CO3	Categorize the cardiac anomalies.														
	CO4	Outline the neurological signal processing methods.														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1		3													
	CO2	3				3										
	CO3		3			3										
	CO4		3			3										

Course Content

UNIT- I

Introduction to Biomedical Signals: The nature of biomedical Signals, Examples of biomedical signals, Objectives and difficulties in biomedical analysis.

Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits.

Signal Averaging: Basics of signal averaging, Signal averaging as a digital filter, A typical average, Software for signal averaging, Limitations of signal averaging.

UNIT II

Adaptive Noise Cancelling: Principal noise canceller model, 60Hz Adaptive cancelling using a sine wave model, Other applications of adaptive filtering.

Data Compression Techniques: Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, Data reduction algorithms, The Fourier transform, Correlation, Convolution, Power spectrum estimation, Frequency domain analysis of the ECG.

	UNIT III **Cardiological Signal Processing:** Basic electrocardiography, ECG data acquisition, ECG lead systems, ECG parameters and their estimation, ECG QRS detection techniques, Arrhythmia analysis monitor, Long term continuous ECG recording. **UNIT IV** **Neurological Signal Processing**: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Linear prediction theory, Auto-Regressive (AR) method. **Analysis of sleep EEG:** Data acquisition and classification of sleep EEG, Markova model and Markova chains.
Text books and Reference books	**Text Book:** [T1] Rangaraj M. Rangayyan, "Biomedical Signal Analysis A Case Study Approach", John Wiley & Sons 2002. [T2] Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India 2004. [T3] D C Reddy, "Biomedical Signal Processing Principles and Techniques", Tata McGraw-Hill Publishing Co. Ltd, 2005. **Reference Books:** [R1] Akay M, "Biomedical Signal Processing", Academic: Press 1994. [R2] Cohen.A, "Biomedical Signal Processing" Vol. I, CRC Press, 1986. [R3] A.V.Oppenheim & R.W.Shafer, "Discrete-time Signal Processing" Prentice Hall, Englewood Cliffs, NJ, 1989.
E-resources and other digital material	1. https://onlinecourses.nptel.ac.in/noc19_ee23//Biomedical Signal Processing

17EI2605/A – Virtual Instrumentation

Course Category:	Open Elective IV	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Outline the architecture of a virtual instrument and data flow techniques														
	CO2	Illustrate the development of virtual instrument using graphical user interface														
	CO3	Use various function palettes to develop a VI														
	CO4	Outline the configuring of data acquisition cards for measurement														
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1					3								3		3
	CO2				2	3								2		3
	CO3				3	3								3		3
	CO4					3								3		3

Course Content

UNIT- I

Review of Virtual Instrumentation: Block diagram and architecture of a virtual instrument, Graphical system design model, Data-flow techniques, Virtual instrument and traditional instrument.

VI Programming Techniques: Introduction to Lab VIEW, Software environment, Creating and saving VI, Controls and indicators, Data types, Strings, For loops, While loops, Local variables and global variables

UNIT – II

Modular Programming: Creating Sub VI's, Creating a standalone application.

Arrays and Clusters: Introduction, Creating one dimensional array, Creating two dimensional array, Array functions, Auto indexing, Matrix operations with arrays, Creating clusters, Cluster operations, Conversion between arrays and clusters, Error handling.

UNIT – III

Plotting Data and Structures: Introduction, Types of wave forms, Wave form graphs, Wave form charts, Wave form data type, XY graphs, Case structures, Sequence structures, Formula nodes, Math script node.

File I/O: Basics of file input/ output, Choosing a file format, File I/O VI's.

UNIT – IV

Data Acquisition Basics: Introduction to data acquisition on PC, Sampling

	fundamentals, Signal conditioning, DAQ hardware configuration, DAQ hardware, DAQ assistant, Channels and task configuration, Components of computer based measurement system
Text books and Reference books	**Text Book:** [T1] Jovitha Jerome, "Virtual Instrumentation using LabVIEW", 1st Ed., PHI, 2013 **Reference Books:** [R1] Sanjay Gupta, Joseph John, "Virtual Instrumentation using LabVIEW", 1st Ed., Tata McGraw-Hill, 2005. [R2] Gary Johnson, Richard Jennings, "LabVIEW Graphical Programming", Tata McGraw-Hill, 2006
E-resources and other digital material	1. http://www.ni.com

17EI2605/B – Intelligent Instrumentation Principles and Application

Course Category:	Open Elective IV	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Summarize the classification and characteristics of sensors														
	CO2	Outline the operative principles of intelligent sensors														
	CO3	Apply the linearization and calibration, standards and protocols to sensors														
	CO4	Make use of intelligent instrumentation in various industrial processes.														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2- Medium, 3– High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2												2		
	CO2		3											2		
	CO3	2												2		2
	CO4	2												2		2
Course Content	**UNIT- I** **Introduction to Intelligent Instrumentation:** Introduction, Classical sensors and transducers - Classification, Self generating transducers, Variable parameter transducers, Radioactive transducer, Semiconductor sensors, Array-based sensors, Biosensors, Sensor performance characteristics - Static characteristics, Dynamic characteristics, Input-Output impedances. **UNIT- II** **Intelligent Sensors:** Classification, Smart sensors, Cogent sensors, Soft or virtual sensors, Self-adaptive sensors, Self-validating sensors. **Sensors with Artificial Intelligence:** Introduction, Multidimensional intelligent sensors, AI for prognostic instrumentation, Fuzzy logic based sensors **UNIT- III** **Linearization and Calibration:** Analog linearization of positive coefficient resistive sensors, Linearization of negative coefficient resistive sensors, ANN-based linearization. Sensor calibration - Conventional calibration circuits, Multiplying DAC calibration, offset calibration, Pulse modulated calibration, ADC calibration, STIM calibration. **UNIT- IV** **Intelligent Sensor Standards and Protocols:** Introduction, IEEE 1451 standard, Network topologies, CEBUS communication protocol for smart home, Plug-n-play smart sensor protocols.															

	Case Studies: Tea fermentation process, Self adaptive pressure sensor system, Soft sensor for water treatment process, Oxygen sensor in industry and environment monitoring.
Text books and Reference books	**Text Book:** [T1] Manabendra Bhuyan, "Intelligent Instrumentation Principles and Applications", CRC Press. **Reference Books:** [R1] Barney G.C.V., "Intelligent Instrumentation", Prentice Hall of India Pvt. Ltd., New Delhi, 1988 [R2] John G. Webster, Halit Eren, "Measurement, Instrumentation, and Sensors Handbook: Electromagnetic, Optical, Radiation, Chemical, and Biomedical Measurement", 2nd Ed [R3]KrysztofIniewski , "Smart Sensor for Industrial Applications", 1st Ed., CRC Press
E-resources and other digital material	

17TP1606 – Quantitative Aptitude

Course Category:	Institutional Core	**Credits:**	1
Course Type:	Learning by doing	**Lecture - Tutorial - Practice:**	1 - 0- 0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	0
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Solve various basic mathematics problems by following different methods
	CO2	Follow strategies in minimizing time consumption in problem solving; apply shortcut methods to solve problems
	CO3	Confidently solve any mathematical problems and utilize these mathematical skills both in their professional as well as personal life
	CO4	Analyze, summarize and present information in quantitative forms including table, graphs and formulas

Contribution of Course Outcomes towards achievement of Program Outcomes

(1 – Low, 2 - Medium, 3 – High

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2														
CO2		2													
CO3	2														
CO4				2											

Course Content

UNIT- I

Numerical Ability I: Number system, HCF & LCM, Average, Simplification, Problems on numbers.

Numerical Ability II: Ratio &proportion, Partnership, Percentages, Profit &loss.

UNIT- II

Arithmetical Ability I: Problems on ages, Time & work, Pipes & cistern, Chain rule.

Arithmetical Ability II: Time & distance, Problems on boats & steams, Problems on trains

UNIT- III

Arithmetical Ability III: Allegation, Simple interest and compound interest, Races & games of skills, Calendar and clock**.**

Logical Ability: Permutations and combination and probability.

UNIT- IV

Mensuration: Geometry, Areas, Volumes.

Data Interpretation: Tabulation, Bar graphs, Pie charts, Line graphs

Text books and Reference books	**Text Book:** [T1] R. S. Aggarwal "Quantitative Aptitude", Revised Ed., S Chand publication, 2017 **Reference Books:**
E-resources and other digital material	1. www. Indiabix.com 2. www.freshersworld.com

17EI3651 – Process Control Lab

Course Category:	Program Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Demonstrate the characteristics of major components of process control loops.													
	CO2	Interpret the performance of different control schemes in various process loops.													
	CO3	Examine the characteristics of various advanced control schemes in different processes.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3			1					2	2	1				3
	CO2	3			3					2	2	1				3
	CO3		3		1					2	2	1				3
Course Content	**List of Experiments** 1. Characteristics of Chromel–Alumel thermocouple and temperature transmitter 2. Characteristics of PID controller in temperature process station. 3. Characteristics of level transmitter and I/P converter. 4. Characteristics of ON/OFF controller in level process station. 5. Characteristics of flow transmitter and control valve. 6. Characteristics of PI controller in flow process station. 7. Characteristics of pressure transmitter and I/P converter. 8. Comparison of P, PI & PID control modes in pressure process station. 9. Characteristics of cascade control. 10. Characteristics of ratio control. 11. Characteristics of feed forward control. 12. Study of pH control system. 13. Study of temperature control in heat exchanger. 14. Characteristics of PID controller in flow process station using LABVIEW. 15. Characteristics of PID controller in level process station using LABVIEW														
Text books and Reference books	**Text Book:** [T1] Process control lab manual. [T2] Donald P. Eckman, "Automatic Process Control', Wiley India Pvt. Ltd. [T3] Donald R. Coughanowr, "Process Systems Analysis and Control, 2nd Ed., McGraw-Hill international edition **Reference Books:**														

E-resources and other digital material	1. www.freevideolectures.com /Course/3126/Process-Control-and-Instrumentation 2. www.nptel.ac.in/courses/103105064

17EI3652 – Virtual Instrumentation Lab

Course Category:	Program Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Develop a virtual instrument for simple applications													
	CO2	Apply various looping constructs , arrays, matrices and clusters													
	CO3	Use various data plotting techniques and structures													
	CO4	Make use of data acquisition device to acquire the measurement data from real world into PC.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1					3				2	2	1				3
	CO2				2	3				2	2	1		1		3
	CO3				2	3				2	2	1		1		3
	CO4				2	3				2	2	1		2		3
Course Content	**List of Experiments** 1. Programs on controls and indicators 2. Programs on arithmetic operations 3. Programs on Boolean operations 4. Programs on sub VI's 5. Programs on repetition and loops 6. Programs on arrays 7. Programs on matrices 8. Programs on clusters 9. Programs on data plotting 10. Programs on structures 11. Programs on formula nodes and math script nodes 12. Programs on strings, file I/O 13. Temperature acquisition using 3-wire RTD. 14. Programs on data logging 15. Programs using NI myDAQ.														
Text books and Reference books	**Text Book:** [T1] Jovitha Jerome, "Virtual Instrumentation using LabVIEW", 1st Ed., PHI, 2013 **Reference Books:** [R1] Sanjay Gupta, Joseph John, "Virtual Instrumentation using LabVIEW", 1st Ed., TataMcGraw-Hill, 2005 [R2] Gary Johnson, Richard Jennings, "LabVIEW Graphical Programming", Tata McGraw-Hill, 2006														

E-resources and other digital material	1. http://www.ni.com

17EI5653 – Engineering Project for Community Services

Course Category:	Program Core	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 1- 2
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	0
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Demonstrate a through and systematic understanding of societal problems and contemporary issues													
	CO2	Develop interest towards research oriented field through literature exploration													
	CO3	Exhibit competency in suggesting optimum solution by detail analysis of the problem													
	CO4	Demonstrate effective interpersonal, communication& presentation skills in relating engineering issues to broader societal context													
Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1						3	3								3
	CO2											2				2
	CO3						2									2
	CO4									2	2		2			2

Fourth Year
(VII Semester)

17EI3701 – Industrial Automation

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply the concepts of programmable logic controller in automation.													
	CO2	Design ladder diagram for simple applications.													
	CO3	Illustrate the overview of distributed control system.													
	CO4	Summarize the applications of distributed control system in industries.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3– High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2														1
	CO2			3		3										1
	CO3															1
	CO4		2													1
Course Content	**UNIT- I** **Introduction:** Conceptual/functional topology of an automation system, Physical architecture. **Overview of Programmable Logic Controllers(PLC):** Definition, Parts of PLC, Principles of operation, PLC versus computer, PLC size and applications, PLC hardware - I/O section addressing, Discrete I/O modules, Analog I/O modules, Special I/O modules, Programming device, Fundamentals of logic, Field I/O devices - Electromagnetic relays, Switches, Sensors, Output devices. **UNIT – II** **Programming of PLC:** Basics of PLC programming - Program SCAN, Programming languages, Relay type instruction, Branch instructions, Programming timers and counters, Program control instructions, Data manipulation instructions, Math instructions, PLC based process control - Data acquisition system, Types of processes, Structure of control system. **UNIT – III** **Distributed Control Systems (DCS):** Evolution, Resulting system architectures, Generalized distributed control system architecture, Functional components of DCS - Field communication, I/O sub system. Local Control Unit (LCU), Function blocks, LCU architectures, LCU process interface issues - Overview of security design approaches, Control output configurations, Operator Interface - Installation and equipment configurations, Operator interface requirements, Low-level operator interface, High-level operator interface, Operator displays**.** .														

	UNIT – IV **Applications of DCS:** Application of DCS in thermal power plants, Iron and steel making process - Integrated control of a steel plant, Cock ovens plant control, Blast furnace control, Bio-technology plant control, Cement plants, Pulp and paper process control, DCS in pulp and paper plants, Oil and gas fields - Onshore oil and gas field automation, Offshore oil and gas field automation
Text books and Reference books	**Text Book:** [T1] Frank D.Petruzella,"Programmable Logic Controllers", 2nd Ed, Glencoe McGraw Hill [T2] Michael P. Lucas, "Distributed Control Systems-Their Evaluation and Design", Van Nostrand Reinhold Company Inc.1986. [T3] DobrivojePopovic and Vijay P.Bhatkar, "Distributed Computer Control", CRC Taylor &Fransis group.1990 **Reference Books:** [R1]B R Mehtha, Y J Reddy, "Industrial Process Automation Systems", ButterworthHeinmann imprint of Elsevier, 2015
E-resources and other digital material	1. http://ee.sharif.edu/~industrialcontrol/LADDER_LOGIC_Tutorial.pdf 2. https://www.elprocus.com/distributed-control-system-features-and-elements/

17EI4702/A – Power Plant Instrumentation

Course Category:	Program Elective III	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Process Control	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Understand the operation and safety measures in thermal power plants														
	CO2	Select suitable measuring techniques for pollution, impurity and turbine parameters														
	CO3	Select suitable control techniques for water, air fuel circuits and turbines in power plant														
	CO4	Determine boiler efficiency in thermal power plants														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3												3		2
	CO2	3												3		2
	CO3		2											3		1
	CO4	2												1		1
Course Content	**UNIT- I** **Overview of Thermal Power Generation:** Introduction to thermal power plants, Comparison of various conventional power plants, Classification of instruments in a power plant, Objectives of instrumentation and control in thermal power plants, Layout of typical thermal power plants, Piping and instrumentation diagram **Instrumentation and Control in Water Circuit:** Water circuit, Boiler feed water circulation, Controls in water circuit, Impurities in water and steam, Effects of impurities, Measurement of impurities **UNIT – II** **Instrumentation and Control in Air-Fuel Circuit:** Air fuel circuit - Fuels, Combustion air, Flue gases, Waste gases, Controls in air fuel circuit - Combustion control, Furnace draft control, Analytical measurement - Oxygen measurement in flue gas, Measurement of carbon dioxide in flue gas, Combustibles analyzer, Infrared flue gas analyzers, Smoke detector, Dust monitor, Fuel analyzers, Chromatography, Pollution monitoring instruments. . **UNIT – III** **Power Plant Management:** Introduction, Master control, Combustion Process - Stoichiometric air requirement, Excess air requirement, Products of combustion, Boiler efficiency - Calculation of boiler efficiency, Types of maintenance, Maintenance costs, Life cycle costs, Maintenance procedures, Intrinsic safety of															

	instruments, Electrical safety, Explosion hazards, Interlocks for boiler control, Application of DCS in power plants **UNIT – IV** **Turbine Monitoring and Control:** Introduction,Classification, Principle parts of steam turbines, Turbine steam inlet system, Turbine measurements - Process parameters, Mechanical parameters, Electrical parameters, Turbine control system - Safety control systems, Lubrication for turbo alternator - Lubrication system, Controls in lubrication system, Turbo Alternator cooling system - Lube oil cooling system, Condensate cooling system, Alternator/Generator cooling system
Text books and Reference books	**Text Book:** [T1] K. Krishnaswamy& M. PonniBala, "Power Plant Instrumentation" PHI Learning Private Limited, 1st Ed., Delhi-110092 **Reference Books:** [R1] P.K. Nag, 'Power Plant Engineering', Tata McGraw Hill, 2001 [R2] S.M. Elonka and A.L. Kohal, 'Standard Boiler Operations', Tata McGraw Hill, New Delhi,1994 [R3] Sam G. Dukelow, 'The Control of Boilers', Instrument Society of America, 1991
E-resources and other digital material	1. http://www.instrumentationguide.com/article/boilerlevelcontrol.htm 2. https://www.wisegeek.com/what-is-hydroelectric-power.htm 3. https://www.brighthub.com/environment/renewable-energy/articles/7728.aspx

17EI4702/B – Industrial Internet of Things

Course Category:	Program Elective III	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Industrial Communication Networks, Embedded Systems	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Classify the industry environments and scenarios covered by IIOT														
	CO2	Use the key technologies in IIOT														
	CO3	Model the Industrial Internet Systems by selecting suitable middleware platforms and WAN technologies														
	CO4	Analyze how IIOT is deployed in Industry 4.0														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1		3													
	CO2	3														
	CO3	3														
	CO4		2													

Course Content

UNIT- I

Introduction to Industrial IOT: Technical Requirements, IOT key technologies, IOT and IIOT Similarities and differences, IOT Analytics and AI, Industry Environments and scenarios covered by IIOT.

Understanding the Industrial Process and Devices: Technical Requirements, The industrial process, The CIM pyramid, The IIOT data flow. Industrial Internet Use -Cases - Health care, Oil and Gas industry, Smart office, Logistics and the industrial internet, Retail

UNIT – II

Industrial Data Flow and Devices: Technical requirements, The IIOT data flow in the factory, Measurements and the actuator chain, Controllers, Industrial protocols, SCADA, Historian, ERP and MES.

Key IIOT Technologies: Cyber physical systems, Wireless technology, IP mobility, Network functionality virtualization, Network virtualization, Smartphone's, Thecloud and fog, Big data and analytics, M2M learning and artificial intelligence, Augmented reality, 3D Printing

UNIT – III

IOT Reference Architecture: Industrial internet architecture Framework, Functional viewpoint, The three-tire topology, Key system characteristics, Data

	management. **Designing Industrial Internet Systems:** The concept of the IIOT, The proximity network, WSN edge node, Legacy industrial protocols, Modern communication protocols, Wireless communication technologies, Proximity network communication protocols, Industrial gateways. **UNIT – IV** Middleware IIOT platforms, IIOT WAN technologies and protocols, Securing the industrial internet, Introduction to Industry 4.0, Main characteristics of Industry 4.0, Industry 4.0 design principles, Building blocks of Industry 4.0, Industry 4.0 reference architecture, Smart factories, Real-world Smart factories.
Text books and Reference books	**Text Book:** [T1] Alasdair Gilchrist "Industry 4.0: The Industrial Internet of Things", 1st Ed., Apress, 2016. [T2] CiacomoVeneri, Antonio Capasso, "Hands on Industrial Internet of Things", 1st Ed., Packt Publishing Ltd., 2018 **Reference Books:** [R1]UlrichSendler, "The Internet of Things: Industry 4.0 unleashed",1st Ed., Springer, 2016. [R2] Sabina Jeschke, Christian Brecher "Industrial Internet of Things: Cyber manufacturing systems", 1st Ed., Springer, 2017
E-resources and other digital material	1. https://blog.seebo.com/ 2. https://medium.com/the-industry-4-0-blog 3. https://www.ibm.com/blogs/internet-of-things/tag/industry-4-0/ 4. https://www.uilabs.org/innovation-platforms/manufacturing/

17EI4702/C – Wireless Sensor Networks

Course Category:	Program Elective III	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the basic concepts of wireless sensor networks													
	CO2	Compare node and network architectures in wireless sensor networks													
	CO3	Apply suitable protocol in routing based on network and user requirement.													
	CO4	Analyze various clustering and localization techniques.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2		2													
	CO3	2														
	CO4		3													

Course Content

UNIT- I

Overview of Wireless Sensor Networks: Characteristic requirements, Required mechanisms, Unique constraints and challenges of sensor networks, Emerging technologies for wireless sensor networks, Advantages of sensor networks, Sensor network applications, Collaborative processing and Key definitions of sensor networks.

UNIT- II

Sensor Node Architectures: Single-node architecture - Hardware components. Energy consumption of sensor nodes, Operating systems and execution environments, Network architecture- Sensor network scenarios. Optimization goals and figures of merit, Gateway concepts.

UNIT- III

NetworkingSensors: Wireless channel and communication fundamentals, Physical layer and transceiver design considerations, MAC Protocols for wireless sensor networks - Low duty cycle protocols and wakeup concepts. Address and name management - Naming and addressing, Assignment of MAC addresses. Routing protocols - Geographic routing, Energy - efficient routing.

UNIT- IV

Infrastructure Establishment: Topology control, Clustering - Hierarchical networks by clustering.Time synchronization, Localization and positioning, Localization and services, Sensor tasking and control.

Sensor Network Platforms and Tools: Sensor node hardware, Programming challenges, Node - level software platforms, Node level simulators

Text books and Reference books	**Text Book:** [T1] Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks" An Information Processing Approach, Elsevier, 2007. [T2] Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005 **Reference Books:** [R1] KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks-Technology, Protocols, And Applications", John Wiley, 2007 [R2] V.Gagrigungor, Gerhard P. Hancke "Industrial Wireless Sensor Networks", CRC Press, 2013
E-resources and other digital material	1. https://nptel.ac.in/courses/106/105/106105160/ 2. http://computerscienceppt.blogspot.com/2010/08/introduction-to-wireless-sensor.html

17EI4702/D – Drives and Control for Industrial Automation

Course Category:	Program Elective III	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Control Systems, Process Control	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply the concepts of hydraulic and pneumatic drives in servo control applications													
	CO2	Apply the concepts of electric and piezoelectric drives in industrial automation applications													
	CO3	Use the programming standards for servo control systems in industrial automation													
	CO4	Illustrate the digital communication protocols used to control servo drives													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3– High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3												3		
	CO2	3												3		
	CO3		2													2
	CO4	2														2
Course Content	**UNIT- I** **Overview of Servo Control:** Introduction, Objectives of servo control, Elements of servo control - Measurement, Actuation, Power moderation, Control. **Servo Hydraulic and Pneumatic Drives:** Overview, Configuration of servo hydraulic and pneumatic drive, Fundamentals of hydraulic and pneumatic drives, Components of fluidic drives system, Basic hydraulic circuits. **UNIT- II** **Electric and Piezoelectric drives:** Overview of electric drives, Electric motors, Power electronics, Sensors, Configuring an electric drive application, Solid state actuators and piezoelectric actuators, Nonlinearity of piezoelectric actuators, Mechanical linkages for piezoelectric drives, Example of application - Micro dispensing system **UNIT- III** **Control System in Servo Drives:** Servo control challenges - System design, Nonlinear dynamics, Disturbances, Servo control structures - Trajectory generator, Feedback control, Feed forward compensator, States feedback with observers, Notch filter, Implementation - Digital control, Analog Control, IEC61131-3 Programming standards - Instruction List(IL), Structured Text(ST), Sequential Functional Chart(SFC), Functional Block Diagrams(FBD) and Continuous Function Chart(CFC) .														

	UNIT- IV **Digital Communication Protocols:** Evolution field buses - Distributed control systems, Issues of proprietary protocols, Field bus protocol stack, Common field buses - CANopen, Profibus, Foundation field bus, Firewire, Sercos, Ethernet, Field buses in hydraulic /pneumatic drives, Field buses in electric drives
Text books and Reference books	**Text Book:** [T1] Tan Kok Kiong and Andi Sudjana Putra, "Drives and Control for Industrial Automation", 1st Ed., AIC, Springer-Verlag London Limited, 2011 **Reference Books:** [R1] Teresa Orlowska Kowalska, Frede Blaabjerg, "Advanced and Intelligent Control in Power Electronics and Drives", 1st Ed., Studies in Computational Intelligence, Springer International Publishing Switzerland 2014.
E-resources and other digital material	1. https://nptel.ac.in/courses/108105062/ 2. https://nptel.ac.in/courses/108102046/

17EI4703/A – Fundamentals of Petrochemical Engineering

Course Category:	Program Elective IV	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Process Control	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Explain the various phases in crude oil processing at petroleum industry.													
	CO2	Illustrate the different stages in petroleum refinery process.													
	CO3	Demonstrate various chemicals produced by petroleum industry.													
	CO4	Analyse the various control techniques in crude oil and petroleum processing.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2	3														
	CO3	2														
	CO4		2													

Course Content

UNIT- I

Introduction to Crude Oil Processing: Introduction, Composition of crude oil, Origin of hydrocarbons, Exploration techniques - Magnetometric method, Seismic survey, Remote sensing method, Stratigraphy, Resource estimation, Oil production process, Crude oil analysis, Domestic fuels, Automotive fuels, Aviation fuels, Furnace fuels, Lubricant oils, Viscosity index.

UNIT – II

Processing Operations in a Petroleum Refinery: Crude oil receiving, Desalting of crude oil, Distillation and Stripping, Stabilization, Amine absorption, De-ethaniser, Meroxing and caustic wash, Liquified petroleum gas splitter, Naphtha re-distillation, Kerosene hydrodesulfurization, Diesel hydrodesulfurization, Hydro finishing, Catalytic processes for lube oil base stock manufacture, Hydrocracking, Coking.

UNIT – III

Chemicals from Petroleum Product: Definitions of petrochemicals, Naphtha cracking,Conversion processes for selected petrochemicals - High density polyethylene, Linear low density polyethylene, Polypropylene, Polyethylene terephthalate, Terephthalic acid, Ethylene glycol, Polystyrene.

UNIT – IV

Instrumentation and Control in Petrochemical Industry: Control hardware, Control loops, Process piping and instrumentation diagram, Distributed control system, Crude throughput control, Desalter control, Reflux drum pressure control,

	Reflux drum level control, Top plate temperature, Draw plate temperature, Furnace control
Text books and Reference books	**Text Book:** [T1] Uttam Ray Chaudhuri, "Petroleum and Petrochemical Engineering", Taylor & Francis Group.2011. (UNIT I, II, III & IV) **Reference Books:** [R1] Gary J.H., Handwerk G.E, "Petroleum Refining: Technology and Economics", Taylor & Francis,2005
E-resources and other digital material	1. https://nptel.ac.in/courses/103/102/103102022/

17EI4703/B – Database Management Systems

Course Category:	Program Elective IV	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Demonstrate the schema using DBMS.														
	CO2	Apply formal and Informal query for various applications														
	CO3	Design normalized databases.														
	CO4	Illustrate transaction processing**,** concurrency control and security issues.														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3														
	CO2	3														
	CO3			3												
	CO4	3														

Course Content

UNIT- I

Overview of Data base systems: File systems vs DBMS, Advantages of a DBMS, Describing and storing data in a DBMS, Structure of a DBMS, People who work with databases.

Introduction to Database Design: Database design and ER diagrams; Entities, Attributes and entity set; Relationships and relationship set; Additional features of the ER Model.

Relational Model: Introduction to the relational model; Integrity constraint over relations; Enforcing integrity constraints; Querying relational data; Logical data base design; Introduction to views; Destroying / Altering tables and views.

UNIT- II

Relational Algebra: Selection and projection, Set operations, Renaming, Joins, Division, Examples of algebra queries; Expressive power of algebra and calculus.

SQL: Queries And Constraints: Form of basic SQL Query - Examples of basic SQL Queries; UNION, INTERSECT and EXCEPT; Nested Queries - Introduction to nested queries, Correlated Nested Queries, Set - Comparison operators; Aggregative operators; NULL values - Comparison using NULL values, Logical connectivity's - AND, OR and NOT, Impact on SQL Constructs, Outer joins, Disallowing NULL values;Complexintegrity constraints in SQL.

UNIT- III

Schema Refinement and Normal forms: Schema refinement - Problems caused by

	redundancy, Decompositions, Problem related to decomposition; Functional dependencies; Reasoning about FDs; Normal forms - First, Second, Third Normal forms, BCNF; Properties of decomposition - Lossless join decomposition, Dependency preserving decomposition; Schema refinement in data base design; Multi valued dependencies - Forth Normal form. **UNIT- IV** **Overview of Transaction Management:** ACID Properties; Transactions and Schedules; Concurrent execution of transaction; Lock based concurrency control; Performance locking; Transaction support in SQL. **Concurrency Control:** Introduction to lock management; Lock Conversions; Dealing with dead locks; Specialized locking techniques; Concurrency without locking. **Security and Authorization:** Introduction to database security; Access control; Discretionary access control - Grant and revoke on views and integrity constraints; Mandatory access control - Multilevel relations and Polyinstantiation
Text books and Reference books	**Text Book:** [T1] K. Raghurama Krishnan, Johannes Gehrke, "Database Management Systems", 3rd Ed., TATA McGraw-Hill, 2003. [T2] Gauravvaish," Getting Started with NoSQL" (Kindle Ed.,), 1st Ed., 2007. **Reference Books:** [R1] C.J.Date, "Introduction to Database Systems", 8th Ed., Pearson Education, 2004. [R2] Rob & Coronel, "Data base Systems design, Implementation, and Management", 8th Ed., 2007. [R3] Elmasri Navrate, "Data base Management System",3rd Ed., Pearson Education, 2005.
E-resources and other digital material	1. https://www.youtube.com/watch?v=1057YmExS-I 2. https://www.youtube.com/watch?v=TlbJk78TqYY 3. https://www.youtube.com/watch?v=yPu6qV5byu4 4. https://www.youtube.com/watch?v=EUzsy3W4I0g 5. https://www.youtube.com/watch?v=ShjrtAQmIVg

17EI4703/C – Intelligent Systems and Control

Course Category:	Program Elective IV	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply fuzzy logic for simple control applications.													
	CO2	Use neural networks for system identification and control applications.													
	CO3	Compare various neuro-fuzzy system configurations.													
	CO4	Present the steps involved in various evolutionary computing techniques.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3														3
	CO2	3														3
	CO3		2													2
	CO4	2														2
Course Content	**UNIT- I** **Fuzzy Logic**: Introduction, Fuzzy sets, Membership Functions (MFs), Features of MFs, Operations on fuzzy sets, Linguistic variables and hedges, Fuzzy relations, Fuzzy If–Then rules, Fuzzification, Defuzzification, Inference mechanism, Examples, Fuzzy system, Fuzzy modelling, Fuzzy control, Design of fuzzy controller. **UNIT- II** **Neural Networks and Applications:** Introduction, Artificial neuron model, Activation functions, Network architecture, Learning in neural networks, Recurrent neural networks, Neural systems, System identification and control, Neural networks for control. **UNIT- III** **Neuro Fuzzy Systems:** Introduction, Combination of neural and fuzzy systems, Cooperative neuro-fuzzy systems, Concurrent neuro-fuzzy systems, Hybrid neuro-fuzzy systems, Adaptive neuro-fuzzy system, Fuzzy neurons **UNIT- IV** **Evolutionary Computing:** Introduction, Terminologies of evolutionary computing, Genetic operators, Performance measures of evolutionary algorithms, Evolutionary algorithms - Genetic Algorithm (GA) and Differential Evolution (DE), Swarm intelligence - Particle Swarm Optimization (PSO).														
Text books and	**Text Book:** [T1] Nazmul Siddique and Hojjat Adeli, Computational Intelligence -Synergies of														

Reference books	Fuzzy Logic, Neural Networks and Evolutionary Computing, Wiley, 1st Ed., 2013. [T2] Andries P.Engelbrecht, Computational Intelligence-An introduction, Wiley, 2nd Ed., 2007 **Reference Books:** [R1] Robert E. King, Computational Intelligence in Control Engineering, Marcel Dekker Inc., 1st Ed., 1999. [R2] Witold Pedrycz, Computational Intelligence-An introduction, CRC Press, 1st Ed., 1997
E-resources and other digital material	1. https://nptel.ac.in/courses/108/104/108104049/ 2. http://uni-obuda.hu/users/fuller.robert/nfs.html 3. https://nptel.ac.in/courses/127/105/127105006/

17EI4703/D – Digital Image Processing

Course Category:	Program Elective IV	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Explain the fundamentals of digital image processing														
	CO2	Apply image enhancement techniques in spatial and frequency domains														
	CO3	Analyze various image restoration techniques for image quality														
	CO4	Analyze the performance of compression techniques and object recognition methods.														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2	2				1										1
	CO3		3			1										1
	CO4		3			1										1

Course Content

UNIT- I

Digital Image Fundamentals: Fundamental steps in digital image processing, Components of an image processing system, Elements of visual perception, Image sensing and acquisition, Image sampling and quantization, Basic relationship between pixels.

Color Image Processing: Color fundamentals, Color models, Pseudo color image processing.

UNIT- II

Image Enhancement in Spatial Domain: Basic gray level transformations, Histogram processing, Enhancement using arithmetic and logical operations, Basics of spatial filtering, Smoothing spatial filters, Sharpening spatial filters.

Image Enhancement in Frequency Domain: Introduction to the Fourier transform, Smoothing frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering.

UNIT- III

Image Restoration: Image degradation/restoration process model, Restoration in the presence of noise only, Spatial filtering, Periodic noise reduction by frequency domain filtering, Linear position-invariant degradations, Inverse filtering, Minimum mean square error (Wiener) filtering, Constrained least squares filtering.

Wavelets and Multiresolution Processing: Multiresolution expansions, Wavelet

	transforms in one dimension, Fast wavelet transform, Wavelet transforms in two dimensions. **UNIT- IV** **Image Compression:** Fundamentals, Image compression models, Error free compression, Lossless predictive, Lossy compression. **Image Segmentation:** Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation. **Representation and Description:** Representation, Boundary descriptors, Regional descriptors.
Text books and Reference books	**Text Book:** [T1] Gonzalez and Woods," Digital Image Processing", 2nd Ed., Pearson Education, 2002. **Reference Books:** [R1] Anil K. Jain, "Fundamentals of Digital Image Processing", 3rd Ed., Pearson Education, 2003. [R2] William K Pratt, "Digital Image Processing", 4th Ed., A Wiley-Interscience Publication, 2007
E-resources and other digital material	1. http://www.imageprocessingplace.com/

17EI4704/A – Instrumentation and Control in Paper Industries

Course Category:	Program Elective V	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Transducers, Electronic Measurements and Instrumentation, Process Control	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Explain the pre-processing stages of raw material in paper making process														
	CO2	Select suitable sensors used in wet and dry end instrumentation and quality measurement of paper making industry														
	CO3	Identify the paper quality and appropriate control strategies for thick and thin stock system														
	CO4	Analyze the role of computers in pulp and paper industries														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2	3												3		
	CO3	2												2		
	CO4		2											2		
Course Content	**UNIT- I** **Papermaking Process:** Process fundamentals, Raw materials, Pulping and preparation, Screening, Bleaching, Cooking, Chemical addition, Papermaking machine, Drying section, Calenders, Drive, Finishing, Other-after treatment processes, Coating, Elementary properties of liquids - Hydrostatics, Liquids in motion. Properties of paper making - Physical, electrical, optical and chemical properties. **UNIT- II** **Wet and Dry End Instrumentation:** Overview of basic sensors used in wet and dry end measurements, Measurement of pH and ORP, Primary viscosity measurement devices, Continuous consistency measuring devices, Liquid density and specific gravity measurement, Granular and wood chip moisture measurements, Paper moisture measurements - Electrical, Energy absorption. Freeness measurement, Grammage or basis weight measurement, Thickness measuring systems - Contacting and non-contacting types, Digester **UNIT- III** **Quality Measurement:** Paper quality measurements - Brightness, Color, Gloss, Opacity, Ash, Modulus. **Thick and Thin Stock Systems Control:** Introduction, Simple thick stock system, Breakers and beaters, Thick stock flow control, Basic thin stock system, Cleaners, Screens, The flow box and its controls, Refiner control instrumentation.															

	UNIT- IV **Computers in the Pulp Mill:** Batch digesters, Continuous digesters - Vertical type, Inclined type, Bleach plant. **Computers in the Paper Mill:** Stock preparation - Refiners, Stock proportioning, Stock Blending. Paper machine - Rush/drag, Basis weight and moisture, Speed change, Coordinated control
Text books and Reference books	**Text Book:** [T1] Robert J.McGill, "Measurement and Control in Papermaking", Adam Hilger Limited, Bristol, 1st Ed., 1980. [T2] John R.Lavigne, "An Introduction to Paper Industry Instrumentation", Miller Freeman Publications, California, 1st Ed., 1985. [T3] John R.Lavigne, "Instrumentation Applications for the Pulp and Paper Industry", Miller Freeman Publications, California, 1st Ed., 1990 **Reference Books:** [R1] Benjamin C. Kuo, "Automatic Control Systems", 7th Ed., PHI, 2001. [R2] James P.Casey, Pulp Paper Chemistry and Chemical Technology, John wiley& sons, New york, 1981. [R3] Sankarnarayanan P.E, "Pulp Paper Industry–Technology & Instrumentation", Kothari's Deskbook, 1995
E-resources and other digital material	1. http://www.nptelvideos.com/control_systems/ 2. https://www.wateronline.com/doc/instrumentation-for-the-pulp-paper%20industry0002

17EI4704/B – Computer Networks

Course Category:	Program Elective V	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Demonstrate different reference models													
	CO2	Demonstrate data link layer protocols													
	CO3	Analyze routing issues in network design													
	CO4	Illustrate the underlying protocols in transport and application layer.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2														2
	CO2	3														3
	CO3		2													2
	CO4	2														2
Course Content	**UNIT- I** **Introduction:** Uses of computer networks, Network hardware, LANs, MANs, WANs, Network software. Reference models: The OSI reference model, TCP/IP reference model, The comparison of the OSI and TCP/IP reference models. Physical Layer: Guided transmission media: Magnetic media, Twisted pair, Coaxial cable, Fibre optics. **UNIT- II** **Data Link Layer**: Data link layer design issues, Error detection and correction, Elementary data link protocols, Sliding window protocols. **Medium Access Control Sub Layer**: The channel allocation problem, Multiple access protocols, ETHERNET. **UNIT-III** **Network Layer:** Network layer design issues, Routing algorithms: Shortest path, Flooding, DVR, Link state routing algorithm, Congestion control algorithms. Quality of Service: Techniques for achieving good quality of service, IP protocol, IP addresses, Internet control protocols. **UNIT-IV** **Transport Layer:** The transport service, Elements of transport protocols, Internet transport protocols TCP and UDP. **Application Layer:** The Domain Name System (DNS), and E-Mail														
Text books	**Text Book:**														

and Reference books	[T1] Andrew S Tanenbaum, "Computer Network", 4th Ed., Pearson Education / PHI **Reference Books:** [R1] Kurose and Ross, "Computer Networks - A Top-down Approach Featuring the Internet", Pearson Education. [R2] Behrouz.A.Forouzan, "Data Communications and Networking". 4th Ed., Tata McGraw Hill.
E-resources and other digital material	1. https://nptel.ac.in/courses/106/105/106105183/

17EI4704/C– Sensor Signal Conditioning

Course Category:	Program Elective V	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Design the signal conditioning circuits for resistive sensors													
	CO2	Select suitable signal conditioning circuits for reactance variation sensors													
	CO3	Illustrate the operation of signal conditioning circuits used for self-generating sensors													
	CO4	Explain the operation of resonant and semiconductor sensors with communication system													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1			2												
	CO2		3													
	CO3	2														
	CO4															
Course Content	**UNIT- I** **Signal Conditioning for Resistive Sensors:** Overview of resistive sensors, Measurement of resistance, Voltage dividers, Wheatstone bridge: Balance measurements, Deflection measurements, Differential and instrumentation amplifiers, Interference, Problems **UNIT- II** **Signal Conditioning for Reactance Variation Sensors:** Overview of reactance variation sensors, Problems and alternatives, AC bridges, Carrier amplifiers and coherent detection, Specific signal conditioners for capacitive sensors, Resolver to Digital and Digital to resolver converters, Problems **UNIT- III** **Signal Conditioning for Self-Generating Sensors:** Overview of self-generating sensors, Chopper and low drift amplifiers, Electrometer and Transimpedance amplifiers, Charge amplifiers, Noise in amplifiers, Noise and drift in resistors, Problems **UNIT- IV** **Resonant Sensors and Other Sensing Methods:** Sensors based on quartz resonators, SAW sensors, Vibrating wire strain gauges, Digital flow meters, Sensors Based on Semiconductor Junctions, Sensors Based on MOSFET Transistors, Charge-Coupled and CMOS Image Sensors, Communication system for sensors														
Text books and Reference books	**Text Book:** [T1] Roman Pallas Areny and John G Webster, "Sensor and Signal Conditioning", 2nd Ed., John Wiley & Sons, Inc. 2001														

	Reference Book: [R1] Daniel H Sheingold "Transducers Interfacing Handbook", 1st Ed., Analog Devices, Inc., USA, 1980
E-resources and other digital material	1. https://nptel.ac.in/courses/108105064/22 2. https://nptel.ac.in/courses/112105232/27

17EI4704/D– Machine Learning

Course Category:	Program Elective V	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Use various classifiers for data classification													
	CO2	Apply decision trees to classification problems													
	CO3	Outline the supervised learning models													
	CO4	Illustrate various ANN models for classification & regression models													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2-Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2														
	CO2	2														
	CO3		3													
	CO4		2													

Course Content

UNIT- I

Introduction: What is machine learning? Challenges, Examples of machine learning applications.

Binary Classification and Related Tasks: Classification, Scoring and ranking, Class probability estimation

Bayesian and Computational Learning: Bayes theorem, Bayes optimal classifier, Gibbs algorithm, Naïve Bayes classifier

UNIT- II

Beyond Binary Classification: Handling more than two classes, Regression, Unsupervised and descriptive learning.

Concept learning: The hypothesis space, Paths through the hypothesis space, Beyond conjunctive concepts.

Tree models: Decision trees, Ranking and probability estimation trees, Tree learning as variance reduction

UNIT- III

Linear models: The least-squares method, The perceptron: A heuristic learning algorithm for linear classifiers, Support vector machines, Obtaining probabilities from linear classifiers, Going beyond linearity with kernel methods.

Distance Based Models: Introduction, Neighbours and exemplars, Nearest

	neighbours classification **UNIT- IV** **Artificial Neural Networks**: Introduction, Neural network representation, Appropriate problems for neural network learning, Multilayer networks, Back propagation algorithm
Text books and Reference books	**Text Book:** [T1] Peter Flach "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, 2012 [T2] Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education **Reference Books:** [R1] EthemAlpaydın, Introduction to Machine Learning, 2nd Ed., MIT press
E-resources and other digital material	1. https://www.youtube.com/playlist?list=PLYihddLF-CgYuWNL55Wg8ALkm6u8U7gps 2. http://www.cs.cmu.edu/~tom/10701_sp11/lectures.shtml

17HS1705 – Engineering Economics and Finance

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand various forms of organizations and principles of management													
	CO2	Understand the various aspects of business economics													
	CO3	Acquire knowledge on human resources and marketing functions													
	CO4	Understand different methods used in calculating depreciation and evaluating alternatives economically													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2										2				
	CO2	2				3						2				
	CO3	2										2				
	CO4	2				3						2				
Course Content	**UNIT - I** **Forms of Business Organization:** Salient features of sole proprietorship, Partnership, Joint stock company, Co-operative society and public sector. **Management:** Introduction to management, Functions of management, Principles of scientific management, Modern principles of management **UNIT - II** **Introduction to Economics:** Introduction to basic economic concepts, Utility analysis: Marginal utility and total utility, Law of diminishing marginal utility, Law of equi marginal utility. **Demand Analysis:** Theory of demand: Demand function, Factors influencing demand, Demand schedule and demand curve, Shift in demand, Elasticity of demand: Elastic and inelastic demand, Types of elasticity. **Supply Analysis:** Supply schedule and supply curve, Factors influencing supply, Supply function. **UNIT – III** **Human Resource Management:** Meaning and difference between personnel management and human resource management, Functions of human resource management.														

	Marketing Management: Concept of selling and marketing – Differences, functions of marketing, Product life cycle, Concept of advertising, Sales promotion, Types of distribution channels, Marketing research, Break-even analysis. **Unit – IV** **Financial Management:** Functions of financial management, Time value of money with cash flow diagrams, Concept of simple and compound interest. **Depreciation:** Causes of depreciation, Factors influencing depreciation, Common methods of depreciation: Straight line method, Declining balance method, Sum of year's digits method – Problems. **Economic Alternatives:** Methods of evaluating Alternatives under present worth method, Future worth method, Annual equivalent method – Problems
Text books and Reference books	**Text Book:** [T1] M. Mahajan, "Industrial Engineering and Production Management", 2nd Ed., Dhanpat Rai Publications [T2] Mart and Telsang" Industrial & Business Management" S.Chand publications **Reference Books:** [R1] R. Paneerselvam, "Production and Operations Management" PHI [R2] Philip Kotler, Gary Armstrong, "Principles of Marketing", Pearson Prentice Hall, New Delhi,2012 [R3] IM Pandey, "Financial Management", 11th Ed., Vikas Publications [R4] B.B.Mahapatro, "Human Resource Management", New Age International, 2011
E-resources and other digital material	1.https://www.toppr.com/guides/fundamentals-of-economics-and-management/supply/supply-function/ 2.https://keydifferences.com/difference-between-personnel-management-and-human-resource-management.html 3. https://productlifecyclestages.com/

17EI3751 – Industrial Automation Lab

Course Category:	Program Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply PLC programming methods to control basic process variables in proto type models													
	CO2	Infer the automation of different industrial proto type processes.													
	CO3	Demonstrate the basic programming of DCS through Experion PKS server													
	CO4	Apply DCS programming methods to control multi tank and cascade processes													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1				3	3				2	2	1				3
	CO2				3	3				2	2	1				3
	CO3				3	3				2	2	1				3
	CO4	3				3				2	2	1				3
Course Content	**List of Experiments** 1. Level control using PLC 2. Pressure control using PLC 3. Temperature control using PLC 4. Motor speed control using PLC 5. Automation of material handling system using PLC 6. Elevator control using PLC 7. Batch process reactor control using PLC 8. Automation of bottle filling System using PLC 9. Automatic drilling system using PLC 10. Automatic pneumatic stamping machine using PLC 11. Study of distributed control system -Honeywell DCS C200 12. Basic programming of DCS through Experion PKS server														

	13. Level control of single tank liquid system using DCS 14. Level control of multi tank liquid system using DCS 15. Implementation of cascade control in liquid system using DCS
Text books	**Text Book:**
E-resources	

Note: Minimum of 10 experiments must be carried out to complete the course

17EI3752 – Advanced Instrumentation Lab

Course Category:	Program Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Use NI-Compact DAQ and NI-myDAQ hardware for measurements														
	CO2	Build various interfacing circuits with NI-myRIO hardware using various sensors and actuators														
	CO3	Analyze outputs and interpretation of data generated from an experiment														
	CO4	Conduct experiment with individual or team using LabVIEW and hardware and record the observations.														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2-Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3				3										3
	CO2				3	3										3
	CO3				3	3						1				3
	CO4				3	3				2	2	1				3

Course Content

List of Experiments

Experiments based on NI-COMPACT DAQ and NI-myDAQ hardware

1. Data Logging of RTD based temperature data acquisition
2. Design of data acquisition to measure vibration parameters
3. Studying earthquakes with the myQuake NI mini System for NI myDAQ
4. Studying flight dynamics with the myVTOL NI mini System for NI myDAQ
5. Study of digital filters with the myDSP NI mini System for NI myDAQ

Experiments based on myRIO

1. Interfacing of DC motor/ rotary encoder
2. Interfacing of photo interrupter,
3. Interfacing of Hall effect sensor
4. Interfacing of servo motor
5. Interfacing of H-bridge / geared motor
6. Interfacing of accelerometer

	7. Interfacing of gyroscope 8. Interfacing of compass 9. Interfacing of webcam 10. Interfacing of GPS receiver
Text books	**Text Book:**
E-resources	

Note: Minimum of 10 experiments must be carried out to complete the course

17EI5753 – Mini Project

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 4
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Develop interest towards research oriented field through literature exploration													
	CO2	Illustrate the concepts of various methods, techniques, algorithms and tools used to address the feasible solution of a problem, identified in EPICS													
	CO3	Exhibit competency in suggesting optimum solution by detail analysis of the problem													
	CO4	Demonstrate effective interpersonal, communication& presentation skills													
Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1									3		3				
	CO2	2					2			2						2
	CO3		2				2		2	2						2
	CO4									3	3		3			3

17EI6754/A– Internship

Course Category:	Program Core	**Credits:**	2
Course Type:	Lab	**Lecture - Tutorial - Practice:**	
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	

CO1	Demonstrate the application of knowledge and skill sets acquired from the course and workplace in the assigned job function/s
CO2	Develop and enhance operational, customer service and other life-long knowledge and skills in a real world work environment.
CO3	Exhibit critical thinking and problem solving skills by analysing underlying issue/s to challenges
CO4	Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means
CO5	Exhibit professional ethics by displaying positive disposition during internship

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3														2
CO2											3				3
CO3		3				2	2								2
CO4										3					3
CO5								2							2

17EI6754/B – Industry Offered Course

17EI6754/C – Global Professional Certification

Fourth Year
(VIII Semester)

17EI4801/A – Measurement and Control in Food Processing

Course Category:	Program Elective VI	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Sensors and Transducers	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Elucidate food process in food processing industries..														
	CO2	Select a suitable measuring technique for quality control in food processing														
	CO3	Select a suitable control technique for food preservation and grading.														
	CO4	Illustrate the role of computers in monitoring and control.														
	CO5	Compare various food processing industries with different measuring and control techniques														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2-Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2	3														
	CO3	2														
	CO4	1														
	CO5		2													
Course Content	**UNIT- I** **Introduction to Food Processing:** Introduction, Desirable characteristics of food product, Food processing phases in industries - Sugar, Black tea and Soft drinks. **Moisture Content Measurement in Food Processing:** Role of moisture content in quality of food, Microwave absorption method, Radio frequency impedance technique, Moisture release during drying of food. **Humidity in the Food Processing Environment:** Role of humidity in quality of food, Conventional type and Electrical type of humidity meters **UNIT- II** **Temperature Measurement in Food Processing:** Temperature of food on a conveyor, Food tempering monitoring, Precision temperature measurement. **Food Flow Metering:** Turbine flow meter, Positive displacement flow meter, Solid flow metering and Gravimetric feeder meters. **Turbidity and Color of Food:** A basic turbidity meter, Standards and units of turbidity, Light scattering type turbidity meter, Color reflectance and digital color image processing in food grains.															

	Viscosity of Liquid Foods: Definition, Newtonian and non Newtonian food flow, Rotating cylinder viscometer. **P^H Values of Food:** P^Hscale, P^H electrodes and potential, Ion sensitive field effect transistor P^H sensors. **UNIT- III** **Brix of Food:** Brix standards, Refractometers - Refraction angle refractometer, Critical angle refractometer. **Food Enzymes:** Importance of food enzyme detection, Enzyme sensors - Principle of operation, Calibration and sensor materials, Semiconductor enzyme sensor. **Flavor Measurement:** Sources of flavor in food,Electronic Nose - Basic electronic nose, Sensor types and signal processing. **Particle Size Detection:** Introduction, Off line methods, On line techniques **UNIT- IV** **Controllers and Indicators:** Introduction, Temperature control in food dehydration and drying, Electronic Controllers, Atmosphere control in food preservation, Timers and indicators in food processing, Food sorting and grading control. **Computer Based Monitoring and Control:** Introduction, Importance of monitoring and control with computers, Hardware features of a data acquisition and control computer, Examples of computer based measurement and control in food processing.
Text books and Reference books	**Text Book:** [T1] ManabendraBhuyan "Measurement and Control in Food Processing", Taylor & Francis Group, 2007. **Reference Books:** [R1] Erika Kress Rogers and Christopher J. B. Brimelow, "Instrumentation and sensors for the food Industry", 2nd Ed., Woodhead Publishing Limited, 2001
E-resources and other digital material	1. https://nptel.ac.in/courses/126105011/

17EI4801/B – Biomedical Instrumentation

Course Category:	Program Elective VI	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Infer the physical foundations of biological systems and bioelectric potentials in medical field														
	CO2	Analyze electrical and non-electrical parameter in the human body														
	CO3	Illustrate the concepts of medical assisting and therapy equipment														
	CO4	Outline various clinical instruments and image modalities applicable in medical field														
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	3												2		
	CO2		3											2		
	CO3	3														
	CO4	2														

Course Content

UNIT- I

Introduction: Introduction to biomedical engineering field, Components of man instrument system, Problems encountered in measuring a living system.

Physiological Systems of the Body: Basic features of cardiovascular system, Nervous system, Muscular system, Respiratory system.

Resting Potential & Action Potential Concepts: Resting potential concept, Characteristics of resting potential, Action potential concept, Propagation of action potential.

Bio-electric Potentials: Bio-electric potential, Electro physiology of nerve and nerve to muscle function, Transmission of impulse from nerve to muscle, Evoked potentials.

UNIT- II

Electrical and Non Electrical Parameter Acquisition and Measurement: Electrodes, ECG, EEG, EMG Lead systems and recording methods, Typical waveforms, Electrical safety in medical environment. Measurement of blood pressure, Cardiac output, Heart sound

UNIT- III

Assisting and Therapeutic Instruments: Pacemakers, Defibrillators, Ventilator, Anesthesia machine, Nerve and muscle stimulator, Heart lung machine, Dialyzers,

	Diathermy, Audiometers, ICCU patient monitoring system **UNIT- IV** **Instruments in Clinical Laboratory:** Pulmonary function measurements, Blood gas analyzers, pH of blood, Measurement of blood pCO2, pO2, Finger-tip oxymeter, Blood cell counters, **Imaging Modalities in Bio-Medical Field:** Use of X-Rays in medicine, X-ray machine, CT scan, MRI scans, PET, SPECT, Ultrasonography
Text books and Reference books	**Text Book:** [T1] Leslie Cromwell, Fred. J, Weibell and Erich A. Pleiffer, "Biomedical Instrumentation and Measurements", 2nd Ed., Prentice Hall of India, 2004 [T2] R.S.Kandpur. "Handbook of Biomedical Instrumentation", 2nd Ed., Tata McGraw Hill, 2011 **Reference Books:** [R1] Webster, "Medical Instrumentation Application & Design", John Wiley & Sons [R2] Dr M. Arumugam, "Biomedical Instrumentation", 2nd Ed., Anuradha publications, 2009
E-resources and other digital material	1. http://www.eeeuniversity.com/2013/08/ei2311-biomedical-instrumentation.html

17EI4801/C – System Identification

Course Category:	Program Elective VI	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Engineering Mathematics, Control Systems, Process Control	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Illustrate various system identification methods.													
	CO2	Infer various parameter estimation methods for system modeling.													
	CO3	Demonstrate the convergence and consistency of the designed models.													
	CO4	Apply recursive estimation methods for model validation													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2														
	CO2		3													
	CO3	2														
	CO4	2														
Course Content	**UNIT- I** **Introduction:** Dynamic Systems, Models, An archetypical problem - ARX models and the linear least squares method, System identification procedure, Models of LTI systems - Linear models and sets of linear models, Transfer function models, State- space models, Linear time-varying models, Models with nonlinearities, Nonlinear state-space models. **UNIT- II** **Parameter Estimation Methods:** Guiding principles behind parameter estimation methods, Minimizing prediction errors, Linear regressions and the least-squares method, A statistical framework for parameter estimation and the maximum likelihood method, Correlating prediction errors with past data, Instrumental-variable methods **UNIT- III** **Convergence and Consistency:** Introduction, Conditions on the data set, Prediction-Error approach, Consistency and identifiabilitv, Linear time-invariant models - A frequency domain description of the limit model, The correlation approach **UNIT- IV** **Recursive Estimation Methods:** Introduction, The recursive least-squares algorithm**,** The recursive IV method, Recursive prediction-error methods, Recursive pseudolinear regressions, The choice of updating step, Implementation														
Text books	**Text Book:**														

and Reference books	[T1] Lennart Jung, "System Identification: Theory for the User", 2nd Ed., Prentice-Hall, 2010 [T2] Karel J. Keesman, "System Identification, An introduction", Springer, 2011 **Reference Books:** [R1] Arun K. Tangirala, "Principles of System Identification: Theory and Practice", CRC Press, 2014 [R2]TorstenSoderstrom, PetreStoica, "System Identification", Prentice Hall International (UK) Ltd., 1989 [R3] Landan ID, "System Identification and Control Design", Prentice Hall, 2003
E-resources and other digital material	https://nptel.ac.in/courses/103106078/

17EI4801/D – Real World Instrumentation with Python

Course Category:	Program Elective VI	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Understand the basic concepts of Python language														
	CO2	Implement an instrument system using Python concepts														
	CO3	Implement control systems using Python simulators														
	CO4	Illustrate various data I/O interfaces for real world applications														
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2	2				2										
	CO3	2				2										
	CO4	2														
Course Content	**UNIT- I** **The Python Programming Language:** Installing python, Command-Line options and environment, Objects in python, Data types in python, Expressions, Operators, Statements, Strings, Program organization, Importing modules, Loading and running a python program, Basic input and output, Hints and tips, Python development tools, Debuggers **UNIT- II** **Project Definition:** Defining the project, Requirements, Traceability, Capturing requirements, Designing the software, Functional testing, Test cases, Testing error handling, Implementation, Code reviews, User documentation, Implementing Control Systems in Python. **UNIT- III** **Building and Using Simulators:** What is simulation, Using python to create a simulator, Data I/O simulator, Serial terminal emulators, Displaying simulation data, Plotting creating your own simulators, Simulation scope, Time and effort **UNIT- IV** **Instrumentation Data I/O:** Data I/O interface software, Interface formats and protocols, Python interface support packages, Data I/O: Acquiring and writing data, Basic data I/O, Blocking versus nonblocking calls, Data I/O methods, Handling data I/O errors, Handling inconsistent data															
Text books and	**Text Book:** [T1] J.Hughes, "Real World Instrumentation with Python" I Ed., O'Reilly Media.															

Reference books	2010. [T2] Mark. Lutz, "Learning Python" V Ed., O'Reilly Media. 2013 **Reference Books:** [R1] E.Balaguruswamy, "Introduction to Computing and Problem Solving Using Python", Ist Ed., Mc Graw Hill, Jul 2017 [R2] SheetalTaneja, Naveen Kumar, "Python Programming: A modular approach", Ist Ed., Pearson Education, Sep 2017
E-resources and other digital material	1. https://nptel.ac.in/courses/106/106/106106145/

17EI2802/A – Automation in Manufacturing (MOOCS)

Course Category:	Open Elective V	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	00
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Explain the concepts of automation in manufacturing industries.													
	CO2	Identify various fabrication components and sensors required in typical automated systems for manufacturing.													
	CO3	Apply the concepts of electric drives and select suitable drive in manufacturing applications.													
	CO4	Analyze the basic Elements & interpolators of CNC technology in manufacturing.													
Contribution of Course Outcomes towards achievement of Program Outcomes **(1 – Low, 2 - Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1															
	CO2		2											2		
	CO3			2										2		
	CO4	2												2		

Course Content

UNIT- I

Introduction to Automation in Manufacturing: Definition of automation in manufacturing, production system, manufacturing system, product lifecycle: importance of automation (L1). Mechatronics, disciplines of mechatronics, mechatronics for replacement of mechanics: wrist watch, mechatronics-based system (L2). Definition of a system, example of a system, a mechanical spring, mechatronics based automated system, building blocks of mechatronics-based system, development of an equivalent mechatronics-based system (L3).

UNIT- II

Fabrication process in Manufacturing: Overview of fabrication, casting, Forming, Joining, Machining, Additive Manufacturing (L9).

Sensors used in Manufacturing: Measurement system, Sensors and transducers, Potentiometer sensors (L10). Displacement. Position and Proximity sensors, Strain gauge-based sensors, capacitive elements, Linear variable differential transducer (LVDT), eddy current based sensor, inductive proximity switch (L11). Optical encoder, Electric connection-based switches, pneumatic sensors, Hall effect-based sensors (L12)

UNIT- III

	Electric Drives in manufacturing process: Application of electric drives in automation (L19). Direct current (DC) motor, alternating current (AC) motor, working principle, construction and application (L20), Types of industrial automation, mechanisms, machines (L22) **UNIT- IV** **CNC technology in manufacturing:** Flexible manufacturing system, CNC technology in manufacturing, vertical milling process: an example (L4). CNC machine tools, adaptive control technology, based machine tools, automated storage and retrieval system, industrial conveyors, Industrial robots (L5). CNC machines and interpolation (L37).
Text books and Reference books	**Text Book:** [T1] E. Sathish, Anup Goel, A. Jacob Moses, Dr. Subhash L. Gadhave, Vinayak V. Gaikwad, "Automation in Manufacturing", Technical Publications [T2] Anup Goel , Dr. Subhash, L. Gadhave, A. Jacob Moses , "Automation in Manufacturing", Technical Publications **Reference Books:** [R1] SIA Experts, "Automation in Manufacturing", 1st Ed., SIA Publishers & Distributors Pvt Ltd, 2018 [R2]Beno Benhabib, "Manufacturing Design, Production, Automation, and Integration", 2003
E-resources and other digital material	

17EI2802/B – MOOCS

Course Category:	Open Elective V	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 00 100

17EI5851 – Major Project

Course Category:	Program Core	**Credits:**	9
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 5- 8
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Design tightly integrated project plans using appropriate tools													
	CO2	Illustrate proficiency in the use modern methodologies, multidisciplinary skill set and knowledge in while working on the project													
	CO3	Demonstrate effective execution process that result in successful projects													
	CO4	Demonstrate effective interpersonal, communication & presentation skills													
Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			3												2
	CO2					2	2	2		2						3
	CO3				2	2				2			2			2
	CO4									3	3		3			3