DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE

SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME [VR17]

Syllabus for

Ist – VIth Semesters

VELAGAPUDI RAMAKRISHNA
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 Laboratory	0	0	3	1.5
7.	17CS1152	Computing and Peripherals Laboratory	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 Laboratory	0	0	3	1.5
7.	17CS1252	Computer Programming Laboratory	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.	17MC1507	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	Food Process Engineering	0	0	0	2
2.	17EI2506/B	Principles of Communication	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	Digital System Design using Verilog	3	0	0	3
3.	17EI4603/C	Robotics &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 Modelling 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: 26**

S.No	Course Code	Course	L	T	P	Credits
1.	17EI3701	Industrial Automation	3	0	2	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.	17EI4751	PLC's Lab	0	0	3	1.5
7.	17EI4752	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**	**0**	**12**	**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	Integrated Circuit Fabrication Technology	3	0	0	3
3.	17EI4702/C	Wireless Sensor Networks	3	0	0	3
4.	17EI4702/D	Data Communication Networks	3	0	0	3

S.No	Course Code	Program Elective – IV	L	T	P	Credits
1.	17EI4703/A	Instrumentation and Control in Paper Industries	3	0	0	3
2.	17EI4703/B	Programmable Automation Controller Systems(PACS)	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 in Water treatment plants	3	0	0	3
2.	17EI4704/B	Low Power VLSI Design	3	0	0	3
3.	17EI4704/C	Optimal and Nonlinear Control Systems	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	Cloud Computing	3	0	0	3

S.No	Course Code	Open Elective – V	L	T	P	Credits
1.	17EI2802/A	Advanced Sensors	3	0	0	3
2.	17EI2802/B	Industrial Safety and Environmental Management	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.

SEMESTER - I

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**
CO1	**3**								**2**		**1**			
CO2	**3**								**2**		**1**			
CO3	**3**								**2**		**1**			
CO4	**3**								**2**		**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, Maclaurin'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 Particular 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

[1] B.S.Grewal , "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2014.

REFERENCE BOOKS

[1] Erwin Kreyszig , " Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition,2015

[2] B.V.Ramana, "Higher Engineering Mathematics", Tata MC Graw Hill, 1st Edition ,2007

[3] N.P.Bali, Dr.Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications, 9th Edition,2014

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] www.nptel videos.com/mathematics/ (Math Lectures from MIT,Stanford,IIT'S)

[2] nptel.ac.in/courses/122104017

[3] nptel.ac.in/courses/111105035

[4] Engineering Mathematics Open Learning Project.
www.3.ul.ie/~mlc/support/Loughborough%20website/

17PH1102B

APPLIED 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	Analyse and understand various types of lasers and their applications.
CO3	Elaborate different types of optical fibers and understand holography.
CO4	Understand the fabrication of nanomaterials 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**
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

[1] M.N. Avadhanulu & P.G. Kshirsagar, Engineering Physics, S. Chand publications, Revised Edition, 2014

[2] P.K. Palanisamy, "Applied Physics", Scitech Publications(INDIA) Pvt. Ltd., Fifth Print, 2008.

REFERENCE BOOKS

[1] B. K. Pandey and S. Chaturvedi, 'Engineering Physics' Cengage Learning', Delhi, 2012.

[2] O. Svelto, Principles of Lasers, 5th Edition, Springer, London, 2010

[3] M.R. Srinivasan, “Engineering Physics”, New age international publishers, First Edition, 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] http://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**
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 problem-solving 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

[1] R.G. Dromey , “How to Solve it By Computer”, Prentice-Hall International Series in Computer Science,1982.

[2] Bansal.R.K, Goel.A.K, Sharma.M.K, “MATLAB and its Applications in Engineering”, Pearson Education, 2012.

REFERENCE BOOKS

[1] Michael Schneider, Steven W. Weingart, David M. Perlman, “An Introduction to Programming and Problem Solving With Pascal”, John Wiley and Sons Inc ,1984.

[2] David Gries, “The Science of Programming”, Springer Verlag, 1981.

[3] ReemaThareja, “Computer Fundamentals and C Programming”, Oxford, 2012

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] MATLAB Getting Started Guide http://www.mathworks.com/help/pdf_doc/matlab/getstart.pdf

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 & 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**
CO1	**3**	**1**			**2**									
CO2	**4**	**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

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

[1] T.K. Nagasarkar and M.S. Sukhja, "*Basic Electric Engineering*", 2nd ed., Oxford University press 2011.

REFERENCE BOOKS

[1] B.H.Khan, "Non Conventional Energy Resources", 2nd ed., Mc.Graw Hill Education Pvt Ltd.,New Delhi,2013.

[2] Ashfaq Husain , Haroon Ashfaq, " Fundamentals of Electrical Engineering", 4th ed., Dhanpat Rai & Co , 2014.

[3] 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] http://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(On-line) 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**
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 an 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

[1] Martin Cutts, " Oxford guide to Plain English", Oxford University Press, 7th Impression 2011.

[2] TM Farhathullah, "Communication skills for Technical Students", Orient Longman, I Edition 2002

[3] John Langan, "College Writing Skills", McGraw Hill, IX Edition, 2014.

"Eclectric Learning materials offered by the Department"

REFERENCE BOOKS

[1] Randolph Quirk, "Use of English", Longman, I Edition (1968) Reprinted 2004.

[2] Thomson A.J & A.V, Martinet, "Practical English Grammar", Oxford University Press, III Edition 2001

[3] V.Sethi and P.V. Dhamija, "A Course in Phonetics and Spoken English", PHI, II Edition 2006

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] https://www.britishcouncil.org/english Accessed on 15th June 2017

www.natcorp.ox.ac.uk/Wkshops/Materials/specialising.xml?ID=online Accessed on 15th June 2017

[2]https://www.unimarburg.de/sprachenzentrum/selbstlernzentrum/.../apps_for_esl.pdf Accessed on 15th June 2017

17PH1151

APPLIED PHYSICS LABORATORY

Course Category:	Institutional Core	**Credits:**	1.5
Course Type:	Laboratory	**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**
CO1	**3**										**2**			
CO2	**3**													
CO3	**3**													

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

[1] Madhusudhan Rao, "Engineering Physics Lab Manual", Ist ed., Scitech Publications, 2015

[2] Ramarao Sri, Choudary Nityanand and Prasad Daruka, "Lab Manual of Engineering Physics"., Vth ed., Excell Books, 2010

E-RESOURCES

[1] http://plato.stanford.edu/entries/physics-experiment

[2] http://www.physicsclassroom.com/The-Laboratory

[3] http://facstaff.cbu.edu/~jvarrian/physlabs.html

VIRTUAL LAB REFERENCES

[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

[3] http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1

17CS1152

COMPUTING AND PERIPHERALS LABORATORY

Course Category:	Institutional Core	**Credits:**	1
Course Type:	Laboratory	**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**
CO1	**1**								**3**					
CO2		**3**	**1**											
CO3	**3**		**1**											
CO4			**3**						**1**					

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, Paragraphsand 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 Blu-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/Web cam/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 andDefault 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: computername sharename)
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 Detectionand 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.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Numerical Methods and Programing by Prof.P.B.Sunil Kumar,Department of Physics, IIT Madras https://www.youtube.com/ watch?v=zjyR9e-#1D4&list=PLC5DC6AD60D798FB7

[2] Introduction to Coding ConceptsInstructor: Mitchell Peabody View the complete course: http://ocw.mit.edu/6-00SCS11

17ME1153

BASIC WORKSHOP

Course Category:	Engineering Sciences	**Credits:**	1.5
Course Type:	Laboratory	**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**
CO1	**3**			**1**										
CO2	**2**			**1**										
CO3	**2**			**1**										
CO4	**1**			**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

[1] Kannaiah P. & Narayana K. C., "Manual on Workshop Practice", Scitech Publications, Chennai, 1999.

[2] Venkatachalapathy, V. S., "First year Engineering Workshop Practice", Ramalinga

Publications, Madurai, 1999.

REFERENCE BOOKS

[1] Gopal, T.V., Kumar, T., and Murali, G., "A first course on workshop practice – Theory, Practice and Work Book", Suma Publications, Chennai, 2005.

17MC1106A

TECHNOLOGY AND SOCIETY

Course Category:	Institutional Core	**Credits:**	1
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 Environemnt 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**
CO1	**3**							**1**						
CO2	**3**				**2**		**1**							
CO3	**3**							**1**						
CO4	**3**				**2**		**1**							

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 Indistrial Revolution, The revolution in Textile Indistry, The Imapact of Indutrial Revolution on Society.

UNIT - III

The Flowering of modern technology: Manufacturing Technologies, Prime Movers, Internal Combustion engines, Production of Metals and Allyos, 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

[1] Dr. R.V.G Menon, "Technology and Society", Pearson Education, 2011

REFERENCE BOOKS

[1] Quan-Haase, A., " Technology and Society: Inequality, Power, and Social Networks", Oxford University Press, 2013.

SEMESTER - II

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:** **Semester end Evaluation:** **Total Marks:**	30 70 100

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**
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^n, 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 a 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's Theorem, Volume Integral, Gauss Divergence Theorem, Irrotational Fields.

TEXT BOOKS

[1] B.S.Grewal, "Higher Engineering Mathematics, Khanna Publishers", 43rd Edition, 2014.

REFERENCE BOOKS

[1] Erwin Kreyszig , "Advanced Engineering Mathematics" , John Wiley & Sons, 10th Edition, 2015

[2] B.V.Ramana, "Higher Engineering Mathematics", Tata MC Graw Hill, 1st Edition, 2007

[3] N.P.Bali, Dr.Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications, 9th Edition, 2014

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] www.nptel videos.com/mathematics/ (Math Lectures from MIT,Stanford,IIT'S)

[2] nptel.ac.in/courses/122104017

[3] nptel.ac.in/courses/111105035

[4] Engineering Mathematics Open Learning Project.
www.3.ul.ie/~mlc/support/Loughborough%20website/

17CH1202A

ENGINEEERING 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 analyse different materials and apply the knowledge of conventional fuels for their effective utilisation.
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 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**
CO1		**3**												
CO2	**2**													
CO3														
CO4			**2**						**3**					

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, and 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, flue 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 undoped polyacetylene, 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 - $Li/SOCl_2$ battery and $Li_xC/LiCoO_2$ battery - construction, working and advantages, Chemistry of H_2-O_2 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, corrosion

inhibitors – types and mechanism of inhibition – principle, process and advantages of electroplating and electroless plating.

TEXT BOOKS

[1] Shikha Agarwal, "Engineering Chemistry – Fundamentals and Applications", Cambridge University Press, New Delhi, 1st edition (2015).

REFERENCE BOOKS:

[1] Sunita Rattan , "A Textbook of Engineering Chemistry", S.K. Kataria & Sons, New Delhi, First edition 2012.

[2] P.C. Jain , "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Limited, New Delhi, 15th edition.

[3] B.S. Bahl, G. D. Tuli and Arun Bahl, "Essentials of Physical Chemistry", S. Chand and Company Limited, New Delhi.

[4] O. G. Palanna, " Engineering Chemistry", Tata McGraw Hill Education Pvt. Ltd., New Delhi.

[5] Y.Anjaneyulu, K. Chandrasekhar and Valli Manickam, Text book of Analytical Chemistry, , Pharma Book Syndicate, Hyderabad.

[6] H. Kaur, Spectroscopy, I Edition, 2001, Pragati Prakashan, Meerut.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://www.cip.ukcentre.com/steam.htm

[2] http://corrosion-doctors.org/Modi;es/mod-basics.htm

[3] http://nopr.niscair.res.in/bitstream/123456789/5475/1/JSIR%2063%289%29%20715-728.pdf

[4] https://chem.libretexts.org/Core/Analytical_Chemistry/Electrochemistry/Basics_of_Electrochemistry

[5] http://www.filtronics.com/blog/tertiary-treatment/stages-in-typical-municipal-water-treatment/

[6] https://www.khanacademy.org/test-prep/mcat/physical-processes/infrared-and-ultraviolet-visible-spectroscopy/e/infrared-and-ultraviolet-visible-spectroscopy-questions

[7] NPTEL online course, "Analytical Chemistry", offered by MHRD and instructed by Prof. Debashis Ray of IIT Kharagpur.

[8] NPTEL online course, "Corrosion Part-I" offered by MHRD and instructed by Prof. Kallol Mondal 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**
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, Multiway 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, Multidimensional 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/Output Operators.

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

[1] Behrouz A. Forouzan & Richard F. Gilberg , "Computer Science A Structured Programming Approach using C" , CENGAGE Learning, Third Edition.

REFERENCE BOOKS

[1] Kernighan and Ritchie , "The C programming language" , The (Ansi C Version), PHI, second edition.

[2] Yashwant Kanetkar , "Let us C" , BPB Publications, 2nd Edition 2001.

[3] Paul J. Dietel and Dr. Harvey M. Deitel, "C: How to Program", Prentice Hall, 7th edition (March 4,2012).

[4] Herbert Schildt, "C:The Complete reference", McGraw Hill, 4th Edition, 2002.

[5] K.R.Venugopal, Sundeep R Prasad, "Mastering C", McGraw Hill, 2nd Edition, 2015

17EI1204C
Electronic Devices and Circuits

Course Category:	Programme core	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial - Practice:**	3-0-0
Prerequisites:	Engineering Physics	**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 a basic understanding of semiconductor physics.
	CO2	Analyze and design basic diode circuits related to various applications
	CO3	Understand and analyze the operation of BJTs and FETs

Contribution of Course outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1	H	L		H								
CO2	H	L		H								
CO3	H	L		L								

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. **(12Hrs)**

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. **(12Hrs)**

	UNIT III: **Transistor Characteristics:** The Junction Transistor**,** Characteristics of Common Base, Common Emitter and Common Collector Configuration. **Transistor Biasing & Thermal Stabilization:** The Operating Point, Bias Stability, Collector to Base Bias, Self Bias, Bias Compensation, Thermistor & Sensistor Compensation, Thermal Runaway and Thermal Stability. **(12Hrs)** **UNIT – IV** **Filed Effect Transistors:** Construction and Characteristics of JFETs, Transfer Characteristics, Specification Sheets (JFETs), Depletion-type MOSFET and Enhancement-type MOSFET. **FET Biasing**: Introduction, Fixed Bias Configuration, Self Bias Configuration, Voltage Divider Biasing, Depletion-type MOSFET and Enhancement-type MOSFET. **(12Hrs)**
Text books and Reference books	**Text Books:** 1. Jacob Millman, Christos C Halkias & Satyabrata JIT, "Millman's Electronic Devices and Circuits", 4th Edition, TMH, 2015. (Unit I, II& III). 2. Robert L Boylested and Louis Nashelsky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson India, 2009. (UNIT IV). **Reference Books:** 1. Nandita Das Gupta and Amitava Das Gupta, "Semiconductor Devices Modelling and Technology", PHI Learning Pvt. Ltd., 2013 2. David A Bell., "Electronic Devices and Circuits", 5th Edition, 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 & 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**
CO1	**3**			**3**							**1**			
CO2	**2**			**3**							**2**			
CO3	**2**			**2**							**2**			
CO4	**1**			**3**							**2**			

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 (Up to 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

[1] N.D. Bhatt & V.M. Panchal, "Elementary Engineering Drawing", Charotar Publishing House, Anand. 49th Edition – 2006

[2] Basanth Agrawal & C M Agrawal," Engineering Drawing", McGraw Hill Education Private Limited, New Delhi

Reference Books

[1] K. L. Narayana & P. Kannaiah, "Text Book on Engineering Drawing", Scitech publications (India) Pvt. Ltd.,Chennai, 2nd Edition - fifth reprint 2006

[2] K. Venugopal, "Engineering Drawing and Graphics + Auto CAD", New Age International, New Delhi

[3] 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] http://www.youtube.com/watch?v=XCWJ XrkWco, Accessed On 01-06-2017.

[2]http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html is so drawing, Accessed On 01-06-2017.

[3] http://www.slideshare.net, Accessed On 01-06-2017.

[4] http://edpstuff.blogspot.in, Accessed On 01-06-2017.

17CH1251

ENGINEERING CHEMISTRY LABORATORY

Course Category:	Institutional Core	**Credits:**	1.5
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:	Knowledge of chemistry practicals 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**
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

REFERENCE BOOKS

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

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

17CS1252

COMPUTER PROGRAMMING LABORATORY

Course Category:	Institutional Core	**Credits:**	1.5
Course Type:	Laboratory	**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
(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**
CO1	**1**		**3**											
CO2		**1**	**3**											
CO3		**1**	**3**											
CO4			**3**								**1**			

COURSE CONTENT

CYCLE – I : PROGRAMMING CONSTRUCTS AND CONTROL STRUCTURES

1. Introduction to C Pogramming:
   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 state- ments (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 goto Statement
   b) Design and develop programs that the use of Break Statement
   c) Design and develop programs that use of 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 single-dimensional 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

[1] Ashok N Kamthane, "C And Data Structures", Pearson Education; First edition, 2008

REFERENCE BOOKS

[1] Brain W Kernighan and Dennis Ritchie, "The C Programming language", Pearson

Education India,2015

[2] David Griffiths and Dawn Griffiths, "Head First C":A Brain Friendly Guide, O:Reilly media, 2012

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Introduction to Programming C: http://nptel.ac.in/courses/106104128/

C-Programming - IIT Kharagpur lectures

[2]https://www.youtube.com/watch?v=S47aSEqm_0I&list=PLeCxvb23g7hrw27XlekHtfygUTQ0TmFfP

[3] Numerical Methods and Programing by Prof.P.B.Sunil Kumar, Department of Physics, IIT Madras https://www.youtube.com/watch?v=zjyR9e-N1D4&list=PLC5DC6AD60D798FB7

17MC1206B

PROFESSIONAL ETHICS & HUMAN VALUES

Course Category:	Mandatory Learning	**Credits:**	-
Course Type:	Theory	**Lecture -Tutorial-Practice:**	2 - 0 - 0
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	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**
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 - Self-interest - 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

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

[1] Mike Martin and Roland Schinzinger, "Ethics in engineering", McGraw Hill, New York (1996).

[2] Govindarajan M, Natarajan S, Senthil Kumar V. S., "Engineering Ethics", Prentice Hall of India, New Delhi(2004).

REFERENCE BOOKS

[1] 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, 335 pp. eds. (1978)

[2] Beabout, G.R., Wennemann, D.J. , "Applied Professional Ethics: A Developmental Approach for Use with Case Studies", University Press of America Lanham, MD, 175 pp (1994).

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE

SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME [VR17]

Syllabus for

IIIrd – IVth Semesters

VELAGAPUDI RAMAKRISHNA
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 Laboratory	0	0	3	1.5
7.	17CS1152	Computing and Peripherals Laboratory	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.	17EC1204A 17EC1204B 17EI1204	Basic Electronic Engineering (CSE/IT) Electronic Devices(ECE) Electronic Devices and Circuits (EIE)	3	0	0	3
5.	17ME1205	Engineering Graphics	2	0	4	4
6.	17CH1251	Engineering Chemistry Laboratory	0	0	3	1.5
7.	17CS1252	Computer Programming Laboratory	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: 24**

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 & Campus Recruitment Training	1	0	0	1
8.	17EI3551	Simulations Lab	0	0	3	1.5
9.	17EI3552	Microcontrollers and Embedded Systems Lab	0	0	3	1.5
Total			**16**	**2**	**6**	**23**
10.	17HS1405	Biology for Engineers	2	0	0	-

S.No	Course Code	Open Elective – I	L	T	P	Credits
1.	17EI2504A	Biomedical Electronics	3	0	0	3
2.	17EI2504B	Control System Components	3	0	0	3

S.No	Course Code	Open Elective – II (Inter Disciplinary Elective)	L	T	P	Credits
1.	17EI2505A	Instrumentation Engineering	3	0	0	3
2.	17EI2505B	Fundamentals of Industrial Automation	3	0	0	3

S.No	Course Code	Open Elective – III (Self-Learning Elective Course)	L	T	P	Credits
1.	17EI2506A	Food Process Engineering	0	0	0	2
2.	17EI2506B	Principles of Communication	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.	17HS3606	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.	17EI4603A	Fiber Optic Sensors	3	0	0	3
2.	17EI4603B	Digital System Design using Verilog	3	0	0	3
3.	17EI4603C	Robotics &Control	3	0	0	3
4.	17EI4603D	Data Communications and Computer Networks	3	0	0	3

S.No	Course Code	Program Elective – II	L	T	P	Credits
1.	17EI4604A	Renewable Energy	3	0	0	3
2.	17EI4604B	Industrial Electronics	3	0	0	3
3.	17EI4604C	Process Modelling and Simulation	3	0	0	3
4.	17EI4604D	Biomedical Signal Processing	3	0	0	3

S.No	Course Code	Open Elective – IV	L	T	P	Credits
1.	17EI2605A	Virtual Instrumentation	3	0	0	3
2.	17EI2605B	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: 26**

S.No	Course Code	Course	L	T	P	Credits
1.	17EI3701	Industrial Automation	3	0	2	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.	17EI4751	PLC's Lab	0	0	3	1.5
7.	17EI4752	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**	**0**	**12**	**22**

S.No	Course Code	Program Elective – III	L	T	P	Credits
1.	17EI4702A	Power Plant Instrumentation	3	0	0	3
2.	17EI4702B	Integrated Circuit Fabrication Technology	3	0	0	3
3.	17EI4702C	Wireless Sensor Networks	3	0	0	3
4.	17EI4702D	Industrial Communication Networks	3	0	0	3

S.No	Course Code	Program Elective – IV	L	T	P	Credits
1.	17EI4703A	Instrumentation and Control in Paper Industries	3	0	0	3
2.	17EI4703B	Programmable Automation Controller Systems(PACS)	3	0	0	3
3.	17EI4703C	Intelligent Systems and Control	3	0	0	3
4.	17EI4703D	Digital Image Processing	3	0	0	3

S.No	Course Code	Program Elective – V	L	T	P	Credits
1.	17EI4704A	Instrumentation in Water treatment plants	3	0	0	3
2.	17EI4704B	Low Power VLSI Design	3	0	0	3
3.	17EI4704C	Optimal and Nonlinear Control Systems	3	0	0	3
4.	17EI4704D	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.	17EI4801A	Measurement and Control in Food Processing	3	0	0	3
2.	17EI4801B	Biomedical Instrumentation	3	0	0	3
3.	17EI4801C	System Identification	3	0	0	3
4.	17EI4801D	Cloud Computing	3	0	0	3

S.No	Course Code	Open Elective – V	L	T	P	Credits
1.	17EI2802A	Advanced Sensors	3	0	0	3
2.	17EI2802B	Industrial Safety and Environmental Management	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.

Second year
(III Semester)

17MA1301 - Complex Analysis & 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

(L – Low, M - Medium, H – High)

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k
CO1	**H**						**L**				
CO2	**H**						**L**				
CO3	**H**			**M**	**M**		**L**				
CO4	**H**			**M**	**M**		**L**				

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:** [1] B.S.Grewal, "Higher Engineering Mathematics", 42nd Edition Khanna Publishers, 2012. **Reference Books:** [1] Krezig, "Advanced Engineering Mathematics", 8th Edition, JohnWiley & Sons.2007, [2] R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishers. [3] N.P.Bali, Manish Goyal, "A Text book of Engineering Mathematics", 1st Edition, Lakshmi Publications (P) Limited, 2011 [4] H.K.Das, Er. RajnishVerma, "Higher Engineering Mathematics", 1st Edition, S.Chand & Co., 2011. [5] 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:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Determine the basic parameters in DC circuits.											
	CO2	Analyze DC electrical circuit using-mesh analysis, Nodal analysis and network theorems.											
	CO3	Analyze AC electrical circuit using-mesh analysis, Nodal analysis and network theorems.											
	CO4	Analyze resonance and DC transient behavior of RLC circuits and calculate the parameters of two port network.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L	H										
	CO2		H		L								
	CO3		H		L								
	CO4		H										
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 of Z, Y and h parameters and their conversions.
Text books and Reference books	**Text Books:** [1]A Sudhakar and SP Shyam Mohan, "Circuits and Networks: Analysis and Synthesis", IInd ed, TMH, 2002. **Reference Books:** [1] Fraklin F.Kuo, "Network Analysis and Synthesis", IInd ed, John Wiley & Sons, 2003 [2] William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", VIth ed, 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	Analyze Multi stage amplifier circuits at low frequency frequencies.
	CO2	Analyze various feedback amplifiers.
	CO3	Analyze various oscillators.
	CO4	Design various types of power amplifiers used in electronic applications.

Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L	H		M	L							
	CO2	L	H		M	L							
	CO3	L	H		M	L							
	CO4	L	H		M	L							

Course Content

UNIT- I

Transistor Amplifiers at Low frequencies

BJT Amplifiers: Hybrid parameter model of transistor, Analysis of transistor amplifier using h parameter 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** [1] Jacob Millman and Christos C Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems",XIIth ed, TMH, 1991. (UNIT I,II & III) [2] A.Anand kumar , "Pulse and Digital Circuits", IInd ed, PHI,2010. (UNIT IV) **Reference Books** [1] G.KMithal, "Electronic Devices and circuits", XXIIIrd ed, Khanna Publishers 2010. [2] Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", VIth ed, PHI 2000
E-resources and other digital material	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:	Basics of Electronics Engineering, Engineering Physics	**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 various performance characteristics of instrument and the quality of measurement.											
	CO2	Identify the type of transducer based on the transduction principles.											
	CO3	Select the relevant transducer for measurement of displacement, velocity and acceleration to meet the requirements of industrial applications.											
	CO4	Identify the additional attributes in advanced sensors.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1		H		L								
	CO2	H	L										
	CO3		H		H								
	CO4	L											
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 & 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:** [1] A.K.Ghosh, "Introduction to Measurements & Instrumentation", IIIrd ed, PHI, 2009. (UNIT I) [2] A.K.Sawhney & Puneet Sawhney, "A Course in Mechnanical Measuremnets & Instrumentation", XIIth ed, Dhanapat Rai & Co., 2012. (UNIT II & III) [3] D.V.S.Murty, "Transducers & Instrumentation", II^{ed}, PHI. (UNIT IV) **Reference Books:** [1] Raman Pallas-Arney & John G.Webster, "Sensors & Signal Conditioning", II nd ed., J. Wiley,2012. [2] D.Patranabis, "Sensors and Transducers" II nd 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:** **Semester end Evaluation:** **Total Marks:**	

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		

17HS2305 (A) – Yoga & 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 life											
	CO3	Develop levels of concentration through mediation											
	CO4	Apply conscience for the missions of life											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1												
	CO2												
	CO3												
	CO4												
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 books	**Text Book:** [1] Common Yoga protocol, Ministry of Ayush, Govt of India [2] Journey of the Soul- Michael Newton, 2003, Llewellyn												

	Reference Books: [1] Lectures from Colombo to Almora, Swami Vivekakanada, 2010 Ramakrishna Mission [2] Essays of Ralph Waldo Emerson, 1982, Eastern press [3] 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

17HS2305 (D) – 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 **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	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:** [1] The story of philosophy ",Will Durant, Simon & Schuster 1926 [2] An Introduction to philosophy ",O.O.Fletcher, Word Public Library,2010 **Reference Books:** [1] Six systems of Indian Philosophy, DH Dutta , [2] The pleasures of philosophy, Will Duran, Simon & Schuster,1929												
E-resources and other digital material													

17HS2305 (I) – Foreign Language (German)

Course Category:	Humanities elective	**Credits:**	1
Course Type:	Theory/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 **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1												
	CO2												
	CO3												
	CO4												
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:** [1] Studio d A1Cornelsen Goyalaas Publications New Delhi. **Reference Books:**												
E-resources and other digital material													

17HS2305 (K) – Psychology

Course Category:	Humanities elective	**Credits:**	1
Course Type:	Practical	**Lecture - Tutorial - Practice:**	1 - 0- 0
Prerequisites:	Introduction to philosophy, psychological processes	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 100

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 **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1												
	CO2												
	CO3												
	CO4												
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:** [1] Zimbardo, P. G. (2013). Psychology and Life (20th Ed.).Pearson Education **Reference Books:** [1] Baron, R. A. (2006). Psychology (5th Ed.). New Delhi: Pearson Education. [2] Coon, D., & Mitterer, J. O. (2007). Introduction to Psychology: Gateway to mind and behaviour. New Delhi: Cengage. [3] Feldman, R. S. (2013). Psychology and your life (2nd Ed.). McGraw Hill											
E-resources and other digital material												

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 **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H			M								
	CO2	M			H								
	CO3	M				M							
	CO4	H											
	CO5	H			L								
	CO6	H			M								

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:** [1] R. S. Aggarwal, " Verbal and non-verbal reasoning", Revised Edition, 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 **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H	H		H								
	CO2		H		H								
	CO3	H	L		L								
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 and	**---**												

Reference books	
E-resources and other digital material	---

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	Analyze the various performance characteristics of first and second order systems.											
	CO2	Analyze the characteristics of displacement, velocity and acceleration transducers to meet the requirements of industrial applications.											
	CO3	Compare the characteristics of different temperature transducers.											
	CO4	Analyze the characteristics of level, flow, pressure and humidity measurement transducers.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1		H			L							
	CO2				H								
	CO3				H								
	CO4				H								
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	**---**												

17HS3353 – 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:**	30
		Semester end Evaluation:	70
		Total Marks:	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 **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1						H			H	H	M	L
	CO2			M	M		H	H	M	H	H	M	M
	CO3	H		M	H	L	M	H	H	H	H	M	H
	CO4	M	L	M	M	L	H	H	H	H	H	H	M
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 Books:** [1] Martin Cutts, Oxford Guide to Plain English, 7th Impression, OUP, 2011 [2] Exercises in Spoken English, Prepared by Department of Phonetics and Spoken English, CIEFL, OUP, 21st Impression, 2003 **Reference Books:** [1] Stephen R Covey, The 7 Habits of Highly Effective people, II edition, (Pocket Books) Simon & Schuster UK Ltd, 2004 [2] Eclectic Learning Materials offered by the Department, "Network Analysis and Synthesis", IInd ed, John Wiley & Sons, 2003
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, British National Corpus accessed on 28-11-2017

17MC1307B – Indian Constitution

Course Category:	Humanities elective	**Credits:**	1
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 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	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 **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1												
	CO2												
	CO3												
	CO4												

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 and Reference books	**Text Book:** [1] Dr. J.N. Pandey, Constitutional Law of India published by Central law Agency, Allahabad, Edition 2018 **Reference Books:** [1] V.N Shukla's, Constitution of India Eastern Book Company, Lucknow. [2] M.P. jain, Indian Constitution Law, Wadhwa and Company, Nagpur. [3] 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:	Program Core	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3 - 0- 0
Prerequisites:	Engineering Chemistry	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	Identify the suitable spectrophotometer based on the application.											
	CO2	Describe the principle and operation of Mass, NMR and ESR Spectrometers.											
	CO3	Outline the various radiation detectors and X-ray spectroscopic instruments											
	CO4	Identify the use of chromatography and gas analyzers in real time industrial environments.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H	H										
	CO2	H											
	CO3		H					L					
	CO4		H					L					
Course Content	**UNIT – I** **SPECTROPHOTOMETERS**: Introduction to analytical instruments- Radiation sources, Filters, Monochromators 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 [1] R.S.Khandpur, " Handbook of Analytical Instruments", IInd ed, TMH, 2006. [2] Willard H.H, Merrit L.L, Dean J.A,"Instrumental Methods of Analysis", VIIth ed, CBS publishers and Distributors, 1988. Reference books [1] D.A.Skoog and James J.Leary, "Principles of Instrumental Analysis", Vth ed , Holt-Saunders, 1997. [1] James W.Robinson, Eileen M.Skelly Frame,George M.Frame, "Undergraduate Instrumental Analysis", VIIth ed , CRC Press, 2014.
E-resources and other digital material	[1] http://www.srmuniv.ac.in/sites/default/files/files/IC0309%20Analytical%20Instumentation.pdf [2] http://nptel.ac.in/courses/103108100 [3] http://nptel.ac.in/courses/102107028/34 https://sites.google.com/site/coolhemakumar/Home/winter-2013/analytical-instrumentation http://instruct.uwo.ca/chemistry/532/lectures.htm http://chemtech.org/cn/cn212/212-video.htm

17EI3402– Integrated Circuits & 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	Analyze various characteristics of op-amp and design different linear op-amp circuits.											
	CO2	Analyze and design different non-linear op-amp circuits and Waveform generators.											
	CO3	Understand the concepts of various DACs, ADCs and design Active filters suitable for various applications.											
	CO4	Design 555 Timer circuits, 565 PLL and µA723 voltage regulators based on applications.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	POl
	CO1	L	H										
	CO2		H		M								
	CO3		H		M								
	CO4	L	H		M								

Course Content

UNIT – I **[Text Book No: 1&2]**

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 **[Text Book No: 1&2]**

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-zero-crossing detector,

	window detector, voltage limiters; Waveform generators- Oscillators, Schmitt Trigger, Square-wave Generator, Triangular wave Generator, saw tooth wave Generator. **UNIT – III** **[Text Book No: 1&2]** **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** **[Text Book No: 1&2]** **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 books** [1]. Roy and Chowdhary, "Linear Integrated Circuits", 4th Edn., New Age International,2003 [2]. Rama Kant A. Gayakwad, "Op-Amps and Linear Integrated Circuits",3rd ed., PHI, 1997 **Reference Books** [1] Jacob, "Applications and Design with Analog Integrated Circuits", 2nd Edn., PHI, 1996 [2] 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. nptel.ac.in/video.php?subjectId=108106068 4. www.linkwitzlab.com/filters.htm 5. www.allaboutcircuits.com.

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	Select the relevant transducer for measurement of temperature to meet the requirements of industrial applications.										
	CO2	Apply most suitable transducer for pressure monitoring in real time applications.										
	CO3	Select the relevant transducer for the measurement of flow in industrial applications.										
	CO4	Compare and select suitable transducer for level, humidity, density and viscosity measurement for real time applications.										
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1		H		H								
	CO2		H		L								
	CO3		H										
	CO4		H		L								

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 meters - 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; Radiative 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 Books** [1] A.K.Ghosh, "Introduction to Measurements & Instrumentation", IIIrd ed, PHI, 2009. [2] A.K.Sawhney & Puneet Sawhney, "A Course in Mechanical Measurements & Instrumentation", XIIth ed, Dhanpat Rai & Co, 2012. **Reference Books** [1] Ernest O Doebelin/Dhanesh, N Manik, "Measurement systems", VIth ed, Tata Mc Grawhill. [2] C.S.Rangan, G.R.Sarma & V.S.V.Mani "Instrumentation Devices & Systems", IInd ed, TMH, 2011.
E-resources and other digital material	[1]http://nptel.ac.in/courses/108105064 [2]http://nptel.ac.in/courses/108106074

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	Select suitable Electromechanical indicating instruments for measurement of voltage, current, Resistance, Power, energy and power factor.											
	CO2	Select suitable analog and digital voltmeters, bridges and Q-Meters for measurement of A.C. & D.C. Voltages, Resistance, Inductance and Capacitance.											
	CO3	Explain the constructional details and working principles of various Oscilloscopes for measurement of electrical parameters.											
	CO4	Explain the principles of working of various signal generators, wave analyzers and Frequency Counters.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H	L		H								
	CO2	H			H								
	CO3	H			H								
	CO4	H			H								
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** [1] W D Cooper & A D Helfrick, "Electronic Instrumentation and Measurement Techniques", PHI, 1998 **(Unit-I)** [2] H.S.Kalsi, "Electronic Instrumentation", IInd ed, TMH. **(Units-II, III and IV)** **Reference books** [1] A.K. Sawhhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co. [2] Oliver & Cage, "Electronic Measurements and Instrumentation", Mc Graw Hill, 1975
E-resources and other digital material	---

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:**	

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 **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1										H		
	CO2										L		M
	CO3					L							
	CO4									L			L
	CO5									M	L	M	
	CO6					M							
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. B. Introducing Basic Grammar 3. C. Practicing on Functional Conversations **UNIT – III** 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** [1] Swaroopa Polineni, “Strengthen Your Communication Skills”, I ed., Maruthi Publications, 2013. ISBN:978-81-907052-2-6 [2] Mamta Bhatnagar&Nitin Bhatnagar, “Communicative English”, I ed., Pearson India, 2010. ISBN:8131732045
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	Perform binary arithmetic operations and explain the characteristics of different logic families.											
	CO2	Simplify logical functions using Boolean algebra and K-map method.											
	CO3	Design various combinational logic circuits and realize using logic gates.											
	CO4	Design and realize various sequential logic circuits using flip flops.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H	H			H							
	CO2	H	H			H							
	CO3	H	H		M	H							
	CO4	H	H		M	H							

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** [1] R P Jain "Modern Digital Electronic", IVth ed., TMH. **Reference Books** [1] A.Anand Kumar, "Fundamentals of Digital Circuits", PHI 2006. [2] 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	Analyze various characteristics of op-amp and design different linear and non-linear op-amp circuits and Waveform generators											
	CO2	Design filters circuits suitable for particular application using ICs											
	CO3	Realize the basic gates using discrete components and universal gates experimentally											
	CO4	Design and test various combinational & sequential logic circuits experimentally											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L	M		H								
	CO2				H								
	CO3				H								
	CO4		M										
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	1.Roy and Chowdhary, "Principles of Integrated Circuits", 2nd Edn., New Age International,2003												

Reference books	2.Rama Kant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 3rd Ed., PHI, 1997
E-resources and other digital material	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	Design and test the working of DC, AC meters, ohmmeters and Calibrate the Voltmeter, Ammeter and ohmmeter											
	CO2	Measure resistance, inductance and capacitance using bridges and Q-meter experimentally.											
	CO3	Explain the function of function generator, true RMS Voltmeter, CRO and spectrum analyser											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H			H								
	CO2	H			H								
	CO3	H			H								
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 & Ref books	**---**												
E-resources and other	---												

digital material	

17MC1407A – Environmental Studies

Course Category:	Mandatory Course	**Credits:**	-
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0 - 0
Prerequisites:	Concern on Conservation and Preservation of Environment	**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 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 a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L											
	CO2			H					H				
	CO3						H		H				
	CO4		L	H								H	

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: {NOT TO BE INCLUDED IN SEMESTER END EXAMS}** 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:** [1] Erach Bharucha, "Text book for **ENVIRONMENTAL STUDIES'**, for under graduate courses of all branches of higher education" University Grants Commission. **Reference Book:** [1] AnjaneyuluY "Introduction to Environmental Sciences", B S Publications PVT Ltd
E-resources and other digital material	---

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE

SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME [VR17]

Syllabus for

Vth – VIth Semesters

VELAGAPUDI RAMAKRISHNA
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 Laboratory	0	0	3	1.5
7.	17CS1152	Computing and Peripherals Laboratory	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 Laboratory	0	0	3	1.5
7.	17CS1252	Computer Programming Laboratory	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.	17MC1507	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	Food Process Engineering	0	0	0	2
2.	17EI2506/B	Principles of Communication	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	Digital System Design using Verilog	3	0	0	3
3.	17EI4603/C	Robotics &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 Modelling 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: 26**

S.No	Course Code	Course	L	T	P	Credits
1.	17EI3701	Industrial Automation	3	0	2	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.	17EI4751	PLC's Lab	0	0	3	1.5
7.	17EI4752	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**	**0**	**12**	**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	Integrated Circuit Fabrication Technology	3	0	0	3
3.	17EI4702/C	Wireless Sensor Networks	3	0	0	3
4.	17EI4702/D	Data Communication Networks	3	0	0	3

S.No	Course Code	Program Elective – IV	L	T	P	Credits
1.	17EI4703/A	Instrumentation and Control in Paper Industries	3	0	0	3
2.	17EI4703/B	Programmable Automation Controller Systems(PACS)	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 in Water treatment plants	3	0	0	3
2.	17EI4704/B	Low Power VLSI Design	3	0	0	3
3.	17EI4704/C	Optimal and Nonlinear Control Systems	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	Cloud Computing	3	0	0	3

S.No	Course Code	Open Elective – V	L	T	P	Credits
1.	17EI2802/A	Advanced Sensors	3	0	0	3
2.	17EI2802/B	Industrial Safety and Environmental Management	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.

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	Develop mathematical models of 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	Develop and analyze the state space models of SISO and MIMO systems.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1		H	L									
	CO2	H	H										
	CO3		H	L	H	H							
	CO4			H		H							
	CO5			H		H							
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 Books:** [1] A.Anand Kumar, "Control Systems", 2nd Ed., PHI, 2014. [2] I J Nagrath & M Gopal, "Control Systems Engineering", 5th Ed., New Age International, 2008. **Reference Books:** [1] Katsuhiko Ogata, "Modern Control Engineering", 4th Ed., Pearson Education, 2003 [2] A.Nagoor Kani, "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	Discuss the properties of Discrete Fourier Transforms and use Fast Fourier Transform algorithms.											
	CO3	Design digital Infinite Impulse Response filters (Butterworth and Chebyshev) using bilinear transformation and impulse invariance transformation methods.											
	CO4	Design the digital Finite Impulse Response filters using windowing techniques.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1			M									
	CO2			H	H	M							
	CO3			H	H	M							
	CO4			H	H	M							

Course Content

UNIT – I **[Text Book No: 1&2]**

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 **[Text Book No: 1&2]**

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 **[Text Book No: 1&2]**

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** **[Text Book No: 1&2]** **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 Books:** [1] John G. Proakis & Dimitris G. Manolakis, "Digital Signal Processing-Principles, Algorithms, and Applications", 4th Ed., Pearson Education, 2007. [2]. Emmanuel C. Ifeachor & Barrie W. Jervis, "Digital Signal Processing a Practical Approach", 2nd Ed., Pearson Education, 2004. **Reference Books:** [1] Alan V. Oppenheim, Ronald W. Schafer, Jhon R. Buck, "Discrete-Time Signal Processing", 2nd Ed., Pearson Education, 2004. [2] 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:	Computer organization	**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	Describe the architecture of 8051 and its instruction set.
	CO4	Use the assembly and C languages to interface the various peripherals with 8051.
	CO5	Describe the ARM architecture and its instruction set.

Contribution of Course Outcomes towards achievement of Program Outcomes

(L – Low, M - Medium, H – High

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1			H	H								
CO2			H	H								
CO3			H	H								
CO4				H	H							
CO5			H	H								

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 books	**Text Book** [1] Shibu.K.V, "Embedded Systems" 3rd Ed., Tata McGraw Hill Education Private Ltd. 2013. (Unit I). [2] Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay "The 8051 Microcontroller and Embedded Systems using assembly and C", 2nd Ed., Pearson. (Unit II, III & IV). **Reference Books** [1] 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	Examine the various sources of bioelectric signals and the types of electrodes and transducers to be used.											
	CO2	Describe the acquisition and amplification of the bio-signals.											
	CO3	Demonstrate about the systems and methods used to record and display the bio-signals											
	CO4	Discuss on electrical safety, hazards, protection against shock and testing of electrical systems.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L		M	H								
	CO2	L		H	M								
	CO3			H	L	M							
	CO4				M	L							
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 Book:** [1] Amshed F. Khan, "Biomedical Electronics", Chintan Publications, 2008 [2] Dr. M. Arumugam, "Biomedical Instrumentation", Anuradha Publications, 2nd Ed., 2006 [3] John G. Webster, "Medical Instrumentation-Application and Design", John Wiley & Sons Inc., 3rd Ed., 1998 **Reference Books:** [1] Khandpur R.S, "Hand-book of Biomedical Instrumentation", McGraw Hill Education, 3rd Ed., 2014 [2] 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	Develop the mathematical models of basic electrical systems and servomechanisms											
	CO2	Select and use the basic switching components for electrical systems											
	CO3	Understand the principle of operation and scope of use of three general type of linear actuators: electric, hydraulic, and pneumatic											
	CO4	Explain the principles of relay logic control and describe the general operation and programming of the PLC											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2		H										
	CO3					H							
	CO4					H							
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:** [1] Christopher T. Kilian "Modern Control Technology: Components and Systems", 2nd Edition, (UNIT I, II, III & IV) [2] B. L. Theraja, "A text book of Electrical Technology", S. Chand & Company Ltd., Vol. II, 1st Ed., 1959. (UNIT I) **Reference Books:** [1] James R. Carstens, "Automatic Control Systems and Components", Prentice Hall Englewood cliffs, New Jersey. [2] Hasebrink J P & Kobler R, "Fundamentals of Pneumatic Control Engineering", FestoDidactic: Esslinger(W Germany),1989. [3] 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	Identify the type of transducer based on the transduction principles											
	CO2	Identify the transducer for measuring pressure to meet the industrial requirements											
	CO3	Select the relevant transducer for measurement of temperature to meet the requirements of industrial applications											
	CO4	Compare and select suitable transducer for level and flow measurement for real time applications.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1												
	CO2												
	CO3												
	CO4												

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, Mcleod guage, 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:** [1] A.K.Ghosh, "Introduction to Measurements & Instrumentation", 3rd Ed., PHI, 2009. [2] A.K.Sawhney & Puneet Sawhney, "A Course in Mechanical Measurements & Instrumentation", 12th Ed., Dhanapat Rai & Co., 2012 **Reference Books:** [1] D.Patranabis " Sensors and Transducers", 2nd Ed., PHI, 2013 [2] 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

17EI2505B – 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 controllers and programming language											
	CO2	Outline the Architecture of Distributed Control Systems (DCS).											
	CO3	Understand the protocols of Industrial Automation											
	CO4	Case study of industrial control applications by DCS											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1		H										
	CO2		H										
	CO3			H									
	CO4				H								
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, Distributed Control 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:** [1] Krishna Kanth, "Computer-Based Industrial Control", 1st Ed., Eastern Economy Edition 2010. [2] Frank D. Petruzella, "Programmable Logic Controller", 3rd Ed., Tata McGraw-												

	Hill Edition 2010. [3] Gary A. Dunning, "Introduction to Programmable Logic Controllers", 3rd Ed., Thomson Delmar learning 2010. [4] Michael P. Lucas, "Distributed Control Systems", Their Evaluation and Design, Van Nostrand Reinhold Co., 1986. [5] Popovic D. and Bhatkar V.P., "Distributed Computer Control for industrial automation", Marcel Dekkar Inc., 1990. **Reference Books:** [1] Madhu Chandra MithraSamarithSen,"PLC & Industrial automation", 1st Ed., 2009. [2] 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 - Food Process Engineering

Course Category:	Open Elective III	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 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 fundamental concepts of food rheology and thermal processing in food processing											
	CO2	Select the suitable drying technique for food preservation											
	CO3	Identify a suitable technique for freezing, size reduction and separation of food particles.											
	CO4	Elucidate the operation of mixing, leaching and extraction during food processing											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2		H										
	CO3		H										
	CO4	L											

Course Content

UNIT- I

Concept of Food Rheology and its Measurements: Food behavior, Structure of the food particles, Food Rheology, Elastic properties, Force deformation of biological materials, Fluid behavior, Plastic flow behavior, Time depended fluid behavior, Classification of Rheology, Rheological models, Application of rheology in processing and handling, Pump selection and pipe sizing.

Measurements of Rheological Properties: Viscosity measurement, Measurement of rheological properties, Mechanical model to viscoelastic material, Combined mechanical models, Dynamic test.

Thermal processing and microbial death kinetics: Thermal processing, Transient heat transfer, Lumped parameter analysis. Fourier's law of conduction, Graphical solutions, Thermal processing methods, Microbial death kinetics.

UNIT- II

Evaporation and Concentration: Evaporation, Factors effecting on evaporation, Types of evaporators, Design of single and multiple effects of evaporator, Evaporation biological material.

Heat Exchangers: Definition of heat exchanger, Different type of heat exchanger, Analysis of heat exchanger in terms of Log Mean Temperature Difference LMTD, Parallel and counter flow heat exchanger, Overall heat transfer coefficient , Fouling

	factor, Correction factor, Effectiveness of heat exchangers (both parallel flow and counter flow), Application of heat exchanger in food industry, Numerical problems. **Drying technology:** Introduction, Aspects and mechanism of drying, Psychrometry-properties, Chart, Processes. Introduction to moisture content and its determination methods, Drying time calculations, Types of dryers. **UNIT- III** **Freezing & Freeze Drying:** Definition and concept of food freezing, Freezing time calculation by planks equation and Pham equation, Different types of freezer, Quality changes during freezing. **Size Reduction:** Introduction about size reduction, Particle size distribution, Energy requirement in size reduction, Types of size reduction equipments; Crushers, Grinders and ultrafine grinders, Cutting and slicing machine, Homogenizer for the liquid food. **Mechanical Separation Techniques:** Classification of mechanical separation methods, Screening, Filtration, Centrifugation, Sedimentation, Numerical problems. **UNIT- IV** **Mixing and Agitation:** Introduction, Mechanism of solid mixing, Mixing index and mixing, Mixers for dry powders, Mixers for cohesive solids, Liquid mixing - Flow patterns, Types of agitator, Power requirement for liquid mixing. **Leaching and Extraction:** Leaching - Introduction, Classification, Equipments, Equilibrium leaching, Stages (single and multiple), Numerical problems. Extractor – Types, Operating modes, Washing and numerical problems, Liquid-liquid extraction, Phase diagrams, Equipments. **Non Thermal Processing:** Fundamental concepts, The high pressure processing, Non thermal preservation technique, Pulse electric field technology, Pulse light technology, Irradiation, Ozone, Cold plasma technology, Hurdle technology.
Text books and Reference books	**Text Book:** [1] R T Toledo, "Fundamental of Food Process Engineering", CBS Publishers, 2nd Ed, 2000. [2] Christie. J Geankoplis, "Transport Process and Unit Operations", Prentice-Hall International, 1999. [3] D.R. Heldman and R.P.Singh, "Food Process Engineering", Springer, 1981. **Reference Books:** [1] McCabe & J CSmith, "Unit Operations of Chemical Engineering", McGraw Hill, 1999. [2] MA Rao & SSH Rizvi, "Engineering Properties of Foods", Marcel Dekkar Inc, 1986
E-resources and other digital material	[1] https://nptel.ac.in/courses/126105011/

17EI2506/B - Principles of Communication

Course Category:	Open Elective III	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 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 concepts of amplitude modulation.											
	CO2	Explain the principles of angle modulation											
	CO3	Elucidate the concepts of pulse amplitude modulation.											
	CO4	Discuss the delta, differential pulse coded modulation and multiplexing techniques.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1			H	H								
	CO2					H							
	CO3				H								
	CO4				H								
Course Content	**UNIT- I** **Introduction to Electronic Communication:** Introduction to principles of communication, Basics of energy and power of signals, Frequency domain representation of signals, Introduction to Discrete Fourier series, Fourier Transform, Inverse Fourier Transform of continuous signals, Modulation property of Fourier Transform. **Amplitude Modulation (AM)**: Introduction, Modulation index, Envelope distortion, Over modulation, Spectrum of AM signals, Power and power efficiency of AM signals, Envelope detection for AM signals. Double Sideband (DSB) Suppressed Carrier (SC) modulation, Spectrum of DSB-SC signals and Coherent demodulation. **UNIT- II** **Angle Modulation:** Introduction to angle modulation, Description of Phase Modulation (PM) and Frequency Modulation (FM), FM with sinusoidal modulating signal, Insights of PM and FM signals, Indirect method for generation of FM Signals – Narrowband and wideband FM signal, Spectrum of FM signals, Bandwidth of FM signals, Demodulation of FM signals. . **UNIT- III** **Pulse Amplitude Modulation (PAM):** Introduction to PAM, Sample and hold, Flat top sampling, Spectrum of PAM signal, Reconstruction of original signal from PAM signal, Equalization, Introduction to quantization, Uniform quantizer, Companding for Non-Uniform Quantization.												

	UNIT- IV **Delta Modulation (DM)**: Introduction to Delta Modulation, One-bit quantizer, Signal reconstruction in DM, Schematic diagrams of DM, Slope overload distortion and granular noise **Differential Pulse Coded Modulation (DPCM):** Quantization and signal reconstruction, Schematic diagrams of DPCM. **Multiplexing:** Frequency Division Multiplexing (FDM), Carrier spacing in FDM, Time Division Multiplexing (TDM), Operation of TDM, Sample spacing in TDM, Bandwidth requirements of TDM.
Text books and Reference books	**Text Book:** [1] Wayne Tomasi, "Electronic Communication Systems", 4th Ed., Pearson Education, 2003 **Reference Books:** [1] Simon Haykin, Analog and Digital Communication Systems, John Wiley & Sons, 2001
E-resources and other digital material	[1] https://nptel.ac.in/courses/108104091/

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:	
		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 **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1								M		H		
	CO2									M	H		
	CO3										H		
	CO4									M	H		

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:** [1] Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press, 2011. [2] S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010' [3] R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand & Company Ltd., 2018. [4] 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	Make use of MATLAB environment.
CO2	Obtain the mathematical modeling of physical systems by block diagram reduction technique.
CO3	Analyze the time, frequency response and stability of given control system.
CO4	Demonstrate the properties of Fourier Transform.
CO5	Use FFT algorithms to compute DFT.
CO6	Design of digital filters.

Contribution of Course Outcomes towards achievement of Program Outcomes

(L – Low, M - Medium, H – High

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1					H							
CO2					H							
CO3					H							
CO4					H							
CO5					H							
CO6					H							

Course Content

List of Experiments

<u>Control Systems:</u>

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 Books:** [1] A.Anand Kumar, "Control Systems", 2nd Ed., PHI, 2014. [2] S.Salivahanan. "Digital Signal Processing" TMH, 2000. **Reference Books:** [1] 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

Note: Any 10 experiments from the above list covering 5 experiments from each group.

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 set of 8051 to solve problems
CO2	Select and use various interfacing peripherals with 8051 Microcontroller
CO3	Develop coding in Embedded C
CO4	Select and use various interfacing peripherals with ARM Microcontroller

Contribution of Course Outcomes towards achievement of Program Outcomes

(L – Low, M - Medium, H – High

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1			H	H								
CO2			H	H								
CO3			H	H	H							
CO4			H	H								

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

Text books and Reference books

Text Book

[1] Shibu.K.V, "Embedded Systems" 3rd Ed., Tata McGraw Hill Education Private Ltd. 2013.

[2] Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay "The 8051 Microcontroller and Embedded Systems using assembly and C", 2nd Ed., Pearson.

[3] Sloss Andrew N, Symes Dominic and Wright Chris, "ARM System Developers

	guide: Designing and Optimizing", Morgan Kaufman Publication, 2004 **Reference books** [1] 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.**

Note: Any 10 experiments from the above list covering 5 experiments from each part.

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

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1												
	CO2												
	CO3												
	CO4												
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1												
	CO2												
	CO3												
	CO4												

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.

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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:** [1] Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd. [2] Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons. [3] Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company [4] Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher. [5] Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition 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: Semester end Evaluation: Total Marks:	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Develop mathematical models of various physical systems.											
	CO2	Select appropriate controllers and final control elements for various processes.											
	CO3	Design advanced control strategies and apply tuning procedures to design PID controllers.											
	CO4	Understand the operation of complex processes in industrial applications.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H			L								
	CO2	H											
	CO3	H			L								
	CO4	H			L								
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** [1] Donald P. Eckman, "Automatic process control", Wiley India Pvt. Ltd. (UNIT I & II) [2] Donald R. Coughanowr, "Process Systems Analysis and Control", 2nd Ed., Mc Graw- Hill International edition. (UNIT III) [3] Shinskey.F.G, "Process Control Systems - Application, Design and Tuning", 3rd Ed., Mc Graw-hill International edition. (UNIT IV) **Reference Books** [1] D Patranabis, "Principles of Process Control" 2nd Ed., TMH, 2007. [2] 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/

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 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	Describe the role of computers in industrial automation											
	CO2	Develop the mathematical modeling of various processes in discrete time domain											
	CO3	Analyze the time response and stability of computer control system using pulse transfer function approach											
	CO4	Design the appropriate digital control algorithm for industrial processes											
	CO5	Select suitable intelligent controllers for real time applications											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2		H										
	CO3		H	H		L							
	CO4			H									
	CO5			L		H							

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 Books:** [1] 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] [2] Krishna Kant, "Computer-based Industrial Control", 2nd Ed., PHI, Delhi, 2010. [Unit-IV] **Reference Books:** [1]C.D. Johnson, "Process Control Instrumentation Technology", 4th Ed., Prentice Hall Inc, 2000. [2] 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	Understand the basic concepts of fiber optic sensors.											
	CO2	Identify wavelength modulated fiber optic sensors to detect physical parameters.											
	CO3	Choose suitable interferometric and frequency modulated fiber optic sensors to monitor physical parameters.											
	CO4	Select appropriate fiber optic sensors for various applications.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L											
	CO2		H										
	CO3		H										
	CO4		H										
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:** [1] B.D. Gupta, "Fiber Optic Sensors Principles and Applications", 1st Ed., New India publishing agency, 2006. (UNIT I,II,III & IV) **Reference Books:** [1] 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

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:** **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 different fabrication methods of integrated circuits.											
	CO2	Analyze basic electrical properties of MOSFET.											
	CO3	Apply the design rules of mask layout for MOS and BiCMOS circuits.											
	CO4	Analyzing basic circuit concepts and scaling of MOS circuits.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2		L										
	CO3			L									
	CO4		L										

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:** [1] Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, "Essentials of VLSI Circuits and Systems", 1st Ed., Prentice-Hall of India Private Limited, 2005. (Unit I. II, III, IV) [2] Wayne Wolf, "Modern VLSI Design", 4th Ed., Pearson Education. (UNIT I, II, III & IV) [3] Neil H. E. Weste and David Money Harris, "CMOS VLSI Design", 4th Ed.,Pearson Education. (UNIT I, II, III & IV) **Reference Books:** [1] A.Albert Raj and T.Latha, "VLSI Design", PHI Learning Private Limited, 2010. [2] 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 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 fundamental concepts and working principles of robot anatomy.											
	CO2	Describe the kinematics and inverse kinematics of manipulators.											
	CO3	Apply various control strategies to manipulator design.											
	CO4	Explain the use of robots in industrial applications											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2		H										
	CO3			H									
	CO4			L									
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 Books:** [1] R.K.Mittal &, I.J.Nagarath, "Robotics and Control", Tata McGraw Hill Pvt. Ltd, 15th Ed., 2010. [2] S.R.Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Pvt. Ltd., 2002. **Reference Books:** [1] R.D.Klafter, T.A.Chimielewski & M. Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall of India, New Delhi, 1994 [2] P.J.Mc Kerrow, "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:	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	Acquire comprehensive knowledge of various industrial networks, topologies, transmission modes and functions of each layer of the OSI model											
	CO2	Understand the technical issues related to HART communication protocol											
	CO3	Identify various types of network devices and hardware suitable for foundation field bus.											
	CO4	Explain the features of PROFIBUS standard for process automation											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2			H									
	CO3			H									
	CO4			H									

Course Content

UNIT – I **[Text Book No: 1&2]**

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 **[Text Book No: 1]**

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 **[Text Book No: 1]**

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 **[Text Book No: 1]**

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 books:** [1] S. Sunit Kumar " Fieldbus and Networking in Process Automation" CRC Press, Taylor and Francis Group, 1st Ed., 2014 [2] 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** [1] S. Mackay, J. Park and E. Wright, "Practical Data Communication for Instrumentation and Control", Newnes Elsevier,2002 [2] 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:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Describe the challenges and problems associated with the use of the current energy sources with regard to future supply and the environment, greenhouse effect.											
	CO2	Discuss the solar energy resource, solar thermal generation of electricity and photovoltaic's.											
	CO3	Explicate about the wind renewable energy resource and its generation.											
	CO4	Explain about the tidal and geothermal renewable energy resources and their generation.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1						H	M	L				
	CO2						H	M	L				
	CO3						H	M	L				
	CO4						H	M	L				

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

Course Category:	Program Core	**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	Explain the various industrial applications of SCR											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H		M									
	CO2			M									
	CO3	H	M										
	CO4	H	M										

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 Supersynchronous motor drives.

Text books and Reference books	**Text Book:** [1] G.K.Mithal and Dr.Maneesh Gupta, "Industrial and PowerElectronics," Khanna Publications, 9th Ed., 2007. **Reference Books:** [1] M.Ramamurthy,Thyristors and their applications", East-WestPress, 2nd Ed.,1998. [2] M.H.Rashid, Power Electronics-Devices, Circuits and Application, Prentice Hall of India,2003. [3] P.S.Bimbra, "PowerElectronics," 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.htmlhttp://onlinevideolecture.com/?course_id=510

17EI4604/C- Process Modeling and Simulation

Course Category:	Program Elective	**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:												
	CO1	Develop nonlinear and linear models for a given process.											
	CO2	Design PID controller for a given process with suitable tuning method.											
	CO3	Design internal model controller for stable and unstable processes.											
	CO4	Outline the concepts of MPC for SISO systems.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1		H			L							
	CO2			H		H							
	CO3			H		H							
	CO4			L									
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 nonminimum phase processes, Antireset windup, Auto tuning 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** [1] Process Control - Modeling, Design and Simulation, Prentice Hall International Series in the Physical and Chemical Engineering Sciences, 1st Ed., 2003. [2] Amiya K.Jana, Chemical Process Modeling and Computer Simulation, PHI, 2nd Ed., 2011. **Reference Book** [1] 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/108105062/13 2. https://in.mathworks.com/help/control/examples/design-internal-model-controller-for-chemical-reactor-plant.html?requestedDomain=www.mathworks.com 3. http://www.cc.ntut.edu.tw/~jcjeng/Model%20Predictive%20Control.pdf 4. https://www.sheffield.ac.uk/acse/staff/jar/mpcmaster

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	Describe the origin, properties and basic signal processing techniques in analyzing biological signals such as ECG and EEG.											
	CO2	Develop the mathematical models relevant to the field of biomedical signal processing.											
	CO3	Develop a thorough understanding on basics of ECG signal compression algorithms.											
	CO4	Understand the promises and challenges of the cardio logical and neurological signal processing.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2	H			H					H			
	CO3					H				H			
	CO4					H							

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 Books** [1] Rangaraj M. Rangayyan, "Biomedical Signal Analysis A Case Study Approach", John Wiley & Sons 2002. [2] Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India 2004. [3] D C Reddy, "Biomedical Signal Processing Principles and Techniques", Tata McGraw-Hill Publishing Co. Ltd, 2005. **Reference Books** [1] Akay M, "Biomedical Signal Processing", Academic: Press 1994. [2] Cohen.A, "Biomedical Signal Processing" Vol. I, CRC Press, 1986. [3] AV Oppenheim & RW 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	Describe various basic programming techniques.
	CO4	Elucidate data acquisition methods.

Contribution of Course Outcomes towards achievement of Program Outcomes

(L – Low, M - Medium, H – High

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1					H							
CO2				M	H							
CO3					H							
CO4				H	H							

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 Books** [1] Jovitha Jerome, "Virtual Instrumentation using LabVIEW", 1st Ed., PHI, 2013. **Reference Books** [1] Sanjay Gupta, Joseph John, "Virtual Instrumentation using LabVIEW", 1st Ed., Tata McGraw-Hill, 2005. [2] 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:	Instrumentation 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	Summarize the classification and characteristics of sensors.											
	CO2	Outline the operative principles of Intelligent sensors.											
	CO3	Able to explain the linearization and calibration, standards and protocols.											
	CO4	Make use of intelligent instrumentation in various industrial processes.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L		L									
	CO2	L		L									
	CO3	L		L									
	CO4			H									

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 Books** [1] Manabendra Bhuyan, "Intelligent Instrumentation Principles and Applications", CRC Press. **Reference Books** [1] Barney G.C.V., "Intelligent Instrumentation", Prentice Hall of India Pvt. Ltd., New Delhi, 1988. [2] John G. Webster, Halit Eren, "Measurement, Instrumentation, and Sensors Handbook: Electromagnetic, Optical, Radiation, Chemical, and Biomedical Measurement", 2nd Ed., [3] Krysztof Iniewski , "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:**	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	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 **(L – Low, M - Medium, H – High**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	M											
	CO2		M										
	CO3	M											
	CO4				M								
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:** [1] R. S. Aggarwal “Quantitative Aptitude”, Revised Ed., S Chand publication, 2017. ISBN:8121924987 **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	Investigate the characteristics of I/P converter control valves and various transmitters used in industrial processes.
CO2	Understand the characteristics of controller modes in various process stations.
CO3	Analyze the characteristics of various advanced control strategies.
CO4	Understand the operation of complex processes.

Contribution of Course Outcomes towards achievement of Program Outcomes

(L – Low, M - Medium, H – High

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1			H	H								
CO2			H	H								
CO3			H	L								
CO4				L								

Course Content

List of Experiments

1. Characteristics of Chromel – Alumel thermo couple and temperature transmitter
2. Characteristics of PID controller in temperature process station.
3. Characteristics of level transmitter and I/P converter.
4. Characteristics of PID 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 Books:

[1] Process control lab manual.
[2] Donald P. Eckman, "Automatic Process Control', Wiley India Pvt. Ltd.
[3] Donald R. Coughanowr, "Process Systems Analysis and Control, 2nd Ed., Mc Graw-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

Any 10 experiments from the above list.

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	Understand the graphical programming terminology and able to create a virtual instruments for simple problems											
	CO2	Able to use the various looping constructs, arrays, matrices and clusters											
	CO3	Able to use various data plotting techniques and structures											
	CO4	Able to use the data acquisition device to acquire the measurement data from real world into PC											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1					H							
	CO2				M	H							
	CO3				M	H							
	CO4				M	H							

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 & Ref books

Text Book

[1] Jovitha Jerome, "Virtual Instrumentation using LabVIEW", 1st Ed., PHI, 2013

Reference Books:

[1] Sanjay Gupta, Joseph John, "Virtual Instrumentation using LabVIEW", 1st Ed., Tata McGraw-Hill, 2005.

	[2] Gary Johnson, Richard Jennings, "LabVIEW Graphical Programming", Tata McGraw-Hill, 2006
E-resources and other digital material	1. http://www.ni.com

Any 10 experiments from the above list.

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