VELAGAPUDI RAMAKRISHNASIDDHARTHA ENGINEERING COLLEGE

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME

VR23

I-VI Semester Syllabus

Effective from 2023-24

Velagapudi Ramakrishna Siddhartha Engineering College

ELECTRONICS & INSTRUMENTATION ENGINEERING

Scheme of Instructions for Four Year B.Tech Programme-VR23

SEMESTER I **CONTACT HOURS: 26**

S. No	Course Code	Course	Subject	L	T	P	Credits
1.	23BS1101	Basic Science	Linear Algebra & Calculus	3	0	0	3
2.	23BS1102B	Basic Science	Chemistry	3	0	0	3
3.	23BS1103B	Basic Science	Basic Electrical & Electronics Engineering	3	0	0	3
4.	23ES1104	Engineering Science	Introduction to Programming	3	0	0	3
5.	23ES1105	Engineering Science	Engineering Graphics	1	0	4	3
6.	23BS1151B	Basic Science	Chemistry Lab	0	0	2	1
7.	23ES1152	Engineering Science	Computer Programming Lab	0	0	3	1.5
8.	23ES1153	Engineering Science	Electrical and Electronic Engineering Lab	0	0	3	1.5
9.	23BS1154B	Basic Science	Health and wellness, Yoga and Sports	0	0	1	0.5
Total				**13**	**0**	**13**	**19.5**
10.	23MC1106	Mandatory Course	Induction Program				-

SEMESTER II **CONTACT HOURS: 27**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	23BS2101	Basic Science	Differential Equations & Vector Calculus	3	0	0	3
2.	23BS2102	Basic Science	Engineering Physics	3	0	0	3
3.	23ES2103A	Engineering Science	Basic Civil and Mechanical Engineering	3	0	0	3
4.	23PC2104C	Professional Core	Network Analysis	3	0	0	3
5.	23HS2105	Basic Science	Communicative English	2	0	0	2
6.	23BS2151	Basic Science	Engineering Physics Lab	0	0	2	1
7.	23PC2152C	Professional Core	Network Analysis & Simulation Lab	0	0	3	1.5
8.	23HS2153	Basic Science	Communicative English Lab	0	0	2	1
9.	23ES2154	Engineering Science	Engineering Workshop	0	0	3	1.5
10.	23ES2155	Engineering Science	IT Work shop	0	0	2	1
11.	23BS2156	Basic Science	NSS/NCC/Community Service	-	-	1	0.5
Total				**14**	**0**	**13**	**20.5**

II Year I Semester (Semester III) **CONTACT HOURS: 28**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	23BS3101C	Basic Science	Complex Analysis and Numerical Methods	3	0	0	3
2.	23HS3102	Humanities and Social Sciences	Universal Human Values – Understanding Harmony	2	1	0	3
3.	23ES3103F	Engineering Science	Analog Electronic Circuits	2	0	0	2
4.	23EI3304	Professional Core	Digital Circuits and Systems	3	0	0	3
5.	23EI3305	Professional Core	Sensors and Transducers	3	0	0	3
6.	23TP3106	Soft Skills - 1	Logic and Reasoning	0	0	2	1
7.	23MC3107	Audit	Environmental Science	2	0	0	-
8.	23EI3651	Skill Enhancement	Numerical Computing using MATLAB	0	0	2	1
9.	23ES3152	Engineering Science	Electronic Circuits Lab	0	0	2	1
10.	23EI3353	Professional Core	Digital System Design Lab	0	0	3	1.5
11.	23EI3354	Professional Core	Transducers Lab	0	0	3	1.5
			Total	**15**	**1**	**12**	**20**

II Year II Semester (Semester IV) **CONTACT HOURS: 28**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	23HS4101	Humanities and Social Sciences	Engineering Economics and Management	2	0	0	2
2.	23ES4102C	Engineering Science	Linear Integrated Circuits and Applications	2	0	0	2
3.	23EI4303	Professional Core	Control Systems	3	0	0	3
4.	23EI4304	Professional Core	Industrial Instrumentation	3	0	0	3
5.	23EI4305	Professional Core	Electrical and Electronic Measurements	3	0	0	3
6.	23TP4106	Soft Skills - 2	English for Professionals	0	0	2	1
7.	23EI4651	Skill Enhancement course	Virtual Instrumentation Lab	0	0	2	1
8.	23ES4152	Engineering Science	Design Thinking & Innovation	1	0	2	2
9.	23EI4353	Professional Core	Linear Integrated Circuits Lab	0	0	3	1.5
10.	23EI4354	Professional Core	Control Systems Lab	0	0	2	1
11.	23EI4355	Professional Core	Measurements Lab	0	0	3	1.5
Total				**14**	**0**	**14**	**21**

III Year I Semester (Semester V) **CONTACT HOURS: 29**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	23EI5301	Professional Core	Microcontrollers	3	0	0	3
2.	23EI5302	Professional Core	Process Control	3	0	0	3
3.	23EI5403	Professional Elective - I	• Sensor Signal Conditioning • Robotics and Control • Industrial Electronics • VLSI Design	3	0	0	3
4.	23EI5204	Open Elective – I (NPTEL)	• MOOCS Course with 12 week duration	3	0	0	3
5.	23EI5205	Open Elective – II	• Essential Principles of Image Sensors • PC Based Instrumentation • Transducers and Measurement Systems	3	0	0	3
6.	23EI5351	Professional Core	Microcontrollers Lab	0	0	3	1.5
7.	23EI5352	Professional Core	Process Control Lab	0	0	3	1.5
8.	23EI5653	Skill Enhancement course (SEC)	Advanced Digital System Design with FPGA	0	0	2	1
9.	23EI5354	EPICS	Evaluation of Community Service Internship	-	-	-	2
10.	23TP5106	Soft Skills – 3	Personality Development	0	0	2	1
11.	23MC5107B	Audit Course	Humanities Elective	2	0	0	-
Total				**17**	**0**	**10**	**22**
Minor/Honors courses two courses from each semester 3-0-0-3							

III Year II Semester (Semester VI) **CONTACT HOURS: 30**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	23EI6301	Professional Core	Embedded Systems	3	0	0	3
2.	23EI6302	Professional Core	Digital Signal Processing	3	0	0	3
3.	23EI6303	Professional Core	Industrial Automation	3	0	0	3
4.	23EI6404	Professional Elective - II	• Biomedical Instrumentation • Drives and Control for Industrial Automation • Process Modeling and Simulation • Industrial Communication Networks	3	0	0	3
5.	23EI6405	Professional Elective - III	• Power Plant Instrumentation • Instrumentation and Control in Food Processing • Industrial Internet of Things • Wireless Sensor Networks	3	0	0	3
6.	23EI6206	Open Elective - III	• Artificial Intelligence and Machine Learning in Healthcare • Safety Instrumentation Systems • Principles of Process Control	3	0	0	3
7.	23EI6351	Professional Core	Embedded Systems Lab	0	0	3	1.5
8.	23EI6352	Professional Core	Advanced Instrumentation Lab I	0	0	3	1.5
9.	23EI6153	HSS -Skill Enhancement course	Advanced Communication Skills Lab	0	0	2	1
10.	23TP6107	Soft Skills - 4	Quantitative Aptitude	0	0	2	1
11.	23MC6108B	Audit Course	Technical Paper Writing & IPR	2	0	0	-
Total				**20**	**0**	**10**	**23**
Mandatory Industry Internship of 08 weeks duration during summer vacation **(Two course to be offered for Honors courses 3-0-0-3)**							

IV Year I Semester (Semester VII) **CONTACT HOURS: 25**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	23EI7301	Professional Core	Computer Control of Processes	3	0	0	3
2.	23EI7302	Professional Core	Analytical Instrumentation	3	0	0	3
3.	23EI7303A 23EI7303B 23EI7303C 23EI7303D	Professional Elective - IV	• Advanced Sensors • Intelligent Systems and Control • Digital Image Processing • Database Management Systems	3	0	0	3
4.	23EI7304A 23EI7304B 23EI7304C 23EI7304D	Professional Elective - V	• Real World Instrumentation with Python • Instrumentation and Control in Paper Industries • HMI & SCADA • Computer Networks	3	0	0	3
5.	23EI7205	Open Elective - IV	• MOOCS- 12 weeks	3	0	0	3
6.	23EI7351	Professional Core	Industrial Automation Lab	0	0	3	1.5
7.	23EI7352	Professional Core	Advanced Instrumentation Lab II	0	0	3	1.5
8.	23EI7653	Skill Enhancement course	Real Time Operating Systems	0	0	2	2
9.	23MC7106	Audit Course	Constitution of India	2	0	0	-
10.	23EI7551	Internship	Evaluation of Industry Internship	-	-	-	2
Total				**17**	**0**	**8**	**22**

IV Year II Semester (Semester VIII) **CONTACT HOURS: 24**

S.No	Course Code	Course	Subject	L	T	P	Credits
1	23EI8551	Internship & Project Work	Full semester Internship & Project Work	0	0	24	12
Total				**0**	**0**	**24**	**12**

First Year
(I Semester)

23BS1101 - Linear Algebra & Calculus

Course Category:	Basic Science	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 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	Solve the system of homogeneous and non-homogeneous linear equations														
	CO2	Examine the nature of a quadratic form by transforming into a canonical form														
	CO3	Determine maxima and minima of multivariable functions														
	CO4	Evaluate areas and volumes using double, triple integrals														
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3	2			1										
	CO2	3	2			1										
	CO3	3	2			1										
	CO4	3	2			1										

Course Content

UNIT- I

Matrices: Rank of a matrix by Echelon form, Normal form, Cauchy–Binet formulae (without proof), Inverse of Non- singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss-Seidel Iteration Methods.

UNIT- II

Eigenvalues, Eigenvectors and Orthogonal Transformation: Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley- Hamilton Theorem (without proof), Finding inverse and power of a matrix by Cayley- Hamilton Theorem, Quadratic forms and Nature of the Quadratic forms, Reduction of Quadratic form to Canonical forms by Orthogonal Transformation

UNIT- III

Differential Calculus

Mean Value Theorems: Rolle's theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclau- rin's theorems with remainders (without proof), Problems and applications on the above theorems.

	Functions of Several Variables: Continuity and Differentiability, Partial derivatives, Total derivatives, Chain rule, Directional derivative, Taylor's and Maclaurin's series expansion of functions of two variables, Jacobians, Functional dependence, Maxima and Minima of functions of two variables, Method of Lagrange multipliers **UNIT- IV** **Multiple Integrals (Multivariable Calculus) :** Double integrals, Triple integrals, Change of order of integration, Change of variables to polar, cylindrical and spherical coordinates, Finding areas (by double integrals) and volumes (by double integrals and triple integrals).
Text books and Reference books	**Text Book:** [T1] B.S.Grewal, "Higher Engineering Mathematics", 44th Ed., Khanna Publishers, 2019 **Reference Books:** [R1] Erwin Kreyzig, "Advanced Engineering Mathematics", 10th Ed., John Wiley & Sons, 2015. [R2] Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018,14th Ed., [R3] R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5th Ed., Narosa Publishers, 2016. [R4] Glyn James, "Advanced Modern Engineering Mathematics", 5th Ed., Pearson publishers, 2018. [R5] Micheael Greenberg, "Advanced Engineering Mathematics", 9th Ed., Pearson publishers. [R6] H.K.Das, Er. Rajnish Verma, "Higher Engineering Mathematics", 3rd Ed., S. Chand Publications, 2014.
E-resources and other digital material	1. Prof. S.K.Gupta & Prof. Sanjeev Kumar, IIT Roorkee, Matrix Analysis with Applications [English], Available: https://onlinecourses.nptel.ac.in/noc19 ma28/ preview 2. Prof. Jitendra Kumar, IIT Kharagpur, Engineering Mathematics – I [English], Available: https://onlinecourses.nptel.ac.in/noc20 ma37/preview 3. Prof. Jitendra Kumar & Prof. Somesh Kumar, IIT Kharagpur, Advanced Calculus For Engineers [English], Available: https://onlinecourses.nptel.ac.in/noc22 ma75/preview 4. Prof. Denis Auroux, Massachusetts Institute of Technology: MIT Open Course- ware, Multivariable Calculus, Available: https://ocw.mit.edu.

23BS1102B – Chemistry

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

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Apply the principles of quantum mechanics for determining structure and bonding of molecules
	CO2	Apply the principles electrochemistry for its applications in chemical analysis, electrodes, electrochemical sensors and energy sources
	CO3	Explain the mechanistic aspects of polymerisation and conduction, types, preparation, properties and applications of polymers
	CO4	Compare different spectroscopic and chromatographic techniques for their application in qualitative and quantitative analysis
	CO5	Choose engineering materials including nanomaterials based on their properties for their applications in various industrial fields

Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3	1													
	CO2	2		3												
	CO3	2				3										
	CO4	2	3													
	CO5	2				3		1								

Course Content	**UNIT- I** **Structure and Bonding Models:** Fundamentals of Quantum mechanics, Schrodinger wave equation, significance of Ψ and Ψ2, particle in one dimensional box, Molecular orbital theory, bonding in homo and heteronuclear diatomic molecules, energy level diagrams of O2,N2, NOand CO,calculation of bond order, - molecular orbitals of butadiene and benzene. **UNIT- II** **Electrochemistry**: Electrochemical cell, Nernst equation, potential and emfcalculations and numerical problems, potentiometry – potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, cell constant and specific conductance, conductomet- rictitrations (acid-base titrations), Electrochemical sensors – potentiometric sensors andamperometric sensors-principle with examples. **Electrochemical Energy Systems:** Types of electrochemical energy systems - Primary cells – Zinc-air battery, Secondary cells – lithium-ion batteries – working of the batteries including cell reactions, Fuel cells – hydrogen–oxygen fuel cell- working of the cells, Polymer Electrolyte Membrane fuel cells(PEMFC). **UNIT- III** **Polymer Chemistry:** Introduction to polymers, functionality of monomers, addition and condensation polymerization, mechanism of chain growth and step growth polymerization, coordi- nation polymerization with specific examples.Plastics – Thermo and thermosetting plastics, preparation, properties and applications of PVC, Teflon, Bakelite, Nylon- 6,6.Elastomers – Buna-S, Buna-N –Preparation, properties and applications. Con- ducting Polymers – Principle and examples, mechanism of conduction in undoped, doped polyacetylene and applications, Biodegradable polymers – polyglycolic acid (PGA), Polylacticacid(PLA). **UNIT- IV** **Instrumental Methods of Analysis:** Electromagnetic spectrum, Interaction of radiation with matter, UV Visible Spectroscopy- principle, electronic transitions, Lambert-Beer's law, Instrumentation, applications,IR spectroscopy-principle, types of vibrations, selection rule, Instrumentation, Chromatography- basic principle and classification. **Nano materials:** Introduction, classification of nanomaterials. Properties and applications of fullerenes, carbon nanotubes, graphene and nanoparticles.

Text books and Reference books	**Text Book:** [T1] Jain and Jain "Engineering Chemistry", 17th Ed., Dhanpatraj 2018 [T2] Prasanth Rath S, Aruna Kumari, " Engineering Chemistry", Cengage Publishers, 2023 **Reference Books:** [R1] Peter Atkins, Julio de Paula and James Keeler, Atkins, "Physical Chemistry", 10th Ed., Oxford University Press, 2010. [R2] Skoog and West, "Principles of Instrumental Analysis", 6th Ed., Thomson, 2007 [R3] J.D.Lee, "Concise Inorganic Chemistry", 5th Ed., Wiley Publications, 2008 [R4] Fred W. Billmayer Jr, "Textbook of Polymer Science", 3rd, Ed.,
E-resources and other digital material	1. https://onlinecourses.nptel.ac.in/noc24 ph02/preview 2. https://onlinecourses.nptel.ac.in/noc24 cy10/preview 3. https://www.youtube.com/watch?v=LMSTMBX 2F4 4. https://www.youtube.com/watch?v=7jOSbtR8mTs&list=PLzPro5owUhRSV-ezegDDfuNpuJ2uU6jZ0 5. https://onlinecourses.swayam2.ac.in/cec24 cy02/preview

23BS1103B – Basic Electrical and Electronics Engineering

Course Category:	Basic Science	**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	Apply different techniques to solve DC circuits.														
	CO2	Understand the magnetic circuit concepts.														
	CO3	Analyze the steady-state response, series, parallel AC circuits, mesh & nodal analysis, and resonance.														
	CO4	Apply network theorems for AC & DC circuits.														
	CO5	Demonstrate the working principles of basic Electronic devices, circuits and Instrumentation system.														
	CO6	Implementation of simple Combinational and Sequential circuits using Logic gates.														
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3	3			2										
	CO2	3	3													
	CO3	2	3			2										
	CO4	2	3													
	CO5	2	1	3	2											
	CO6	2	1	3	2											

Course Content

UNIT- I

DC & AC Circuits

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing phenomenon, Safety Precautions to avoid shock.

UNIT II

Machines and Measuring Instruments

	Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines. **Measuring Instruments:** Construction and working principle of Voltage, Current, temperature sensors, basic block diagram of multimeter. Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, calculation of electricity bill for domestic consumers. **UNIT – III :** **Semiconductor Devices** I**ntroduction** - Evolution of electronics - Vacuum tubes to nano electronics - Characteristics of PN junction diode - Zener effect - Zener diode and its characteristics. Bipolar junction transistor - CB, CE, CC configurations and characteristics - Elementary treatment of small signal CE amplifier. **Rectifiers and power supplies**: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, Capacitor filter (no analysis), Working of simple zener voltage regulator. **Amplifiers**: Block diagram of Public Address system, Circuit diagram. **Electronic Instrumentation:** Block diagram of an electronic instrumentation system. **UNIT – IV** **Digital Electronics:** Overview of number systems, Logic gates including universal gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean algebra, Basic theorems and properties of Boolean algebra, Truth tables and functionality of logic gates - NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits - Half and Full adders. Introduction to Flip flops, Registers and counters (Elementary Treatment only)
Text books and Reference books	**Text Book:** **(for UNITS I & II)** [T1] Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition [T2] Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020 [T3] Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017 [T4]Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition. **(for UNITS III & IV)** [T5] R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021. [T6] P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009 **Reference Books:** **(for UNITS I & II)**

	[R1] Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition [R2] Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020 [R3] Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017 [R4] Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition **(for UNITS III & IV)** [R5] R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010. [R6] Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002. [R7] R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.
E-resources and other digital material	**(for UNITS I & II)** 1. https://nptel.ac.in/courses/108105053 2. https://nptel.ac.in/courses/10810807 **(for UNITS III & IV)** 3. https://embeddedengineers.files.wordpress.com/2015/09/electronic-devices-and-circuits-by- salivahanan.pdf 4. http://www.nptelvideos.in/2012/12/basic-electronics-drchitralekha-mahanta.html 5. https://en.wikipedia.org/wiki/Digital_electronics

23ES1104 – Introduction to Programming

Course Category:	Engineering Science	**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	To introduce students to the fundamentals of computer programming.													
	CO2	To provide hands-on experience with coding and debugging on control structures and arrays.													
	CO3	To foster logical thinking and problem-solving skills on strings and ponters.													
	CO4	To familiarize students with programming concepts such as functions, structures and files.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
	CO1	3	1													
	CO2		2	3												
	CO3		2	3												
	CO4		2													
Course Content	**UNIT- I** **Introduction to Programming and Problem Solving:** Introduction, History of Computers, Basic organization of a computer: ALU, Input-output units, Memory, Program counter, Introduction to programming languages, Basics of a computer program- Algorithms, Flowcharts (Using Dia Tool), Pseudo code. Introduction to compilation and execution, Primitive data types, Variables, and constants, Basic input and output, Operations, Type conversion, and casting.Problem solving techniques: Algorithmic approach, Characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms **UNIT- II** **Control Structures and Arrays:** Taylor's Simple sequential programs Conditional statements (if, if-else, switch), Loops (for, while, do- while) Break and continue, Arrays indexing, Memory model, Programs with array of integers, two dimensional arrays **UNIT- III** **Strings and pointers:** Introduction to Strings. Pointers, Dereferencing and address operators, Pointer and address arithmetic, Array manipulation using pointers														

	UNIT- IV **Numerical Differentiation:** First and second order derivatives using Newton's forward and backward difference formulae, Numerical integration with Trapezoidal rule and Simpsons 1/3 Rule, Numerical Solutions of Differential Equations-Taylor's series method, Euler's method, Modified Euler's method and Runge - Kutta method of 4th order.
Text books and Reference books	**Text Book:** [T1] B.S.Grewal, "Higher Engineering Mathematics", 44th Ed., Khanna Publishers, 2019 **Reference Books:** [R1] Erwin Kreyzig, "Advanced Engineering Mathematics", 10th Ed., John Wiley & Sons, 2015. [R2] R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5th Ed., Narosa Publishers, 2016. [R3] N.P.Bali, Manish Goyal, "A Textbook of Engineering Mathematics", 9th Ed., Lakshmi Publications (P) Limited, 2016. [R4] H. K. Das, Er. Rajnish Verma, "Higher Engineering Mathematics", 3rd Revised Ed., S.Chand & Co., 2014. [R5] S. S. Sastry, "Introductory Methods of Numerical Analysis", 5th Ed., PHI Learning, 2012.
E-resources and other digital material	1. Prof.Pranav Haridas, Kerala School of Mathematics, Complex Analysis, Available: https://onlinecourses.nptel.ac.in/noc21_ma39/preview 2. Prof. Ameeya Kumar Nayak, Sanjeev Kumar, IIT Roorkee, Numerical methods, Available: https://onlinecourses.nptel.ac.in/noc21_ma45/preview 3. Jeremy Orloff, Massachusetts Institute of Technology: MIT Open Courseware, Complex Variables with Applications, Available: https://ocw.mit.edu. 4. Henrik Schmidt, Massachusetts Institute of Technology: MIT Open Courseware, Introduction to Numerical Analysis for Engineering, Available: https://ocw.mit.edu.

23ES1105 – Engineering Graphics

Course Category:	Basic Science	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	1 - 0- 4
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	Determine analytic, non-analytic functions and evaluate complex integrals													
	CO2	Analyze Taylor, Laurent series and apply residue theorem for computing real definite integrals													
	CO3	Find solutions for algebraic, transcendental equations and estimate functions using polynomial interpolation													
	CO4	Solve initial value problems numerically													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3	2													
	CO2	3	2													
	CO3	3	2			2								L		
	CO4	3	2			2								L		

Course Content

UNIT- I

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

UNIT- II

Taylor's series, Laurent's series, Zeros and Singularities of an analytic function, Residue theorem, Calculation of Residues, Evaluation of real definite integrals:(i) Integration around the unit circle (ii) Integration around a small semi-circle, Bilinear transformation

UNIT- III

Numerical Methods & Interpolation: Solution of Algebraic and Transcendental Equations with Newton - Raphson method, Interpolation Introduction, Finite Differences-Forward, Backward and Central differences, Symbolic Relations, Newton's interpolation formulae-forward and backward differences, Central difference interpolation formulae-Gauss's, Stirling's, Bessel's formulae, Interpolation with unequal intervals - Lagrange's and Newton's divided difference formulae

	UNIT- IV **Numerical Differentiation:** First and second order derivatives using Newton's forward and backward difference formulae, Numerical integration with Trapezoidal rule and Simpsons 1/3 Rule, Numerical Solutions of Differential Equations-Taylor's series method, Euler's method, Modified Euler's method and Runge - Kutta method of 4th order.
Text books and Reference books	**Text Book:** [T1] B.S.Grewal, "Higher Engineering Mathematics", 44th Ed., Khanna Publishers, 2019 **Reference Books:** [R1] Erwin Kreyzig, "Advanced Engineering Mathematics", 10th Ed., John Wiley & Sons, 2015. [R2] R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5th Ed., Narosa Publishers, 2016. [R3] N.P.Bali, Manish Goyal, "A Textbook of Engineering Mathematics", 9th Ed., Lakshmi Publications (P) Limited, 2016. [R4] H. K. Das, Er. Rajnish Verma, "Higher Engineering Mathematics", 3rd Revised Ed., S.Chand & Co., 2014. [R5] S. S. Sastry, "Introductory Methods of Numerical Analysis", 5th Ed., PHI Learning, 2012.
E-resources and other digital material	1. Prof.Pranav Haridas, Kerala School of Mathematics, Complex Analysis, Available: https://onlinecourses.nptel.ac.in/noc21_ma39/preview 2. Prof. Ameeya Kumar Nayak, Sanjeev Kumar, IIT Roorkee, Numerical methods, Available: https://onlinecourses.nptel.ac.in/noc21_ma45/preview 3. Jeremy Orloff, Massachusetts Institute of Technology: MIT Open Courseware, Complex Variables with Applications, Available: https://ocw.mit.edu. 4. Henrik Schmidt, Massachusetts Institute of Technology: MIT Open Courseware, Introduction to Numerical Analysis for Engineering, Available: https://ocw.mit.edu.

23BS1151B – Chemistry Lab

Course Category:	Institutional Core	**Credits:**	1
Course Type:	Laboratory	**Lecture - Tutorial - Practice:**	0 - 0- 2
Prerequisites:	Knowledge of chemistry practical's at Intermediate level	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Analyze acids from batteries and metal ions in solutions based on volumetric method													
	CO2	Apply standard procedures for preparation of nanomaterials, polymers and blueprinting													
	CO3	Analyze different solutions by applying various instrumental methods like conductometry, potentiometry, colorimetry, and chromatography.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2	3													
	CO2	3														
	CO3	2	3			2										
Course Content	**List of Experiments** 1. Determination of strength of acid in Lead-acid battery 2. Determination of ferrous iron by dichrometry 3. Determination of ferrous iron by permanganometry 4. Conductometric titration of a strong acid vs. strong base 5. Verification of Lambert-Beer's law 6. Potentiometric titration of a redox reaction 7. Chemistry of blueprinting 8. Conductometric titration of a weak acid vs. strong base 9. Determination of cell constant and conductance of solutions 10. Preparation of nanomaterials – Precipitation method 11. Preparation of urea-formaldehyde resin 12. Separation of ions by paper chromatography														

Text books and Reference books	**Reference Books:** [R1] Vogel's quantitative chemical analysis", 6th Ed., by J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar, Pearson Publications
E-resources and other digital material	

23ES1152 – Computer Programming Lab

Course Category:	Engineering Science	**Credits:**	1
Course Type:	Laboratory	**Lecture - Tutorial - Practice:**	0 - 0- 2
Prerequisites:	23BS1101LinearAlgebra & Calculus 23BS2101DifferentialEquations& Vector Calculus	**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	Read, understand, and trace the execution of programs written in C language													
	CO2	Select the right control structure for solving the problem.													
	CO3	Develop C programs which utilize memory efficiently using programming constructs like pointers													
	CO4	Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
	CO1	3	1													
	CO2		2	3												
	CO3	2	2	3												
	CO4		2	3												

Course Content

UNIT- I

WEEK 1

Objective: Getting familiar with the programming environment on the computer and writing the first program.

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment

i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.

ii) Exposure to Turbo C, gcc

iii) Writing simple programs using printf(), scanf()

WEEK 2

Objective: Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

Suggested Experiments /Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Lab 1: Converting algorithms/flow charts into C Source code.

	Developing the algorithms/flowcharts for the following sample programs i) Sum and average of 3 numbers ii) Conversion of Fahrenheit to Celsius and vice versa iii) Simple interest calculation **WEEK 3** Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants. Suggested Experiments/Activities: Tutorial 3: Variable types and type conversions: Lab 3: Simple computational problems using arithmetic expressions. i) Finding the square root of a given number ii) Finding compound interest iii) Area of a triangle using heron's formulae iv) Distance travelled by an object **UNIT- II** **WEEK 4** Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works. Suggested Experiments/Activities: Tutorial4: Operators and the precedence and as associativity: Lab4: Simple computational problems using the operator' precedence and associativity i) Evaluate the following expressions. a. A+B*C+(D*E) + F*G b. A/B*C-B+A*D/3 c. A+++B---A d. J= (i++) + (++i) ii) Find the maximum of three numbers using conditional operator iii) Take marks of 5 subjects in integers, and find the total, average in float **WEEK 5** Objective: Explore the full scope of different variants of "if construct" namely if-else, null- else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct". Suggested Experiments/Activities: Tutorial 5: Branching and logical expressions: Lab 5: Problems involving if-then-else structures. i) Write a C program to find the max and min of four numbers using if-else. ii) Write a C program to generate electricity bill. iii) Find the roots of the quadratic equation. iv) Write a C program to simulate a calculator using switch case. v) Write a C program to find the given year is a leap year or not.

WEEK 6

Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and

loop in addition to structured jump constructs like break and continue including when each of these statements is more appropriate to use.

Suggested Experiments/Activities:

Tutorial 6: Loops, while and for loops

Lab 6: Iterative problems e.g., the sum of series

i) Find the factorial of given number using any loop.

ii) Find the given number is a prime or not.

iii) Compute sine and cos series

iv) Checking a number palindrome

v) Construct a pyramid of numbers.

UNIT- III

WEEK 7:

Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:

Tutorial 7: 1 D Arrays: searching.

Lab 7:1D Array manipulation, linear search

i) Find the min and max of a 1-D integer array.

ii) Perform linear search on1D array.

iii) The reverse of a 1D integer array

iv) Find 2's complement of the given binary number.

v) Eliminate duplicate elements in an array.

WEEK 8:

Objective: Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:

Tutorial 8: 2 D arrays, sorting and Strings.

Lab 8: Matrix problems, String operations, Bubble sort

i) Addition of two matrices

ii) Multiplication two matrices

iii) Sort array elements using bubble sort

iv) Concatenate two strings without built-in functions

v) Reverse a string using built-in and without built-in string functions

UNIT- IV

WEEK 9:

Objective: Explore pointers to manage a dynamic array of integers, including memory

	allocation & value initialization, resizing changing and reordering the contents of an array memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C Suggested Experiments/Activities: Tutorial 9: Pointers, structures and dynamic memory allocation Lab 9: Pointers and structures, memory dereference. i) Write a C program to find the sum of a 1D array using malloc() ii) Write a C program to find the total, average of n students using structures iii) Enter n students data using calloc() and display failed students list iv) Read student name and marks from the command line and display the student details along with the total. v) Write a C program to implement realloc() **WEEK 10:** Objective: Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures Suggested Experiments/Activities: Tutorial 10: Bitfields, Self-Referential Structures, Linked lists Lab10 : Bitfields, linked lists Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields i) Create and display a singly linked list using self-referential structure. ii) Demonstrate the differences between structures and unions using a C program. iii) Write a C program to shift/rotate using bitfields. iv) Write a C program to copy one structure variable to another structure of the same type. **UNIT- V** **WEEK 11:** Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration Suggested Experiments/Activities: Tutorial 11: Functions, call by value, scope and extent, Lab 11: Simple functions using call by value, solving differential equations using Eulers theorem. i) Write a C function to calculate NCR value. ii) Write a C function to find the length of a string. iii) Write a C function to transpose of a matrix. iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method **WEEK 12:** Objective: Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct

	problems that have naturally recursive solutions. Suggested Experiments/Activities: Tutorial 12: Recursion, the structure of recursive calls Lab 12: Recursive functions i) Write a recursive function to generate Fibonacci series. ii) Write a recursive function to find the lcm of two numbers. iii) Write a recursive function to find the factorial of a number. iv) Write a C Program to implement Ackermann function using recursion. v) Write a recursive function to find the sum of series. **WEEK 13:** Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers Suggested Experiments/Activities: Tutorial 13: Call by reference, dangling pointers Lab 13: Simple functions using Call by reference, Dangling pointers. i) Write a C program to swap two numbers using call by reference. ii) Demonstrate Dangling pointer problem using a C program. iii) Write a C program to copy one string into another using pointer. iv) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers. **WEEK14:** Objective: To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files. Suggested Experiments/Activities: Tutorial 14: File handling Lab 14: File operations i) Write a C program to write and read text into a file. ii) Write a C program to write and read text into a binary file using fread() and fwrite() iii) Copy the contents of one file to another file. iv) Write a C program to merge two files into the third file using command-line arguments. v) Find no. of lines, words and characters in a file vi) Write a C program to print last n characters of a given file.

Text books and Reference books	**Text Book:** [T1] Ajay Mittal, Programming in C: A practical approach, Pearson. [T2] Byron Gottfried, Schaum' s Outline of Programming with C, McGraw Hill
E-resources and other digital material	1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice- Hall of India 2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

23HS1153 – Basic Electrical and Electronics Engineering Lab

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

23BS1154B – Health and Wellness, Yoga and Sports

Course Category:	Basic Science	**Credits:**	0.5
Course Type:	L(Activity Based Course)	**Lecture - Tutorial - Practice:**	0 - 0- 1
Prerequisites:		**Continuous Evaluation:** **Max Activities:6** **Viva** **Total Marks:**	6x15=90 10 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the importance of yoga and sports for Physical fitness and sound health													
	CO2	Demonstrate an understanding of health-related fitness components													
	CO3	Compare and contrast various activities that help enhance their health													
	CO4	Assess current personal fitness levels													
	CO5	Develop Positive Personality													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
	CO1															
	CO2															
	CO3															
	CO4															
	CO5															
Course Content	**UNIT- I** Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups. Activities: 1. Organizing health awareness programmes in community 2. Preparation of health profile 3. Preparation of chart for balance diet for all age groups **UNIT- II** Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.														

	Activities: Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar **UNIT- III** Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games. Activities: 1. Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc. 2. Practicing general and specific warm up, aerobics 3. Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running
Text books and Reference books	**Reference Books:** [R1] Gordon Edlin, Eric Golanty. Health and Wellness, 14th Ed., Jones & Bartlett Learning, 2022 [R2] T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice [R3] Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993 [R4] Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Any where Third Edition, William Morrow Paperbacks, 2014 [R5] The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014
E-resources and other digital material	

23MC1106 – Induction Program

Course Category:	Mandatory	**Credits:**	
Course Type:		**Lecture - Tutorial - Practice:**	
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	

First Year
(II Semester)

23BS2101– Differential Equations & Vector Calculus

Course Category:	Basic Science	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	23BS1101LinearAlgebra & Calculus	**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 first order linear differential equations													
	CO2	Solve higher order linear differential equations with constant coefficients													
	CO3	Solve Partial differential equations													
	CO4	Evaluate the work done against field, circulation and flux using vector calculus													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3	2			1										
	CO2	3	2			1										
	CO3	3	2			1										
	CO4	3	2			1										
Course Content	**UNIT- I** **Differential Equations of First Order and First Degree ;** Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form, Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits **UNIT- II** **Linear differential equations of higher order (Constant Coefficients):** Definitions, ,homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters, Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion. **UNIT- III** **Partial Differential Equations:** Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method, Homogeneous Linear Partial differential equations with constant coefficients														

	UNIT- IV **Vector Calculus:** Scalar and vector point functions, vector operator Del, Del applies to scalar point functions- Gradient, Directional derivative, del applied to vector point functions-Divergence and Curl, vector identities. Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems.
Text books and Reference books	**Text Book:** [T1] B.S.Grewal, "Higher Engineering Mathematics", 44th Ed., Khanna Publishers, 2019 **Reference Books:** [R1] Erwin Kreyzig, "Advanced Engineering Mathematics", 10th Ed., John Wiley & Sons, 2015. [R2] Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 14th Ed., 2018. [R3] Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Ed., 2021 (9th reprint). [R4] Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 5th Ed., 2018 [R5] Advanced Engineering Mathematics, Micheael Greenberg, Pearson publishers, 9th Ed., [R6] Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications,2014, 3rd Ed., (Reprint 2021)
E-resources and other digital material	1. Prof. Srinivas Rao Manam, IIT Madras,Differential equations for engineers[English], Available: https://onlinecourses.nptel.ac.in/noc22_ma72/preview 2. Prof. Jitendra Kumar , IIT Kharagpur, Engineering Mathematics – I[English], Available:https://onlinecourses.nptel.ac.in/noc20_ma37/preview 3. Prof. Jitendra Kumar , IIT Kharagpur, Engineering Mathematics – II[English], Available: https://onlinecourses.nptel.ac.in/noc22_ma08/preview 4. Prof. Jitendra Kumar & Prof. Somesh Kumar, IIT Kharagpur, Advanced Calculus For Engineers [English], Available: https://onlinecourses.nptel.ac.in/noc22_ma75/preview 5. Prof. Denis Auroux, Massachusetts Institute of Technology: MIT Open Courseware, Multivariable Calculus, Available: https://ocw.mit.edu.

23BS2102 – Engineering Physics

Course Category:	Basic Science	**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	Elaborate different types of lasers, optical fibers and their applications													
	CO2	Familiarize with the basics of crystals and their structures													
	CO3	Summarize various types of polarization of dielectrics and classify the magnetic materials													
	CO4	Explain the basic concepts of Quantum Mechanics and types of semiconductors using Hall Effect													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3	1													
	CO2	3	2													
	CO3	3														
	CO4	3														

Course Content

UNIT- I

Lasers and Fiber Optics

Lasers: Introduction, Characteristics of laser, Basic Principles of lasers (absorption, spontaneous emission and stimulated emission), Requirements of lasers (pumping, population inversion and cavity resonance), Einstein's coefficients, different types of lasers: solid-state lasers (Ruby), gas lasers, (He-Ne), Semiconductor laser, applications of lasers in science, engineering and medicine

Fibre Optics: Introduction, Fundamentals of optic fibre, Propagation of light through optical fiber, Types of optical fibers, Numerical aperture, Fractional Refractive Index change, Fiber optics in communication and its advantages

UNIT- II

Crystallography and X-ray diffraction

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination

	by Laue's and powder methods. **UNIT- III** **Dielectric and Magnetic Materials** **Dielectric Materials**: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - Frequency dependence of polarization – complex dielectric constant (Qualitative) – dielectric loss (Qualitative). **Magnetic Materials**: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, Para and Ferro magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials **UNIT- IV** **Quantum Mechanics and Semiconductors** **Quantum Mechanics:** Dual nature of light, Matter waves,Properties and Debroglie's hypothesis, G.P.Thomson experiment,Heisenberg's Uncertainty Principle and its applications (Non existence of electron in nucleus) and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well. **Semiconductors:** Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors- Fermi level-Extrinsic semiconductors-Fermi level - Drift and diffusion currents – Einstein's equation – Hall effect and its applications, Photodiode,Light Emitting Diode,Solar cell and its applications
Text books and Reference books	**Text Book:** [T1] M. N. Avadhanulu, P.G.Kshirsagar & TVS Arun Murthy, "A Text book of Engineering Physics", 11th Ed., S. Chand Publications, 2019. [T2] D.K.Bhattacharya and Poonam Tandon, "Engineering Physics", 11th Ed., Oxford press (2015) S. Chand Publications. **Reference Books:** [R1] B.K. Pandey and S. Chaturvedi, "Engineering Physics", Cengage Learning 2021. [R2] Shatendra Sharma, Jyotsna Sharma, "Engineering Physics", Pearson Education, 2018. [R3] Sanjay D. Jain, D. Sahasrabudhe and Girish, "Engineering Physics", University Press. 2010 [R4] M.R. Srinivasan, "Engineering Physics", New Age international publishers (2009).

E-resources and other digital material	1. https://www.loc.gov/rr/scitech/selected-internet/physics.html

23ES2103A – Basic Civil and Mechanical Engineering

Course Category:	Engineering Science	**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	Understand various Civil Engineering sub-divisions thereby appreciate their role in ensuring a better society and understand the basic building components along with attaining knowledge of Civil Engineering Materials and prefabricated technology
	CO2	Know the basic concepts, uses and classification of surveying and realize the importance of Transportation in the nation's economy and the engineering measures related to Transportation and understand the importance of Water Storage and Conveyance Structures so that the social responsibilities of water conservation will be appreciated
	CO3	Understand the scope of Mechanical Engineering in different sectors and industries and know about different manufacturing processes
	CO4	Explain the basics of thermal engineering, Power plants , power transmission and robotics

Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2				1	3	2								
	CO2	1				2	2	3								
	CO3	2				1	2	3								
	CO4	2				1	2	3								

Course Content	**UNIT- I** **Basics of Civil Engineering**: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel- Introduction to Prefabricated Construction Techniques **UNIT- II** **Surveying and Transportation Engineering**: Objectives of Surveying- Principles of Surveying-Classification based on function and instruments, Importance of Transportation in Nation's Economic Development- Basics components of Road-Classification of Highways. **Water Resources and Environmental Engineering**: Introduction, Sources of water- Quality of water- Specifications- Simple introduction to Dams and Reservoirs **UNIT- III** **Introduction to Mechanical Engineering**: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors. Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials. Manufacturing Processes: Principles of Casting, joining processes, **Machining**, Introduction to CNC machines, 3D printing, and Smart manufacturing **UNIT- IV** Thermal Engineering: –IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Otto cycle,Diesel cycle,Components of Electric and Hybrid Vehicles., Refrigeration and air conditioning Working principle of Boilers: classification of Boilers Power plants – Working principle of Steam, Nuclear power plants. Mechanical Power Transmission - Belt and Gear Drives, Introduction to Robotics

Text books and Reference books	**Text Book:** [T1] M.S.Palanisamy, "Basic Civil Engineering", 4th Ed., Tata Mcgraw Hill publications (India) Pvt. Ltd. [T2] S.S. Bhavikatti, "Introduction to Civil Engineering", 1st Ed., New Age International Publishers. 2022. [T3] Satheesh Gopi, "Basic Civil Engineering",1st Ed., Pearson Publications, 2009 [T4] V.Ganesan, "Internal Combustion Engines", Tata McGraw Hill publications (India) Pvt. Ltd. [T5] S.S. Rattan, "A text book of Theory of Machines", Tata McGraw Hill Publications, (India) Pvt. Ltd. [T6] Jonathan Wicker and Kemper Lewis, "An introduction to Mechanical Engg", Cengage learning India Pvt. Ltd. **Reference Books:** [R1] S.K. Duggal, "Surveying", Vol- I and Vol-II, 5th Ed., Tata McGraw Hill Publishers 2019. [R2] Santosh Kumar Garg, "Hydrology and Water Resources Engineering", Khanna Publishers, Delhi. 2016 [R3] Santosh Kumar Garg, "Irrigation Engineering and Hydraulic Structures", 38th Ed., Khanna Publishers, Delhi 2023. [R4] S.K.Khanna, C.E.G. Justo and Veeraraghavan, "Highway Engineering", 10th Ed., Nemchand and Brothers Publications 2019 [R6] Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012 [R7] S. Sathish , "Advances in Civil Engineering (Volume - 5)", AkiNik Publications,2021 [R8] G. Shanmugam and M.S.Palanisamy, "Basic Civil and the Mechanical Engineering", Tata McGraw Hill publications (India) Pvt. Ltd. [R9] Mahesh M Rathore, 'Thermal Engineering", Tata McGraw Hill publications (India) Pvt. Ltd. [R10] L. Jyothish Kumar, Pulak M Pandey, "3D printing & Additive Manufacturing Technology", Springer publications [R11] Appuu Kuttan KK, "Robotics", I.K. International Publishing House Pvt. Ltd. Volume-I
E-resources and other digital material	1. http://nptel.iitm.ac.in/video.php?subjectId=10810607 2. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm 3. http://www.mike-willis.com/Tutorial/PF2.htm 4. https://www.scribd.com/document/680441639/Basic-Civil-and-Mechanical-Engineering 5. https://www.imeche.org/careers-education/careers-information/what-is-mechanical-engineering/where-do-mechanical-engineers-work

23PC2104C – Network Analysis

Course Category:	Professional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	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	Analyse the electrical circuit using network simplification theorems													
	CO2	Find Transient response of a network													
	CO3	Find Steady state response and Resonance of a network													
	CO4	Compute the parameters of a two-port network													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3														
	CO2	3	2													
	CO3	3	2													
	CO4	3	1													

Course Content

UNIT- I

Types of circuit components, Types of Sources and Source Transformations, Mesh analysis and Nodal analysis, problem solving with resistances only including dependent sources also. Principal of Duality with examples.

Network Theorems: Thevenin's, Norton's, Milliman's, Reciprocity, Compensation, Substitution, Superposition, Max Power Transfer, Tellegens - problem solving using dependent sources also.

UNIT- II

Transients: First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, evaluating initial conditions procedure, second order differential equations, homogeneous, non-homogenous, problem-solving using R-L-C elements with DC excitation and AC excitation, Response as related to s-plane rotation of roots

UNIT- III

Steady State Analysis of A.C Circuits: Impedance concept, phase angle, series R-L, R-C, R-L- C circuits problem solving. Complex impedance and phasor notation for R-L, R-C, R-L-C problem solving using mesh and nodal analysis, Star-Delta conversion, problem

	solving using Laplace transforms also. **Resonance:** Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, general case-resistance present in both branches, anti-resonance at all frequencies **UNIT- IV** Two-port Networks: Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h- parameters, Relationships Between parameter Sets, Parallel & series connection of two port networks, cascading of two port networks, problem solving using dependent sources also
Text books and Reference books	**Text Book:** [T1] ME Van Valkenburg, "Network Analysis", 3rd Ed., Prentice Hall of India, 2019. [T2] William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin, "Engineering Circuit Analysis", 9th Ed., 2020. [T3] John. D. Ryder, "Network lines and Fields", 2nd Ed.,PHI **Reference Books:** [R1] D. Roy Choudhury, "Networks and Systems", New Age International Publications, 2013. [R2] Joseph Edminister and Mahmood Nahvi, "Electric Circuits", 7th Ed., Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, 2017 [R3] Charles K. Alexander and Matthew N. O. Sadiku,, "Fundamentals of Electric Circuits", McGraw-Hill Education.
E-resources and other digital material	1. http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT-%20kharagpur/basic%20electrical% 2. https://onlinecourses.nptel.ac.in/noc23_ee54/preview 3. https://nptel.ac.in/courses/108105159

23HS2105 – Communicative English

Course Category:	Basic Science	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 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	Understand the context, topic, and pieces of specific information from social or Transactional dialogues													
	CO2	Apply grammatical structures to formulate sentences and correct word forms													
	CO3	Analyze discourse markers to speak clearly on a specific topic in informal discussions													
	CO4	Evaluate reading texts / listening to write summaries based on global comprehension and create a coherent paragraph, essay and résumé													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
	CO1	2									3		2			
	CO2	2	2								3		2			
	CO3	2									3		2			
	CO4	2	2								3		2			

Course Content

UNIT- I

Lesson: HUMAN VALUES: Gift of Magi (Short Story)

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

Grammar: Parts of Speech, Basic Sentence Structures-forming questions

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT- II

Lesson: NATURE: The Brook by Alfred Tennyson (Poem)

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structure

	talks. Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together. Writing: Structure of a paragraph - Paragraph writing (specific topics) Grammar: Cohesive devices - linkers, use of articles and zero article; prepositions. Vocabulary: Homonyms, Homophones, Homographs **UNIT- III** **Lesson: BIOGRAPHY: Elon Musk** Listening: Listening for global comprehension and summarizing what is listened to. Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed Reading: Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Writing: Summarizing, Note-making, paraphrasing, Essay Writing, (The Power of Intrapersonal Communication) Grammar: Verbs - tenses; subject-verb agreement; Compound words, Collocations Vocabulary: Compound words, Collocations **UNIT – IV** **Lesson: INSPIRATION: The Toys of Peace by Saki** Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video. Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data. Writing: Letter Writing: Official Letters, Resumes & Report Writing Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice Vocabulary: Words often confused, Jargons & Technical Jargons

Text books and Reference books	**Text Book:** [T1] Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1,2 & 3) [T2] Empowering with Language by Cengage Publications, 2023 (Units 4 & 5) [T3] English: Language, Context and Culture, 1st Edition, Orient Black Swan, 2023 (Units5) **Reference Books:** [R1] Dubey, Sham Ji & Co. "English for Engineers", Vikas Publishers, 2020 [R2] Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014. [R3] Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019. [R4] Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.
E-resources and other digital material	**Grammar**: 1. www.bbc.co.uk/learningenglish 2. https://dictionary.cambridge.org/grammar/british-grammar/ 3. www.eslpod.com/index.html 4. https://www.learngrammar.net/ 5. https://english4today.com/english-grammar-online-with-quizzes/ 6. https://www.talkenglish.com/grammar/grammar.aspx **Vocabulary** 1. https://www.youtube.com/c/DailyVideoVocabulary/videos 2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA.

23BS2151 – Engineering Physics Lab

Course Category:	Basic Science	**Credits:**	1
Course Type:	Laboratory	**Lecture - Tutorial - Practice:**	0 - 0- 2
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	Test optical components using principles of interference and diffraction of light													
	CO2	Use spectrometer, travelling microscope and function generator in various experiments													
	CO3	Determine the V-I characteristics of photo cells and appreciate the accuracy in measurements													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1				3											
	CO2				3											
	CO3	2			3											
Course Content	1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings. 2. Study the variation of B versus H by magnetizing the magnetic material (B-H curve). 3. Determination of wavelength of Laser light using diffraction grating. 4. Estimation of stopping potential and work function of a photo material using photoelectric effect. 5. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method. 6. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect. 7. Determination of Acceleration due to Gravity and radius of Gyration by using a compound pendulum. 8. Sonometer: Verification of laws of stretched string. 9. Determination of Dielectric constant of different solid materials 10. Determination of Numerical Aperture of a given optical fiber														

	11. Determination of Frequency of electrically maintained tuning fork by Melde's experiment. 12. Determination of Rigidity Modulus of the material of the given wire using Torsional pendulum. 13. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration. 14. Determination of Energy Gap of a semiconductor using p-n junction diode. 15. Determination of thickness of a thin foil by Wedge Method. 16. Estimation of Fill Factor of a given Solar Cell. 17. Study the frequency response and determination of resonating frequency of LCR Circuit. 18. Determination of Figure of merit of a Galvanometer. Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.
Text books and Reference books	**Text Book:** [T1] Madhusudhan Rao, "Engineering Physics Lab Manual", 1st Ed., Scitech Publications, 2015 [T2] Ramarao Sri, Choudary Nityanand and Prasad Daruka, "Lab Manual of Engineering Physics"., 5th Ed., Excell Books, 2010
E-resources and other digital material	1. http://plato.stanford.edu/entries/physics-experiment 2. http://www.physicsclassroom.com/The-Laboratory 3. http://facstaff.cbu.edu/~jvarrian/physlabs.html 4. http://vlab.amrita.edu/?sub=1&brch=201&sim=366&cnt=1 5. http://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1 6. http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1

23PC2152C – Network Analysis & Simulation Lab

Course Category:	Professional Core	**Credits:**	1.5
Course Type:	Laboratory	**Lecture - Tutorial - Practice:**	0 - 0- 3
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	Verify Kirchoff's laws and network theorems													
	CO2	Measure time constants of RL & RC circuits													
	CO3	Analyze behavior of RLC circuit for different cases													
	CO4	Design resonant circuit for given specifications													
	CO5	Characterize and model the network in terms of all network parameters													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3				3				3						
	CO2	3	2			3				3						
	CO3	3	2			3				3						
	CO4	3	1			3				3						
	CO5	3				3				3						
Course Content	The following experiments need to be performed using both Hardware and simulation Software. 1 Study of components of a circuit and Verification of KCL and KVL. 2. Verification of mesh and nodal analysis for AC circuits 3.Verification of Superposition, Thevenin's & Norton theorems for AC circuits 4.Verification of maximum power transfer theorem for AC circuits 5. Verification of Tellegen's theorem for two networks of the same topology. 6. Study of DC transients in RL, RC and RLC circuits 7. To study frequency response of various 1st order RL & RC networks 8. To study the transient and steady state response of a 2nd order circuit by varying its various parameters and studying their effects on responses 9. Find the Q Factor and Bandwidth of a Series and Parallel Resonance circuit. 10. Determination of open circuit (Z) and short circuit (Y) parameters 11. Determination of hybrid (H) and transmission (ABCD) parameters 12. To measure two port parameters of a twin-T network and study its frequency response														

Text books and Reference books	**Text Book:** [T1] ME Van Valkenburg, "Network Analysis", 3rd Ed., Prentice Hall of India, 2019. [T2] William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin, "Engineering Circuit Analysis", 9th Ed., 2020. [T3] John. D. Ryder, "Network lines and Fields", 2nd Ed., PHI **Reference Books:** [R1] D. Roy Choudhury, Networks and Systems, New Age International Publications, 2013. [R2] Joseph Edminister and Mahmood Nahvi, Electric Circuits, Schaum's Outline Series, 7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017 [R3] Fundamentals of Electric Circuits by Charles K. Alexander and Matthew N. O. Sadiku, McGraw-Hill Education.
E-resources and other digital material	1. https://asnm-iitkgp.vlabs.ac.in/List%20of%20experiments.html

23HS2153 – Communicative English Lab

Course Category:	Basic Science	**Credits:**	1
Course Type:	Laboratory	**Lecture - Tutorial - Practice:**	0 - 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	Understand the different aspects of the English language proficiency with emphasis on LSRW skills													
	CO2	Apply communication skills through various language learning activities													
	CO3	Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension													
	CO4	Evaluate and exhibit professionalism in participating in debates and group discussions													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		2								3		2			
	CO2										3		2			
	CO3										3		2			
	CO4										3		2			
Course Content	**List of Topics** 1. Vowels and Consonants 2. Neutralizaton/Accent Rules 3. Communication Skills & JAM 4. Role Play or Conversational Practice 5. E-mail Writing 6. Resume Writing, Cover Letter, SOP 7. Group Discussions-methods & practice 8. Debates – Methods & Practice 9. PPT Presentations/Poster Presentations 10. Interview Skills SUGGESTED SOFTWARE: 1. WALDEN 2. SOFTX 3. VISIONET														

Text books and Reference books	**Text Book:**
E-resources and other digital material	

23ES2154 – Engineering Workshop

Course Category:	Engineering Science	**Credits:**	1.5
Course Type:	Laboratory	**Lecture - Tutorial - Practice:**	0 - 0- 3
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	Understand the basic joints using wood and familiarize with various fundamental aspects of house wiring, fitting and foundry													
	CO2	Prepare basic models using sheet metal and practice joining of metals using various types of welding													
	CO3	Familiarize with various advanced manufacturing processes such as injection moulding and 3D printing													
	CO4	Understand the preparation of PCB and simple IOT applications using Arduino													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			2		3										
	CO2			2		3										
	CO3			2		3										
	CO4			2		1										
Course Content	**PART-A** 1. Demonstration: Safety practices and precautions to be observed in workshop. 2. Wood Working: Familiarity with different types of woods and tools used in wood working and make following joints. a) Half – Lap joint b) Bridle joint c) Demonstration of power tools. (2 classes) 3. Sheet Metal Working: Familiarity with different types of tools used in sheet metal working, developments of following sheet metal job from GI sheets. a) Tapered tray b) Conical funnel (2 classes) 4. Fitting: Familiarity with different types of tools used in fitting and do the following fitting exercises. a) V-fit b) Semi-circular fit c) Bicycle tire puncture and change of two-wheeler tyre (2 classes) 5. Electrical Wiring: Familiarity with different types of basic electrical circuits and make the following connections. a) Parallel and series b) Two-way switch c) Godown lighting d) Tube light (1 class) 6. Foundry Trade: Demonstration and practice on Moulding tools and processes, Preparation of Green Sandmoulds for given Patterns. (1 class)														

	7. Welding Shop: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint. (1 class) 8. Advanced manufacturing processes: Demonstration of injection moulding and 3 D printing processes.(1 class) 9. Electronic Circuits: Demonstration of preparation of simple electronic circuit (PCB) and testing its operation. (1 class) 10. Basic IOT: Demonstration of different components & pin configuration of Arduino board a) Measure Temperature & Humidity b) Measure Distance (1 class) **PART-B** **GROUP ACTIVITY (2 classes)** • Students must prepare a Working model / Assembly using the knowledge gained from the above trades.
Text books and Reference books	**Text Book:** [T1] Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. [T2] Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015. [T3] A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, DhanpathRai& Co., 2015 & 2017 **Reference Books:** [R1] Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, 14th Ed., Media Promoters and Publishers, Mumbai. 2007. [R2] Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004. [R3] Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; AtulPrakashan, 2021-22
E-resources and other digital material	1. https://dsceme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17- 1.pdf 2. https://www.protosystech.com/rapid-prototyping.htm 3. https://www.arduino.cc/en/Tutorial/Foundations 4. https://www.tutorialspoint.com/arduino/

23ES2155 – IT Workshop

Course Category:	Engineering Science	**Credits:**	1
Course Type:	Laboratory	**Lecture - Tutorial - Practice:**	0 - 0- 2
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	Perform Hardware troubleshooting.													
	CO2	Understand Hardware components and inter dependencies.													
	CO3	Safeguard computer systems from viruses/worms													
	CO4	Document/ Presentation preparation.													
	CO5	Perform calculations using spreadsheets.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2															
	CO3															
	CO4															
	CO5															
Course Content	**PC Hardware & Software Installation** **Task** 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor. **Task 2:** Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content. **Task 3:** Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva. **Task 4**: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva														

	Task 5: Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva **Internet & World Wide Web** **Task1:** Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN**.** **Task 2**: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured. **Task 3:** Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student. **Task 4:** Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms. **LaTeX and WORD** **Task 1** – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word **Task 2:** Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word. **Task 3:** Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes. **Task 4:** Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word **EXCEL** **Excel Orientation**: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources

	Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text **Task 2:** Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function. **LOOKUP/VLOOKUP** **Task 3**: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting **POWER POINT** **Task 1:** Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint **Task 2:** Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts **Task 3**: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides **AI TOOLS – ChatGPT** **Task 1:** Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them. • Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?" **Task 2:** Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas • Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality." **Task 3**: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are. • Ex:Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Text books and Reference books	**Reference Books:** [R1] Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003. [R2] The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech,2013, 3rd edition [R3] Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition. [R4] PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft) [R5] LaTeX Companion, Leslie Lamport, PHI/Pearson [R6] IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition [R7] IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition
E-resources and other digital material	

23BS2156 – NSS/NCC/Community Service

Course Category:	Basic Science	**Credits:**	0.5
Course Type:	Lab (Activity Based Course)	**Lecture - Tutorial - Practice:**	0 - 0- 1
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	Understand the importance of discipline, character and service motto.													
	CO2	Solve some societal issues by applying acquired knowledge, facts, and techniques.													
	CO3	Explore human relationships by analyzing social problems.													
	CO4	Determine to extend their help for the fellow beings and downtrodden people.													
	CO5	Develop leadership skills and civic responsibilities.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2															
	CO3															
	CO4															
Course Content	**UNIT- I** **Orientation** General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance. Activities: i) Conducting – ice breaking sessions - expectations from the course-knowing personal talents and skills ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc. iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc. iv) Conducting talent show in singing patriotic songs-paintings- any other contribution. **UNIT- II** **Nature & Care Activities:** i) Best out of waste competition.														

	ii) Poster and signs making competition to spread environmental awareness. iii) Recycling and environmental pollution article writing competition. iv) Organising Zero-waste day. v) Digital Environmental awareness activity via various social media platforms. vi) Virtual demonstration of different eco-friendly approaches for sustainable living. vii) Write a summary on any book related to environmental issues **UNIT- III** **Community Service Activities:** i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities- experts-etc. ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS, iii) Conducting consumer Awareness. Explaining various legal provisions etc. iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education. v) Any other programmes in collaboration with local charities, NGOs etc.
Text books and Reference books	**Reference Books:** [R1] Nirmalya Kumar Sinha & Surajit Majumder, A Text Book of National Service Scheme Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6) [R2] Red Book - National Cadet Corps – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi [R3] Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e 2008 [R4] Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e 2007 [R5] Ram Ahuja. Social Problems in India, Rawat Publications, New Delhi.
E-resources and other digital material	.

Second Year
(III Semester)

23BS3101C - Complex Analysis and Numerical Methods

Course Category:	Basic Science	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	23BS1101LinearAlgebra & Calculus 23BS2101DifferentialEquations& Vector Calculus	**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, non-analytic functions and evaluate complex integrals													
	CO2	Analyze Taylor, Laurent series and apply residue theorem for computing real definite integrals													
	CO3	Find solutions for algebraic, transcendental equations and estimate functions using polynomial interpolation													
	CO4	Solve initial value problems numerically													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
	CO1	3	2													
	CO2	3	2													
	CO3	3	2			2								L		
	CO4	3	2			2								L		

Course Content

UNIT- I

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

UNIT- II

Taylor's series, Laurent's series, Zeros and Singularities of an analytic function, Residue theorem, Calculation of Residues, Evaluation of real definite integrals:(i) Integration around the unit circle (ii) Integration around a small semi-circle, Bilinear transformation

UNIT- III

Numerical Methods & Interpolation: Solution of Algebraic and Transcendental Equations with Newton - Raphson method, Interpolation Introduction, Finite Differences-Forward, Backward and Central differences, Symbolic Relations, Newton’s interpolation formulae-forward and backward differences, Central difference interpolation formulae-Gauss’s, Stirling’s, Bessel’s formulae, Interpolation with unequal intervals - Lagrange’s and Newton’s divided difference formulae

	UNIT- IV **Numerical Differentiation:** First and second order derivatives using Newton's forward and backward difference formulae, Numerical integration with Trapezoidal rule and Simpsons 1/3 Rule, Numerical Solutions of Differential Equations-Taylor's series method, Euler's method, Modified Euler's method and Runge - Kutta method of 4th order.
Text books and Reference books	**Text Book:** [T1] B.S.Grewal, "Higher Engineering Mathematics", 44th Ed., Khanna Publishers, 2019 **Reference Books:** [R1] Erwin Kreyzig, "Advanced Engineering Mathematics", 10th Ed., John Wiley & Sons, 2015. [R2] R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5th Ed., Narosa Publishers, 2016. [R3] N.P.Bali, Manish Goyal, "A Textbook of Engineering Mathematics", 9th Ed., Lakshmi Publications (P) Limited, 2016. [R4] H. K. Das, Er. Rajnish Verma, "Higher Engineering Mathematics", 3rd Revised Ed., S.Chand & Co., 2014. [R5] S. S. Sastry, "Introductory Methods of Numerical Analysis", 5th Ed., PHI Learning, 2012.
E-resources and other digital material	1. Prof.Pranav Haridas, Kerala School of Mathematics, Complex Analysis, Available: https://onlinecourses.nptel.ac.in/noc21_ma39/preview 2. Prof. Ameeya Kumar Nayak, Sanjeev Kumar, IIT Roorkee, Numerical methods, Available: https://onlinecourses.nptel.ac.in/noc21_ma45/preview 3. Jeremy Orloff, Massachusetts Institute of Technology: MIT Open Courseware, Complex Variables with Applications, Available: https://ocw.mit.edu. 4. Henrik Schmidt, Massachusetts Institute of Technology: MIT Open Courseware, Introduction to Numerical Analysis for Engineering, Available: https://ocw.mit.edu.

23HS3102 – Universal Human Values – Understanding Harmony

Course Category:	Humanities and Social Sciences	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 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	Understand and aware of themselves and their surroundings (family, society and nature).													
	CO2	Handle problems with sustainable solutions, while keeping human relationships and human nature in mind													
	CO3	Exhibit critical ability and become sensitive to their commitment towards their understanding of human values, human relationship and human society													
	CO4	Apply what they have learnt to their own self in different day-to-day settings in real life													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
	CO1						1			1						
	CO2			3												
	CO3						2									
	CO4								3				2			
Course Content	**UNIT- I** **Course Introduction, Need, Basic Guidelines, Content and Process for Value Education:** **Part-1**: Purpose and motivation for the course, recapitulation from UHV-I, Self-exploration: What is it? Its content and process, 'Natural acceptance' and experiential validation- As the process for self-exploration. Continuous happiness and prosperity – A look at basic human aspirations. **Part-2**: Right understanding, Relationship and physical facility – The basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding happiness and prosperity correctly – A critical appraisal of the current scenario, Method to fulfill the above human aspirations: Understanding and living in														

	harmony at various levels. (Practice sessions are to be included to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking). **UNIT- II** **Understanding Harmony in the Human Being – Harmony in Myself:** **Part-1**: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of self ('I') and 'body' – Happiness and physical facility, Understanding the body as an instrument of 'I' (I being the doer, seer and enjoyer). **Part-2**: Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the body: Sanyam and health; Correct appraisal of physical needs, Meaning of prosperity in detail, Programs to ensure sanyam and health. (Practice sessions are to be included to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease). **UNIT- III** **Understanding Harmony in the Family and Society – Harmony in Human-Human Relationship:** **Part-1:** Understanding values in human-human relationship; Meaning of justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and respect as the foundational values of relationship, Understanding the meaning of trust; Difference between intention and competence, Understanding the meaning of respect, Difference between respect and differentiation; The other salient values in relationship. **Part-2**: Understanding the harmony in the society (society being an extension of family); Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive human goals, Visualizing a universal harmonious order in society–Undivided society, Universal order– From family to world family. (Practice sessions are to be included to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives). **UNIT- IV** **Part-1: Understanding Harmony in Nature & Existence – Whole existence as Coexistence:** Understanding the harmony in the nature, Interconnectedness and mutual fulfillment among the four orders of nature – Recyclability and self-regulation in nature, Understanding existence as co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence

	Part-2: Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, Definitiveness of ethical human conduct, Basis for humanistic education, Humanistic constitution and humanistic universal order, Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to universal human order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations. (Part-1: Practice sessions are to be included to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology, etc. Part-2: Practice exercises and case studies are to be taken up in practice (tutorial) sessions eg. to discuss the conduct as an engineer or scientist, etc.).
Text books and Reference books	**Text Book:** [T1] R. R. Gaur, R. Sangal and G. P. Bagaria, "Human Values and Professional Ethics", Excel Books Private Limited, New Delhi (2010). **Reference Books:** [R1] A. Nagaraj, Jeevan Vidya Prakashan, Amarkantak, "Raman Jeevan Vidya: Ek Parichaya (1999). [R2] A. N. Tripathi, "Human Values", New Age International Publishers, New Delhi (2004). [R3] Annie Leonard, "The Story of Stuff: The Impact of Overconsumption on the Planet, our Communities, and our Health and how we can make it better",Free Press, New York (2010). [R4] Mohandas Karamchand Gandhi, "The Story of my Experiments with Truth: Mahatma Gandhi Autobiography", B. N. Publishing (2008). [R5] E. F. Schumacher, "Small is Beautiful: A Study of Economics as if People Mattered", Vintage Books, London (1993). [R6] Cecile Andrews, "Slow is Beautiful: New Visions of Community", New Society Publishers, Canada (2006). [R7] J. C. Kumarappa, "Economy of Permanence", Sarva-Seva-Sangh Prakashan Varanasi (2017). [R8] Angreji Raj, Pandit Sunderlal, Prabhath Prakashan, "Bharat Mein"Delhi (2018). [R9] Dharampal, "Rediscovering India Society for Integrated Development of Himilayas" (2003).

	[R10] M. K. Gandhi, "Hind Swaraj or Indian Home Rule",Navajivan Publishing House, Ahmedabad (1909) [R11] Maulana Abul Kalam Azad, "India Wins Freedom: The Complete Version",Orient Blackswan (1988). [R12] Romain Rolland, "The Life of Vivekananda and the Universal gospel",Advaitha Ashrama, India (2010). [R13] Romain Rolland, "Mahatma Gandhi: The Man who become one with the Universal Being", Srishti Publishers &Distributors, New Delhi (2002).
E-resources and other digital material	1. AICTE – SIP Youtube Channel https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ 2. AICTE – UHV Teaching Learning Material https://fdp-si.aicte-india.org/download.php#1

23ES3103F – Analog Electronic Circuits

Course Category:	Engineering Science	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0- 0
Prerequisites:	Basic Electronics, 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 stability biasing techniques in BJT and FET													
	CO2	Analyze amplifier circuits at low frequencies													
	CO3	Design different oscillator circuits													
	CO4	Analyze various power amplifier circuits with respect to efficiency													
	CO5	Develop analog electronic circuits using modern tools													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1		3												2	
	CO2	3													2	
	CO3			2											2	
	CO4		2												2	
	CO5					2										2

Course Content

UNIT- I

Transistor & FET Biasing: Introduction**,** Operating point, Biasing circuits - Fixed bias, Collector to base bias, Self bias; Stability factors, Bias compensation circuits - Diode compensation for V_{BE} and I_{CO}, Thermistor and Sensistor compensation; Thermal runaway and thermal stability, JFET biasing circuits - Fixed bias, Voltage divider bias.

UNIT- II

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- III

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.

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", 12th ed, TMH, 1991. [2] G.K.Mithal, "Electronic Devices and circuits", 23rd ed, Khanna Publishers 2010. **Reference books** [1]A.P.Godse and U.A.Bakshi "Electronic Circuit Analysis", 1st ed, fourth reprint, Technical Publications,2010. [2] Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 6th ed, PHI 2000.
E-resources and other digital material	1. http://nptel.iitm.ac.in/courses.php?branch=Ece

23EI3304 – Digital Circuits and Systems

Course Category:	Professional Core	**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	Analyze digital electronic circuits using analytical tools													
	CO2	Design digital electronic circuits with and without memory elements													
	CO3	Select suitable memories and logic families for digital system design													
	CO4	Use the spice software to design the digital electronic circuits													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		3												1	
	CO2		3												2	
	CO3	2													1	
	CO4					2										2

Course Content

UNIT- I

Digital Fundamentals: 1's and 2's complements, Minterms and Maxterms, Canonical forms, Standard forms, Simplification of Boolean functions using algebraic techniques Karnaugh map minimization and Quine-McCluskey method of minimization.

UNIT- II

Combinational Logic Design: Parallel adder, Carry Look-ahead adder, Half - Subtractor, Full - Subtractor, BCD to 7 segment decoder, Design of a Binary to G++ray 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, Encoders, Priority encoder.

UNIT- III

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 a flip-flop, Flip-Flop conversions

	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. **UNIT- IV** **Memory Devices**: Functional block diagram and operation - ROM, PROM, EPROM, EEPROM, Flash memory, RAM: Static and dynamic RAM, ROM as a PLD, PAL and PLA Programming. **Digital Integrated Circuits**: Characteristics of Digital ICs, Logic Families: MOS and CMOS logic families
Text books and Reference books	**Text Book:** [T1] R P Jain "Modern Digital Electronics", 4th Ed., TMH **Reference Books:** [R1] M. Morris Mano, "Digital Logic and Computer Design", PHI,2003 [R2] A. Anand Kumar, "Fundamentals of Digital Circuits", PHI, 2006
E-resources and other digital material	

23EI3305 – Sensors and Transducers

Course Category:	Professional Core	**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	Analyze various performance characteristics of instrument and the quality of measurement.													
	CO2	Identify the type of transducer based on transduction principles													
	CO3	Select a relevant transducer for measurement of various physical parameters													
	CO4	Apply the concepts of signal conditioning circuit for various transducers													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		2											1		
	CO2	2												1		
	CO3		3											2		
	CO4	2														1
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. **Variable Resistance Transducers**: Principle of operation, Construction details, Characteristics and applications of Resistance potentiometers, Strain gauge, Resistance thermometer, Thermistors, Hot-wire anemometer, Resistive hygrometer and Signal conditioning of resistive transducers														

	UNIT- III **Reactance Transducers** **Variable Inductance Transducers**: Principle of operation, Construction, Characteristics and applications of LVDT - RVDT, Variable reluctance accelerometer, Signal conditioning of inductive transducers **Capacitive Transducers** – Principle of operation, Construction, Characteristics and applications of Variable air gap, Variable distance, Variable permittivity capacitive transducer, Frequency response, Signal conditioning of capacitive transducers **UNIT- IV** **Special Sensors:** Introduction, Smart sensors, Micro Sensors, IR radiation Sensors, Ultrasonic Sensors, Fiber optic sensors, Colour sensor, Proximity sensors, Chemical sensor, IC sensor, Bio Sensors.
Text books and Reference books	**Text Book:** [T1] A.K.Sawhney & Puneet Sawhney,"A Course In Electrical And Electronic Measurements And Instrumentation", 19th Ed., Dhanapat Rai & Co., 2015 [T2] D.V.S.Murty, "Transducers & Instrumentation", 2nd Ed., PHI, 2013 **Reference Books:** [R1]A.K.Ghosh, "Introduction to Measurements & Instrumentation",3rd Ed., PHI, 2009 [R2] Raman Pallas & John G.Webster, "Sensors & Signal Conditioning", 2nd Ed., J. Wiley,2012
E-resources and other digital material	1. https://nptel.ac.in/courses/108/108/108108147

23TP3106 – Logic and Reasoning

Course Category:	Soft Skills-1	**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	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 for companies and in other competitive exams													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1						2									
	CO2		2													
	CO3								2							
	CO4									2						
	CO5	2														
	CO6	1														
Course Content	**UNIT- I** 1. Series Completion 2. Coding-Decoding 3. Blood Relation Blood 4. Puzzles test 5. Direction sense test **UNIT- II** 1. Logical Venn diagrams														

	2. Number test, Ranking test 3. Mathematical operations 4. Arithmetical Reasoning 5. Syllogism **UNIT- III** 1. Binary Logic 2. Inserting missing character 3. Data sufficiency 4. Analogy 5. Classification **UNIT- IV** 1. Water images, 2. Mirror images, 3. Paper folding, 4. Paper cutting, 5. Embedded Figures, 6. Dot situation, 7. Cubes & Dice
Text books and Reference books	**Text Book:** [T1] S. Aggarwal, "Verbal and Non-Verbal reasoning", S Chand Publication, 2017
E-resources and other digital material	1. https://www.indiabix.com/ 2. https://treeknox.com/ 3. https://www.examveda.com/

23MC3107 – Environmental Science

Course Category:	Audit Course	**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	Identify various factors causing degradation of natural resource and control measures													
	CO2	Identify various ecosystem and need for biodiversity													
	CO3	Realize and explore the problems related to environmental pollution and its management													
	CO4	Apply the information and technology to analyse social issues, use acts associated with environment													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	1							1							
	CO2		1	1							1					
	CO3				1	1										
	CO4						1	1	1							

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.

) **Water Resources**: Use and over-utilization of surface and ground water, Floods, Drought, Conflicts over water, Dams-benefits and problems.

) **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.

- **Energy Resources:** Growing energy needs, Renewable and non-renewable energy sources, Use of alternate energy sources.
- **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:** 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. **Self-Study**: Water resources, Threats to biodiversity, Solid waste management, Role of information technology in environment and human health
Text books and Reference books	**Text Book:** [T1] "Grants Commission", New Delhi, Bharati Vidyapeeth Institute of Environment Education and Research **Reference Books:** [R1]AnjaneyuluY. "Introduction to Environmental Sciences", B S Publications PVT Ltd, Hyderabad [R2].Anjireddy.M "Environmental Science & Technology", BS Publications PVT Ltd, Hyderabad. [R3]Benny Joseph, "Environmental Studies", The Tata McGraw- Hill publishing company limited, New Delhi, 2005. [R4]. P.VenuGopalaRao, "Principles of Environmental Science. &Engineering", Prentice-Hall of India Pvt. Ltd., New Delhi, 2006. [R5]Santosh Kumar Garg, RajeswariGarg, "Ecological and Environmental Studies", Khanna Publishers, New Delhi 2006. [R6] Kurian Joseph & R Nagendran, "Essentials of Environmental Studies",Pearson Education publishers, 2005. [R7] A.K Dee, "Environmental Chemistry",New Age India Publications. [R8] BharuchaErach, "Biodiversity of India", Mapin Publishing Pvt.Ltd
E-resources and other digital material	

23EI3651 – Numerical Computing using MATLAB

Course Category:	Skill Enhancement	**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	Develop a program using MATLAB													
	CO2	Develop a solution using MATLAB for linear algebra													
	CO3	Develop a solution using MATLAB for curve fitting and interpolation													
	CO4	Develop a solution using MATLAB for differential equations													
Contribution of Course Outcomes towards achievement of Program Outcomes		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	PS O3
	CO1			3		3									3	
	CO2			3		3									3	
	CO3			3		3									3	
	CO4			3		3									3	
Course Content	**Week 1:** Introduction to MATLAB **Week 2:** Error estimation and methods of roots finding **Week 3:** Order of convergence of various methods **Week 4:** Solving System of Linear Algebraic equations **Week 5:** Continuing...Solving System of Linear Algebraic equations **Week 6:** Curve fitting and Interpolation **Week 7:** Continuing... Curve fitting and Interpolation **Week 8:** Continuing... Curve fitting and Interpolation **Week 9:** Numerical differentiation **Week 10:** Numerical Integration **Week 11:** Numerical solution to ordinary differential equations (ODE's) **Week 12:** Continuing with numerical solution to ODE's														
Text books and Reference books	**Text Book** [1] Gerald & Wheatley, “Applied Numerical Analysis”, Pearson- 7th Edition, 2003. [2] R.S. Gupta “Elements of Numerical Analysis”, second edition, Cambridge university press, 2015 **Reference books** [1] Mathew & Fink, “Numerical Methods Using MATLAB”, Pearson, 1998. [2] Rudra Pratap, “Getting started with MATLAB: A quick introduction for scientist & engineers”, Oxford, 2010.														
E-resources and other digital material	https://in.mathworks.com/														

23ES3152 – Electronic Circuits Lab

Course Category:	Engineering Science	**Credits:**	1
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 2
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	Design various analog electronic circuits													
	CO2	Analyze the outputs and intercept the data generated by electronic circuits, such as waveforms and characteristics of devices.													
	CO3	Conduct experiments as an individual or team using discrete components and using spice software such as NI Multisim													
	CO4	Prepare an effective report based on experiments.													
Contribution of Course Outcomes towards **achievement of Program Outcomes**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1				3										3	
	CO2				3										3	
	CO3					3				1		1				3
	CO4										1					
Course Content	**List of Experiments** **A. Hardware 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 unbiased clampers. 5. Design of clippers. 6. Characteristics of Uni Junction Transistor. 7. Characteristics of SCR Characteristics. 8. Frequency response of CE amplifier. 9. Frequency response of CS Amplifier. 10. Design of Hartley Oscillator. 11. Design of Wein Bridge oscillator. 12. CRO Operation and its Measurements														

23EI3353 – Digital System Design Lab

Course Category:	Professional 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	Construct scalar and wide combinatorial circuits using HDL and FPGA													
	CO2	Construct the sequential circuits using HDL and FPGA													
	CO3	Analyze outputs and interpret the data for a given problem													
	CO4	Conduct experiments as an individual or team by using modern tools													
	CO5	Prepare an effective report based on experiments.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1			3		2										
	CO2			3		2										
	CO3				3											
	CO4									3			2			
	CO5										3					

Course Content

List of Experiments

1. Modeling Concepts- Write models to read switches and push buttons, and output on LEDs and 7-segment displays
2. Numbering Systems Create a 4-bit ripple carry adder using dataflow modeling.
3. Multi-Output Circuits-Design and implement a popular IC, 74138, functionality using dataflow modeling and the decoder.
4. Design an 8-to-3 priority encoder.
5. Design a 2-bit comparator that compares two 2-bit numbers.
6. Implement 2-bit by 2-bit multiplier using a ROM. Output the product in binary on four LEDs.
7. Tasks, Functions, and Testbench- Develop tasks for modeling a combinational circuit, develop functions for modeling a combinatorial circuit, develop a test bench to test and validate a design under test.
8. Modeling Latches and Flip-Flops.
9. Modeling Registers- Model a 4-bit register with synchronous reset, set, and loadsignals. Assign Clk, D input, reset, set, load, and output Q. Verify the design in hardware.
10. Modeling Counters
11. Behavioral Modeling and Timing Constraints- Use various language constructs using behavioral modeling, Communicate timing expectations through timing constraints.
12. Architectural Wizard and IP Catalog- Use the Architectural Wizard to configure clocking resource, Use the IP Catalog tool to configure and use counters and

	memories. 13. Counters, Timers, and Real-Time Clock- Generate several kinds of counters, timers, and real-time clocks. 14. Finite State Machines- Model Mealy FSMs, Model Moore FSMs. 15. Sequential System Design using Algorithmic State Machine (ASM) Charts.
Text books and Reference books	**Text Book** [T1] M. Rafiquzzaman, Steven A. McNinch, "Digital Logic: With an Introduction to Verilog and FPGA-Based Design", 1st Ed., Wiley, 2019. [T2] Cem Unsalan, Bora Tar, "Digital System Design with FPGA: Implementation Using Verilog and VHDL", 1st Ed., McGraw Hill Professional, 2017. [T3] Frank Bruno, "FPGA Programming for Beginners: Bring your ideas to life by creating hardware designs and electronic circuits with SystemVerilog", Packt Publishing Ltd., 2021
E-resources and other digital material	1.https://www.xilinx.com/ 2.https://digilent.com/reference/learn/programmable-logic/tutorials/start

23EI3354 – Transducers Lab

Course Category:	Professional Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
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	Use transducers for measurement of various parameters													
	CO2	Analyze the characteristics of various transducers													
	CO3	Conduct experiments as an individual or team.													
	CO4	Write an effective report based on experiments.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3				1								3		
	CO2				3									2		
	CO3									1			1	2		
	CO4										2					
Course Content	**List of Experiments** 1. Characteristics of Resistance Temperature Detector (RTD) 2. Temperature measurement using Thermocouple 3. Characteristics of Light Dependent Resistor (LDR) and phototransistor 4. Measurement of magnetic flux density using Hall effect transducer 5. Speed measurement using magnetic pick-up and photoelectric pick-up 6. Flow measurement using Ultrasonic flow transmitter 7. Calibration of pressure gauges using dead weight tester. 8. Displacement measurement using Linear Variable Differential Transformer (LVDT) 9. Pressure measurement using strain gauge 10. Interfacing a Passive Infrared (PIR) sensor with Arduino for motion detection 11. Interfacing an inductive proximity sensor with Arduino for object detection 12. Interfacing a soil moisture sensor with Arduino Note: Any 10 of the experiments in the above list, need to be completed by the student for him/her to be eligible to write University Practical Examinations														

Text books and Reference books	[T1] A.K.Ghosh, "Introduction to Measurements & Instrumentation", 3rd Ed., PHI, 2009. [T2] A.K.Sawhney & Puneet Sawhney, "A Course in Mechanical Measurements & Instrumentation", 7th Ed., Dhanapat Rai & Co., 2012
E-resources and other digital material	https://create.arduino.cc/ https://www.allaboutcircuits.com/

Second Year
(IV Semester)

23HS4101 – Engineering Economics and Management

Course Category:	Humanities and Social Sciences	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 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	Understand various forms of organizations and principles of management.													
	CO2	Understand the various aspects of business economics.													
	CO3	Perceive the knowledge on Human resources and Marketing functions.													
	CO4	Evaluate various alternatives economically.													
Contribution of Course Outcomes towards the achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
	CO1	2														
	CO2	2				3										
	CO3	2														
	CO4	2				3										
Course Content	**UNIT- I** **Forms of Business Organization:** Salient features of sole proprietorship, Partnership, Joint stock company, Co-operative society and public sector. **Management:** Introduction to management, Functions of management, Principles of scientific management, Modern principles of management. **UNIT – II** **Introduction to Economics:** Introduction to basic economic concepts, Utility analysis: Marginal utility and total utility, Law of diminishing marginal utility, Law of equi marginal utility. **Demand Analysis:** Theory of demand: Demand function, Factors influencing demand, Demand schedule and demand curve, Shift in demand, Elasticity of demand: Elastic and inelastic demand, Types of elasticity. **Supply Analysis:** Supply schedule and supply curve, Factors influencing supply, Supply function.														

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

23ES4102C – Linear Integrated Circuits and Applications

Course Category:	Engineering Science	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Electronic Devices and 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	Understand the characteristics of 741IC.													
	CO2	Apply the concepts of 741IC to implement various linear and non-linear applications.													
	CO3	Design different IC circuits using 741,555 and 723 ICs.													
	CO4	Illustrate the operation of Special purpose ICs and their applications.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2													2	
	CO2	3													2	
	CO3		3												3	
	CO4	2													2	

Course Content

UNIT- I

Operational Amplifier: Integrated circuits - Package types and temperature ranges, Power supplies; Block diagram representation of Op amp, Ideal Op amp, Ideal and practical Op-amp specifications, 741 Op-amp features and specifications, Op-amp characteristics - DC and AC Characteristics of an Op Amp - Frequency Response, Slew Rate.

Linear applications of Op-Amp - Inverting amplifier, Non-inverting amplifier, Voltage follower, Differential amplifier, Summing amplifier, Instrumentation amplifier, Integrator, Voltage to current converter and current to voltage converter.

UNIT- II

Non-linear applications of Op-Amp: Precision diode, Applications - Precision full wave rectifier, Clippers and Peak Detector; Sample and hold circuit.

Comparators and Waveform Generators: Basic comparator, Applications – Zero crossing detector, Window detector, Voltage limiters; Schmitt trigger, Waveform generators - Square wave generator, Triangular wave generator.

UNIT- III

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

	notch filters. **Analog to Digital and Digital to Analog Converters:**Introduction, Basic DAC techniques - Weighted resistor DAC, R-2R ladder D/A converter; A/D conversion - Parallel comparator type ADC, Successive approximation ADC and Dual slope ADC;DAC and ADC specifications **UNIT- IV** **Special Purpose ICs and Applications:** 555 Timer - 555 as Monostable and Astable operation, Applications, Schmitt trigger;IC 566 Voltage controlled oscillator; Phase locked loops - Operating principle,565 Monolithic PLL, 565 PLL Applications.
Text books and Reference books	**Text Book:** [T1] D. Roy Choudhry and Shail B. Jain, "Linear Integrated Circuits"- (4/e), New Age International Pvt. Ltd, 2011. [T2] Rama Kant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th Ed,PHI, 2012. **Reference Books:** [R1] S. Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", TMH, 2016. [R2] R. F. Coughlin & F. F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 6thEd,PHI, 2012. [R3] Jacob, "Applications and Design with Analog Integrated Circuits", 2nd Ed., PHI 1996 [R4] Sanjay Sharma, "Op-Amps and Linear Integrated circuits",1st Ed, Katson educational series,2008. [R5] S.Salivahanan & V.S. KanchanaBhaskaran, Linear Integrated Circuits, TMH, 2nd edition, 2015.
E-resources and other digital material	1. www.analog.com 2. https://nptel.ac.in/courses/108106068/ 3. https://www.allaboutcircuits.com/ 4. https://www.linkwitzlab.com/filters.htm

23EI4303 – Control Systems

Course Category:	Professional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Laplace transforms and integral calculus, 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	Define and explain the concepts of control systems.												
	CO2	Model the transfer functions of physical systems using block diagram and signal flow graph approaches												
	CO3	Analyze the responses and stability of control systems using time and frequency domain approaches												
	CO4	Analyze the stability of the given control system using modern tools.												
Contribution of Course Outcomes towards achievement of Program Outcomes		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 3
	CO1													2	
	CO2	2												2	
	CO3		3												2
	CO4		2			2									2

Course Content

UNIT- I

Introduction: Control system terminology, Examples of simple control systems – Open loop and closed loop control systems, Effect of feedback on overall gain, Stability, Sensitivity and external noise.

Mathematical Models of Physical Systems: Formulation of differential equations for electrical, mechanical and electromechanical systems, Poles, Zeros, Characteristic equation, 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-undamped, under damped, critically damped and over damped systems, Time domain specifications, Expressions for time domain specifications, Steady state error and static and dynamic error constants, Proportional, Integral and derivative control actions

UNIT – III

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. **Root Locus Technique:** The root locus concept, Magnitude and angle conditions, Properties and construction of the root loci (For positive K only),Effect of adding poles and zeros to root locus **UNIT – IV** **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.
Text books and Reference books	**Text Book:** [T1] A.Anand Kumar, "Control Systems", 2nd Ed., PHI, 2014 [T2] I J Nagrath& M Gopal, "Control Systems Engineering", 5th Ed., New Age International, 2008 **Reference Books:** [R1] Katsuhiko Ogata, "Modern Control Engineering", 4th Ed., Pearson Education, 2003 [R2] A.NagoorKani, "Control Systems", 2nd Ed., RBA Publications, 2006
E-resources and other digital material	1 http://www.nptelvideos.com/control_systems/ 2 https://nptel.ac.in/courses/108101037/

23EI4304 – Industrial Instrumentation

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

Course outcomes	Upon successful completion of the course, the student will be able to:													
	CO1	Explain the basic concepts of industrial process variables												
	CO2	Apply the concepts of industrial process variables to solve the engineering problems												
	CO3	Identify suitable transducer for measurement of industrial process variables												
	CO4	Analyze the performance of various measurement techniques in industrial process variables												
Contribution of Course Outcomes towards achievement of Program Outcomes		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														
	CO2	3													
	CO3	3													
	CO4		2												

Course Content

UNIT- I

Temperature Measurement: Introduction, Classification of temperature sensors based on change in dimensions - Bimetals & Liquid-in-Glass thermometers; Change in electrical properties – RTD, Thermistor; Thermoelectricity – Thermocouples; IC sensors, Radiation pyrometers, Fiber-optic sensors, Quartz thermometer, Ultrasonic thermometer.

.

UNIT- II

Pressure Measurement: Introduction, pressure standards, Manometers; Force summing devices – Diaphragms, Bellows, Bourdon tubes; Secondary transducers – Resistive, Inductive, Capacitive, Piezoelectric and Hall Effect; 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 and Thermal mass flow meters; 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 level sensors; Electrical type - Resistive, inductive and Capacitive; Acoustic Level Sensors – Ultrasonic; Radiative methods - Gamma ray and Radar Level Sensors. **Humidity, Density & Viscosity Measurement:** Introduction, Hygrometers-Wet and dry bulb, Electrolytic, piezoelectric hygrometers; Moisture Analyzer-Neutron back scatter Moisture analyzer; Densitometers- Ultrasonic and gamma ray densitometers; Viscometers-Say bolt, Rotational and Float viscometers.
Text books and Reference books	**Text Book:** [T1] A.K.Ghosh, "Introduction to Measurements & Instrumentation", 3rd Ed., PHI, 2009. [T2] A.K.Sawhney & Puneet Sawhney,"A Course in Mechnanical Measuremnets & Instrumentation", 12th Ed., Dhanapat Rai & Co., 2012. **Reference Books:** [R1] Ernest O Doebelin/Dhanesh, N Manik, "Measurement systems", 6th Ed., Tata Mc Grawhill. [R2] 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

23EI4305 – Electrical and Electronic Measurements

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

Course outcomes	Upon successful completion of the course, the student will be able to:													
	CO1	Apply suitable Null or Deflection type technique to measure prescribed electrical parameter.												
	CO2	Select a suitable digital instrument to measure physical and electrical parameters.												
	CO3	Compare the operation of various oscilloscopes and probes.												
	CO4	Explain the principles of various signal generators and wave analyzers.												
Contribution of Course Outcomes towards achievement of Program Outcomes		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		2												
	CO4														
Course Content	**UNIT- I** **Electromechanical Indicating Instruments**: Suspension type galvanometer- Torque equation at steady state deflection, Dynamic behavior, Damping mechanisms; Permanent magnet moving coil mechanism – Torque equation, Taut-band suspension, Temperature compensation. **Electrical Measurements**: DC ammeters - Shunt resistor, Ayrton shunt, Multirange ammeters, The Ayrton shunt, DC voltmeters - Multiplier resistor, Multirange voltmeter, Ohms per volt rating, Loading effect, Series type ohmmeter, Shunt type ohmmeter, Calibration of dc instruments, Alternating current indicating instruments - Electrodynamometer, Thermo Instruments, Electrodynamometers in power measurements, Watt hour meter, Power factor meters. **UNIT- II** **Bridges:** Wheatstone bridge, Kelvin bridge, Maxwell bridge, Hay bridge, Schering bridge, Wien bridge, Wagner 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, Analog pH meter – pH measurement using hydrogen electrode. **UNIT- III** **Oscilloscopes:** Block diagram of oscilloscope, Cathode Ray Tube, Vertical amplifier, Horizontal deflecting system, Typical CRT connections, Delay line in triggered sweep, Dual beam CRO, Dual trace oscilloscope (basic block diagram), Sampling oscilloscope, Digital 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, Harmonic distortion analyzers, Spectrum analyzer. **Frequency Counters And Time-Interval Measurements**: Digital frequency meter - Principle of operation, Basic circuit of a digital frequency meter, Digital measurement of time - Principle of operation, Time base selector, Period measurement
Text books and Reference books	**Text Book:** [T1] W D Cooper & A D Helfrick, "Electronic Instrumentation and Measurement Techniques", PHI, 1998 (Unit-I) [T2] H.S.Kalsi, "Electronic Instrumentation", 2ndEd., TMH. (Units-II, III and IV) **Reference Books:** [R1] A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation",Dhanpat Rai & Co [R2] Oliver & Cage, "Electronic Measurements and Instrumentation", Mc Graw Hill, 1975
E-resources and other digital material	1. https://www.youtube.com/watch?v=3eYmFjHnQjY&list=PLbRMhDVUMngcoKrA4sH-zvbNVSE6IpEio

23TP4106 – English for Professionals

Course Category:	Soft Skills-2	**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	Present themselves effectively in the professional world by shedding off their inhibitions about communicating in English													
	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 and respond positively by developing their analytical thinking													
	CO5	Learn about various expressions to be used in different situations													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1										3	3				
	CO2									3	3	3				
	CO3										3	3				
	CO4								2		3	3				
	CO5										3	3				
Course Content	**UNIT- I** 1. Beginners, Functional, Situational conversations 2. Practicing on functional conversations **UNIT- II** 1. Errors in usage of parts of speech with a thrust on verbs, adjectives and conjunctions, idioms/phrases. 2. Introducing basic grammar 3. Practicing on functional conversations **UNIT- 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 Books:** [T1] Swaroopa, Polineni, "Practicing on Situational Conversations - Strengthen Your Communication Skills", 1st Ed., Maruthi Publications, 2013. [T2] Mamta Bhatnagar & Nitin Bhatnagar, "Communicative English", 1st Ed., Pearson India, 2010.
E-resources and other digital material	

23EI4651 – Virtual Instrumentation Lab

Course Category:	Skill Enhancement	**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	Understand the graphical programming terminology and able to create a virtual instrument 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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3				3										
CO2				2	3										
CO3				2	3										
CO4				2	3										

Course Content

List of Experiments

1. Introduction to Virtual Instrumentation and LabVIEW
2. Programs on controls and indicators
3. Programs on arithmetic operations
4. Programs on Boolean operations
5. Programs on sub VI's
6. Programs on repetition and loop
7. Programs on arrays
8. Programs on matrices
9. Programs on clusters
10. Programs on data plotting
11. Programs on structures
12. Programs on formula nodes and math script nodes
13. Programs on strings, file I/O
14. Temperature acquisition using 3-wire RTD.
15. Programs on data logging
16. Programs using NI myDAQ.

	Note: Any 10 of the experiments in the above list need to be completed by the student, by choosing a minimum of 3 experiments from part- A and 7 from part-B for him/her to be eligible to write University Practical Examinations
Text books and Reference books	**Text Books:** [T1] Jovitha Jerome, "Virtual Instrumentation using LabVIEW", 1st Ed., PHI, 2013. **Reference Books:** [R1] Sanjay Gupta, Joseph John, "Virtual Instrumentation using LabVIEW", 1st Ed., TataMcGraw-Hill, 2005 [R2] Gary Johnson, Richard Jennings, "LabVIEW Graphical Programming", Tata McGraw-Hill, 2006
E-resources and other digital material	1. http://www.ni.com

23ES4152 – Design Thinking & Innovation

Course Category:	Humanities and Social Sciences	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	1 - 0- 2
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

23EI4353 – Linear Integrated Circuits Lab

Course Category:	Professional Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
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	Design linear applications of op-amp circuits,													
	CO2	Design non-linear applications of op-amp circuits,													
	CO3	Design applications of 555 timer and IC voltage regulators													
	CO4	Conduct the experiment as well as analyze the outputs for given specifications as an individual or a team.													
	CO5	Prepare an effective report based on experimental results.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PS O 1	PS O 2	PSO 3
	CO1				3										2	
	CO2				3										2	
	CO3				3											
	CO4				3					2		1			2	
	CO5										2				2	
Course Content	**List of Experiments** **<u>Analog ICs Experiments using discrete components</u>** 1. Basic applications of 741IC –Inverting amplifier, Non Inverting amplifier and summing amplifier. 2. Design of Instrumentation Amplifier using 741IC 3. Design of Integrator using 741IC 4. Precision Full wave rectifiers using Op-Amp 741IC 5. Basic applications of comparator using 741IC 6. Waveform generation using 741IC (square, triangular) 7. Design of Wein bridge Oscillator using 741IC 8. Design of First order Active Low pass and high pass filter using 741IC 9. Design of IC 555 Timer Astable circuit 10. Design of Schmitt trigger using IC 555 Timer 11. Design of a voltage Regulator using IC 723 12. D/A Converters using 741IC 4 bit R-2R ladder circuit.														
Note:	Any 10 of the experiments in the above list need to be completed by the student to be eligible to write University Practical Examinations.														

23EI4354 – Control Systems Lab

Course Category:	Professional Core	**Credits:**	1
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 2
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	Apply control system techniques/approaches to solve problems													
	CO2	Analyze the responses and stability of the given control system													
	CO3	Conduct the experiments as individual or team													
	CO4	Make an effective report based on experiments													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2				2										1
	CO2				3	2										2
	CO3									2			1			
	CO4										2					
Course Content	**List of Experiments** **Part-A** 1. Determination of transfer functions of first order systems. 2. Time response P, PI and PID controllers of second order systems. 3. Characteristics of synchro transmitter and receiver. 4. DC motor position control using PI controller 5. Characteristics of Magnetic Amplifier **Part-B** **1.** Using MATLAB/SIMULINK for control systems Part I: Introduction to MATLAB/SIMULINK/LabVIEW Part II: Polynomials in MATLAB Part III: Scripts, Functions & flow control in MATLAB **2.** Block diagram reduction techniques for determination of transfer function of a given system using MATLAB/LabVIEW. **3.** Simulation of standard test signals using MATLAB/LabVIEW **4.** Determination of step, impulse and ramp responses for first order unity feedback system using MATLAB/LabVIEW **5.** Determination of step, impulse and ramp responses for second order unity feedback system using MATLAB/LabVIEW **6.** Determination of step and impulse responses for a type ‘0’,type ‘1’ and type ‘2’ systems **7.** Root locus plot for a given transfer function using MATLAB/LabVIEW														

	8. Stability studies using Bode and Nyquist plots for a given transfer function using MATLAB/LabVIEW **Note**: Any 10 of the experiments in the above list need to be completed by the student, by choosing a minimum of 3 experiments from part- A and 7 from part-B for him/her to be eligible to write University Practical Examinations
Text books and Reference books	**Text Book:** [T1] A.Ananda Kumar, "Control Systems", PHI Learning, 2nd Ed. [T2] I.J.Nagrath & M.Gopal, "Control systems Engineering", New Age publisher, 5th Ed **Reference Books:** [R1] B.C.Kuo, "Automatic Control Systems", 7th Ed., PHI.
E-resources and other digital material	1. www.linearcontrolsystems.com 2. www.linearcontrols.net

23EI4355 – Measurements Lab

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

Course outcomes

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

CO1	Apply the basic measurement techniques to measure the parameters such as resistance, capacitance, inductance, etc
CO2	Analyze the outputs and integrate the data generated from the bridge measurements
CO3	Conduct the experiments as individual or team
CO4	Make an effective report based on experiments

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3														
CO2				3											
CO3									1	2					
CO4											1				

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. Simulation of CRO, Function generator using Analog discovery kit.
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. Simulation of Spectrum analyzer using Analog discovery kit.
9. Measurement of resistance, inductance and capacitance using a LCR meter.
10. Measurement of amplitude and frequency of different types of waveforms using function generator.
11. Measurement of amplitudes of different types of waveforms using 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

	Note: Any 10 of the experiments in the above list need to be completed by the student, by choosing a minimum of 3 experiments from part- A and 7 from part-B for him/her to be eligible to write University Practical Examinations
Text books and Reference books	
E-resources and other digital material	

Third Year
(V Semester)

23EI5301- Microcontrollers

Course Category:	Professional Core	**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 architecture of 8051 microcontroller.														
	CO2	Use the instruction set of 8051 to solve problems.														
	CO3	Select and use various interfacing peripherals along with microcontroller.														
	CO4	Select and use various digital and analog interfacing methods.														
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3														
	CO2	3														
	CO3		2													
	CO4	3														

Course Content

UNIT – I

Introduction: Introduction to microcontrollers, Comparison between microprocessors and microcontrollers The 8051 Architecture: 8051 Microcontroller hardware, Input/output pins, Ports & circuits, External memory, Counters and timers, Serial data input/ output, Interrupts.

UNIT – II

Instruction Set: Addressing modes of 8051, Data Transfer operations, Arithmetical operations, Logical operations, Jump and call op-codes, Simple Programs.

Microcontroller Design: A Microcontroller design, Testing the design, Timing Subroutines, Lookup tables for the 8051, Serial Data Transmission.

UNIT – III

System Design: Peripherals and Interfacing: Serial IO, USART Communication Interface 8251, ADC circuit interfacing, DAC interfacing, Stepper motor interfacing, LED, Array of LEDs, Keyboard-cum-Display controller 8279, Interfacing with external memory

	UNIT – IV **Systems Design: Digital and Analog Interfacing Methods:** Programmable DMA controller 8257, Programmable Interrupt Controller 8259, Interfacing to high power devices, Analog input interfacing, Analog output interfacing, Optical motor shaft encoders, Industrial control, Industrial process control.
Text books and Reference books	**Text Book:** [T1] Kennth J. Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", 3rd Ed., West Publishing Company. (Unit I & II). [T2] Raj Kamal, "Microcontrollers Architecture, Programming, Interfacing and System Design" Pearson Education. (Unit III & IV). **Reference Books:** [R1] Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay "The 8051 Microcontroller and Embedded Systems using assembly and C", 2nd Ed., Printice Hall.
E-resources and other digital material	1. http://nptel.iitg.ernet.in (Unit I, Unit II, Unit III, Unit IV)

23EI5302- Process Control

Course Category:	Professional Core	**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	Explain the concepts associated with process control
	CO2	Built mathematical models and model based control schemes for various physical systems
	CO3	Select suitable controller, mode, final control element and control schemes for a given application
	CO4	Analyze various control schemes and tuning methods
	CO5	Use simulation software to analyze the control system

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2	2														1
CO3			2												2
CO4		1													1
CO5					2										1

Course Content

UNIT – I

Introduction to Physical Processes and Dynamics: Need for process control, Hierarchy of process control activities, An overview of control system design, Degrees of freedom, Introduction to process control, Process control block diagram, Definition, Servo and regulatory operation

UNIT – II

Modeling and Control of Physical Systems: Need of mathematical modeling, Characteristics of physical systems, Mathematical modeling of liquid systems, Gas and thermal systems, Mathematical modeling of binary distillation column

	UNIT – III **Basic Controller Modes**: Introduction to feedback control, Basic control actions, Characteristic of on-off, proportional, Integral and derivative control modes **Controlling Elements**: Pneumatic controllers, Hydraulic controllers, Electrical controllers and electronic controllers **Controller Tuning:** PID controller design and tuning, Criteria for good control, Tuning methods - Ziegler-Nichols method of tuning, Cohen-Coon method of tuning. **UNIT – IV** **Advanced Control Strategies**: Cascade control, Feed forward control, Ratio control, Smith predictor control, and internal model control. **Control Valves**: Sliding stem control valves, Rotating shaft control valves, Control valve sizing**.**
Text books and Reference books	**Text Book:** [T1] Seborg, D E., Mellichamp, D.A. Edger, T.F., "Process Dynamics and Control", 2nd Ed., John Wiley, 2009 [T2] Donald P. Eckman, "Automatic Process Control", Wiley India Pvt. Ltd [T3] Donald R. Coughanowr, "Process Systems Analysis and Control", 2nd Ed., Mc Graw-Hill International Edition **Reference Books:** [R1] Stephanopoulos G, "Chemical Process Control", 3rd Ed., PHI, 1994 [R2] D Patranabis, "Principles of Process Control", 2nd Ed., TMH, 2007
E-resources and other digital material	1. www.freevideolectures.com /Course/3126/Process-Control-and-Instrumentation 2. www.nptel.ac.in/courses/103105064/

23EI5403A- Sensor Signal Conditioning

Course Category:	Professional 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	Develop the signal conditioning circuits for resistive sensors.													
	CO2	Select suitable signal conditioning circuits for reactance variation sensors.													
	CO3	Identify suitable signal conditioning circuits for self-generating sensors.													
	CO4	Illustrate the operation of resonant and semiconductor sensors with communication system.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3														3
	CO2		3													3
	CO3		2													2
	CO4		2											2		

Course Content

UNIT – I

Signal Conditioning for Resistive Sensors: Overview of resistive sensors, Measurement of resistance, Voltage dividers, Wheatstone bridge: Balance measurements, Deflection measurements, Differential and instrumentation amplifiers, Interference, Problems.

UNIT – II

Signal Conditioning for Reactance Variation Sensors: Overview of reactance variation sensors, Problems and alternatives, AC bridges, Carrier amplifiers and coherent detection, Specific signal conditioners for capacitive sensors, Resolver to Digital and Digital to resolver converters, Problems

UNIT – III

Signal Conditioning for Self-Generating Sensors: Overview of self-generating sensors, Chopper and low drift amplifiers, Electrometer and Transimpedance amplifiers, Charge amplifiers, Noise in amplifiers, Noise and drift in resistors, Problems.

UNIT – IV

Resonant Sensors and Other Sensing Methods: Sensors based on quartz resonators,

	SAW sensors, Vibrating wire strain gauges, Digital flowmeters, Sensors Based on Semiconductor Junctions, Sensors Based on MOSFET Transistors, Charge-Coupled and CMOS Image Sensors, Communication system for sensors
Text books and Reference books	**Text Book:** [T1] Roman Pallas Areny and John G Webster, "Sensor and Signal Conditioning", 2nd Ed., John Wiley & Sons, Inc. 2001 **Reference Books:** [R1] Fred Schraff, Steve Lekas, Mike Fraser, Paul Holland "Signal Conditioning and PC based Data Acquisition Handbook", 3rd Ed., Measurement Computing corporation, USA, 2012 [R2] Daniel H Sheingold "Transducers Interfacing Handbook", 1st Ed., Analog Devices, Inc., USA, 1980
E-resources and other digital material	1. https://nptel.ac.in/courses/108105064/22 2. https://nptel.ac.in/courses/112105232/27

23EI5403B- Robotics and Control

Course Category:	Professional Elective – I	**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	Understand the fundamental concepts and working principles of robot anatomy
	CO2	Describe the kinematics and inverse kinematics of manipulators
	CO3	Select various control strategies to manipulator design
	CO4	Identify the use of robots in industrial applications
	CO5	Select various types of sensors in the field of robotics

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1															
CO2	3														3
CO3		2													2
CO4	2														2
CO5	2														2

Course Content

UNIT – I

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

UNIT – II

Robot Kinematics: Coordinate Frames, Mapping and Transformations: Coordinate frames, Description of objects in space, 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, 3 DOF RPY wrist kinematics. 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** **Robot Sensors and Vision**: Sensors in robotics, kinds of sensors used in robotics, industrial applications of vision controlled robotic systems, process of imaging, architecture of robotic vision systems. **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.
Text books and Reference books	**Text Book:** [T1] R.K.Mittal &, I.J.Nagarath, "Robotics and Control", Tata McGraw Hill Pvt. Ltd, 15th Ed., 2010 [T2] S.R.Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Pvt. Ltd., 2002 **Reference Books:** [R1] R.D.Klafter, T.A.Chimielewski & M. Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall of India, New Delhi, 1994 [R2] P.J.McKerrow, "Introduction to Robotics", Addison Wesley, USA, 1991
E-resources and other digital material	1. http://nptel.ac.in/courses/112103174/4 2. http://nptel.ac.in/courses/112103174/3

23EI5403C- Industrial Electronics

Course Category:	Professional Elective – I	**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	Understand the principles and characteristics of different power electronic devices.													
	CO2	Analyze the operation of SCR converters, Inverters ,Choppers and Cyclo Converters.													
	CO3	Outline the operation of DC amplifiers and Regulated power supplies, UPS and SMPS for industrial applications.													
	CO4	Illustrate various industrial applications of SCR													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1														2	
	CO2		2												2	
	CO3		2												2	
	CO4	3													2	

Course Content

UNIT – I

Thyristors: SCR structure and operation, Characteristics of SCR: Static V-I characteristics, Switching characteristics and gate characteristics, SCR turn on methods, SCR commutation techniques

Modern Semi-Conductor Power Electronic Devices: DIAC, TRIAC, PUT, SUS, SBS, SCS & LASCR

UNIT – II

AC-DC Converters – Thyristor Converters: Introduction, Single phase converters: Half wave converters, Full wave converters, Bridge converters

DC-AC Converters – Thyristor Inverters: Introduction, Single phase inverters, MacMurray inverter, MacMurray Bedford inverter

UNIT – III

DC-DC Converters – Thyristor Choppers: Introduction, Principle of step-down chopper, Principle of step-up chopper, Chopper configurations

AC-AC Converters – Thyristor Cyclo Converters: Introduction, Single phase cyclo

	converters, Single phase centre tapped cyclo converters, Single phase bridge type cyclo converters **UNIT – IV** **Amplifiers and Regulated Power Supplies:** DC Amplifier, Differential amplifier as a DC amplifier, Regulated power supplies, Uninterrupted power supply (UPS), Switched Mode Power Supplies (SMPS) **Industrial Applications:** Industrial timing circuits, Electric welding methods and types, Induction and dielectric heating: Principle, Theory and applications, Ultrasonic generators and applications
Text books and Reference books	**Text Book:** [T1] G.K.Mithal and Dr.Maneesh Gupta, "Industrial and Power Electronics," 9th Ed., Khanna Publications, 2007 **Reference Books:** [R1] M.Ramamurthy, "Thyristors and their Applications", East-West Press, 2nd Ed., 1998 [R2] M.H.Rashid, Power Electronics Devices, Circuits and Application, Prentice Hall of India, 2003 [R2] P.S.Bimbra, "Power Electronics," 4th Ed., Khanna Publications,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

23EI5403D- VLSI Design

Course Category:	Professional Elective – I	**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	Understand VLSI fabrication processes and CMOS logic design													
	CO2	Analyze basic electrical properties of MOSFET													
	CO3	Apply the design rules of Mask layout for MOS, CMOS and BiCMOS circuits													
	CO4	Understand the basic circuit concepts, scaling of MOS circuits and subsystem design approach													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3													2	
	CO2		2												2	
	CO3		3												2	
	CO4	2													2	

Course Content

UNIT – I

Introduction to MOS Technology: Introduction to IC technology, The IC Era, MOS and related VLSI technology, Basic MOS transistors, Enhancement and Depletion modes of transistor action, NMOS fabrication, CMOS fabrication, BiCMOS technology

UNIT – II

Basic Electrical Properties of MOS and BICMOS Circuits: Drain-to-Source Current Ids versus Voltage (Vds) relationships, Aspects of MOS Transistor Threshold voltage (Vt), Transconductance (gm) and Output Conductance (gds), Figure of Merit (ωo), The Pass Transistor, NMOS inverter, Pull-up to Pull-down ratio for an 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 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, Layout Diagrams of CMOS inverter, NAND and NOR gates,

	Symbolic Diagrams - Translation to Mask Form **UNIT – IV** **Basic Circuit Concepts**: Sheet Resistance Rs, Sheet Resistance Concept Applied to MOS Transistors and Inverters, Area Capacitances of Layers, Standard Unit of Capacitance, The Delay Unit, Inverter Delays, Propagation Delays. **Scaling of MOS Circuits**: Scaling Models and Scaling Factors, Scaling Factors for Device Parameters. **Subsystem Design and Layout**: Architectural Issues, Switch Logic, Gate Logic, Examples of Structured Design (Combinational Logic) - A Parity Generator, Multiplexers (Data Selectors).
Text books and Reference books	**Text Book:** [T1] Douglas A. Pucknell, "Basic VLSI Systems and Circuits", Prentice Hall of India, 3rd Ed., Reprint 2008. [T2] Neil H. E. Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design", 3rd Ed., Pearson Education 2009. [T3] John F Wakerly, "Digital Design Principles & Practices", 3rd Ed., Pearson Education, 2002 **Reference Books:** [R1] Weste & Eshraghian, "Principles of CMOS VLSI Design", Addison-Wesley 1993. [R2] John P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley & Sons, Reprint 2009
E-resources and other digital material	

23EI5205- MOOCS for 12 weeks

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

23EI5205A- Essential Principles of Image Sensors

Course Category:	Open 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	Understand the characteristics of image sensors													
	CO2	Describe the general design and limitations of various image sensors													
	CO3	Analyze the effect of sampling on image quality													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		2													
	CO2	3														
	CO4		2													

Course Content

UNIT – I

Imaging and Role of Image Sensors: Factors Constructing Image Information, Image types, Functional Elements of Image Sensors, Circuit Components for image sensors.

Dynamic Range: Low-Light Imaging Limitations, Bright-Light Imaging Limitations, Signal-to-Noise Ratio, Dynamic Range Gaps, Optical limitations

UNIT – II

Hardware Methods to Extend Dynamic Range: Integrating Linear Pixels, Multilinear Pixels, Multiple Sampling, Multiple-Sensing Nodes, Logarithmic Photovoltaic Pixel, Time to Saturation, Gradient-Based Image

Software Methods to Extend Dynamic Range: General Structure of a Software Approach, High Dynamic Range Image Data Merging, Noise Removal, Tone Mapping

UNIT – III

CCD Sensors: Principle of CCD Sensors, Pixel Technology, Progress, Electronic Shutter

MOS Sensors: Principle of MOS Sensors, Pixel Technology, Progress, Electronic Shutter

CMOS sensors: Principle of CMOS Sensors, Pixel Technology, Progress, Electronic Shutter

UNIT – IV

Image Information Quality: Deteriorating Elements of Image Information Quality, Impacts of Digitization, Sampling in Space Domain, Sampling in Time Domain, Sampling

	in Wavelength Domain and Color Information, Technologies to Improve Image Information Quality
Text books and Reference books	**Text Book:** [T1] Takao Kuroda, "Essential Principles of Image Sensors", CRC Press, 2015. [T2] Arnaud Darmont, "High dynamic range imaging: sensors and architectures", 1st Ed., SPIE Press, 2013 **Reference Books:** [R1] Jun Ohta, "Smart CMOS Image Sensors and Applications", CRC Press,2008. [R2] Junichi Nakamura, "Image Sensors and Signal Processing for Digital Still Cameras", Taylor & Francis, 2006.
E-resources and other digital material	

23EI5205B- PC Based Instrumentation

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Identify the generalized and PC based Instrumentation system and Explain the principles of Data Acquisition													
	CO2	Elucidate the hardware organization of IBM PC													
	CO3	Design the plug-in data acquisition and control boards and explain the data acquisition using GPIB													
	CO4	Explain the data acquisition using serial interface and networked data acquisition													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3												1		
	CO2	3												2		
	CO3		2													2
	CO4		2											2		
Course Content	**UNIT – I** **Introduction:** Generalized instrumentation system - Measurement system, Control system. Features of personal computers - Expansion slots, Ports, Monitor, Storage devices, Software. PC-based instrumentation system - Data acquisition systems, PC interfaces, Software, Features **Principles of Data Acquisition:** Sampling Concepts-Sampling and reconstruction, Shannon sampling theorem, Aliasing, Oversampling, Interpolation, Data acquisition systems - Analog input, Analog output, Digital 1/0 , Timing I/O data acquisition configurations - Local data acquisition, GPIB data acquisition, Data acquisition using serial interfaces, Networked data acquisition **UNIT – II** **Hardware Organization of IBM PC: S**ystem resources - Interrupt request lines, DMA channels, I/0 space, Utilization of system resources. System and peripheral control chips- System control chips, Peripheral control chips. Expansion buses and I/O ports - Expansion buses, I/0 ports. Peripherals - Drives, Keyboard and Mouse, Monitors, Printers **UNIT – III**														

	Plug-In Data Acquisition and Control Boards: Plug-in boards- Digital I/0 board, Timing I/0 board. General purpose plug-in DAQ board, PIC plug-in DAQ board **Data Acquisition Using GPIB:** Overview or GPIB-GPIB System, GPIB implementation, GPIB pins and signals, GPIB handshake protocol, Service requests, GPIB capabilities; IEEE 488.2 - Commands and queries, Control sequences, Control protocol, Status reporting structure. SCPI - SCPF generalized instrument model, the SCPI command structure **UNIT – IV** **Data Acquisition using Serial Interfaces:** Microcontroller serial interfaces - UART interface, SPI Bus, Microwire. USB 500 - Features of USB, USB system, USB transfer, USB descriptors, USB microcontrollers. IEEE1349 - Features of 1349, IEEE1349 Signal transmission, IEEE1349 protocol transfer modes, Remote I/O modules **Networked Data Acquisition:** Network data communication- Analog transmission, Hybrid communication, Digital communication, Comparison of communication protocols. Local area networks - OSI model, LAN Characteristics, LAN types, TCP/IP, Network devices, Wireless LAN. Fieldbuses - MODBUS, PROFIBUS, 43 Device net and Control net, FOUNDATION Fieldbus, Industrial Ethernet, IEEE1394 for industrial Automation
Text books and Reference books	**Text Book:** [T1] "Pc-based Instrumentation" Concepts And Practice by N.Mathivanan, PHI Publication **Reference Books:** [R1] PC-based Instrumentation and Control" By. Mike Tooley [R2] Govindarajulu, IBM PC & Clones, TMH, 1996 [R3] Krishna Kant, Computer based Industrial Control, PHI
E-resources and other digital material	

23EI5205C- Transducers and Measurement Systems

Course Category:	Open 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	Identify the type of transducer based on transduction principles													
	CO2	Select a relevant transducer for measurement of various physical parameters													
	CO3	Select a suitable digital instrument to measure physical and electrical parameters													
	CO4	Compare the operation of various oscilloscopes and probes and principles of various signal generators and wave analyzers													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2															
	CO3															
	CO4															

Course Content

UNIT – I

Transducers: Classification of transducers, Characteristics of transducers**.**

Variable Resistance Transducers: Principle of operation, Construction details, Characteristics and applications of Resistance potentiometers, Strain gauge, Resistance thermometer, Thermistors, Hot-wire anemometer, Resistive hygrometer and Signal conditioning of resistive transducers

UNIT – II

Reactance Transducers

Variable Inductance Transducers: Principle of operation, Construction, Characteristics and applications of LVDT - RVDT, Variable reluctance accelerometer, Signal conditioning of inductive transducers

Capacitive Transducers – Principle of operation, Construction, Characteristics and applications of Variable air gap, Variable distance, Variable permittivity capacitive transducer, Frequency response, Signal conditioning of capacitive transducers

UNIT – III

Electromechanical Indicating Instruments: Suspension type galvanometer- Torque

	equation at steady state deflection, Dynamic behavior, Damping mechanisms; Permanent magnet moving coil mechanism – Torque equation, Taut- band suspension, Temperature compensation. **Electrical Measurements:** DC ammeters - Shunt resistor, Ayrton shunt, Multirange ammeters, The Ayrton shunt, DC voltmeters - Multiplier resistor, Multirange voltmeter, Ohms per volt rating, Loading effect, Series type ohmmeter, Shunt type ohmmeter, Calibration of dc instruments, Alternating current indicating instruments - Electrodynamometer, Thermo Instruments, Electrodynamometers in power measurements, Watt hour meter, Power factor meters**.** **Bridges:** Wheatstone bridge, Kelvin bridge, Maxwell bridge, Hay bridge, Schering bridge, Wien bridge, Wagner ground connection**.** **UNIT – IV** **Oscilloscopes:** Block diagram of oscilloscope, Cathode Ray Tube, Vertical amplifier, Horizontal deflecting system, Typical CRT connections, Delay line in triggered sweep, Dual beam CRO, Dual trace oscilloscope (basic block diagram), Sampling oscilloscope, Digital storage oscilloscope, Probes for CRO - Direct probes, Passive voltage probe, Active probes, Attenuators - Uncompensated attenuators, Simple compensated attenuator
Text books and Reference books	**Text Book:** [T1] A.K.Sawhney & Puneet Sawhney,"A Course In Electrical And Electronic Measurements And Instrumentation", 19th Ed., Dhanapat Rai & Co., 2015 [T2] W D Cooper & A D Helfrick, "Electronic Instrumentation and Measurement Techniques", PHI, 1998 [T3] H.S.Kalsi, "Electronic Instrumentation", 2nd Ed., TMH. **Reference Books:** [R1] A.K.Ghosh, "Introduction to Measurements & Instrumentation",3rd Ed., PHI, 2009 [R2] Oliver & Cage, "Electronic Measurements and Instrumentation", Mc Graw Hill, 1975
E-resources and other digital material	1. https://nptel.ac.in/courses/108/108/108108147 2. https://www.youtube.com/watch?v=3eYmFjHnQjY&list=PLbRMhDVUMngcoKrA4sH-zvbNVSE6IpEio

23EI5351 - Microcontrollers Lab

Course Category:	Professional Core	**Credits:**	1.5
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 0- 3
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 architecture of 8051 microcontroller														
	CO2	Use the instruction set of 8051 to solve problems														
	CO3	Select and use various interfacing peripherals along with microcontroller														
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3														
	CO2			3	3											
	CO3			3	3	3										

Course Content

List of Experiments

PART A

Programs on Data Transfer Instructions

Programs on Arithmetic and logical Instructions

Programs on subroutines

Programs on stack operations

Program on Serial data transmission

PART B

Interfacing of stepper motor Interfacing of DAC

Interfacing of LED Interfacing of LCD

Interfacing of Keyboard Interfacing of DC Motor

Interfacing of DAC for ADC & Temperature sensor

Interfacing of Elevator

Interfacing of traffic signals

Interfacing of logic controller

Any 10 experiments from the above list

Text books and Reference books

Text Book:

[T1] Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", 3rd, Ed., West Publishing Company.

[T2] Raj Kamal, "Microcontrollers Architecture, Programming, interfacing and system design" Pearson Education

Reference Books:

E-resources and other digital material	1. http://nptel.iitg.ernet.in.

23EI5352 - Process Control Lab

Course Category:	Professional Core	**Credits:**	1.5
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 0- 3
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	Demonstrate the characteristics of major components of process control loop														
	CO2	Analyze the performance of different control schemes in various process stations														
	CO3	Conduct experiments as individual or team on various process stations														
	CO4	Write an effective report based on experiments														
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3														
	CO2				3											
	CO3				3	1				1		1				
	CO4										2					
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 ON/OFF controller in level process station. 5. Characteristics of flow transmitter and control valve. 6. Characteristics of PI controller in flow process station. 7. Characteristics of pressure transmitter and I/P converter. 8. Comparison of P, PI & PID control modes in pressure process station. 9. Characteristics of cascade control. 10. Characteristics of ratio control. 11. Characteristics of feed forward control. 12. Study of pH control system. 13. Study of temperature control in heat exchanger. 14. Characteristics of PID controller in flow process station using LABVIEW. 15. Characteristics of PID controller in level process station using LABVIEW **Any 10 experiments from the above list**															

Text books and Reference books	**Text Book:** [T1] Process control lab manual. [T2] Donald P. Eckman, "Automatic Process Control', Wiley India Pvt. Ltd. [T3] Donald R. Coughanowr, "Process Systems Analysis and Control, 2nd Ed., McGraw-Hill international edition **Reference Books:**
E-resources and other digital material	1. www.freevideolectures.com /Course/3126/Process-Control-and-Instrumentation 2. www.nptel.ac.in/courses/103105064

23EI5653- Advanced Digital System Design with FPGA

Course Category:	Skill Enhancement course	**Credits:**	1
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 0- 2
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	Design, simulate and synthesize complex digital system													
	CO2	Analyze and fix the timing violations													
	CO3	Design ASIC based digital systems using industry standard EDA tools													
	CO4	Generate test patterns and perform fault simulation for digital logic and memory circuits.													
	CO4	Apply DFT techniques viz. scan based testing, BIST and boundary scan for improving testability using EDA tools													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2															
	CO3															
	CO4															
	CO5															
Course Content	**List of Experiments** 1. Design of Digital Architecture for given specification 2. Logical Synthesis of Digital Architecture 3. Netlist Optimization, GLS and Formal Verification 4. Physical Synthesis of Digital Architecture 5. Physical Verification of Digital Architecture 6. Fault Simulation and Test generation for combination circuits 7. Clock and reset rule check at RTL 8. Scan Chain Insertion, DRC and ATPG 9. At-Speed Patterns and On-Chip Clock Controllers (LoS and LoC) 10. Advanced fault modelling 11. SDF annotated simulation 12. Boundary scan test **13.** Testing of memories (BIST insertion, validation and BIST repair) **Any 10 experiments from the above list**														

Text books and Reference books	**Text Book:** [T1] Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen, VLSI Test Principles and Architectures, 2013, The Morgan Kaufmann. [T2] M. Bushnell, Vishwani Agrawal - Essentials of Electronic Testing for Digital, Memory, and Mixed-Signal VLSI Circuits, 2006, Springer **Reference Books:** [R1] Laung-Terng Wang, Charles E. Stroud, Nur A. Touba, "System-on-chip Test Architectures: Nanometer Design for Testability", 2008, Morgan Kaufmann Publishers
E-resources and other digital material	

23EI5554 - EPICS

Course Category:	Internship/Project Work	**Credits:**	2
Course Type:	Internship/Project Work	**Lecture - Tutorial - Practice:**	0 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

23TP 5106- Personality Development

Course Category:	Soft Skills-3	**Credits:**	1
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0- 2
Prerequisites:	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing	**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	Recall the fundamentals of developing a positive attitude using verbal and nonverbal communication													
	CO2	Understand how to listen, reflect, and speak while communicating with others using Management skills, team building and leadership qualities													
	CO3	Apply language skills and etiquettes in professional and social contexts with clarity and accuracy													
	CO4	Analyze ideas with coherence, cohesion and precision in formal communication through group discussion & Interviews													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2									3		2			
	CO2	2								2	3		2			
	CO3	2									3		2			
	CO4	2									3		2			

Course Content

1**) Positive Attitude**

Benefits of positive attitude – Cultivation of positive attitude – Building resilience – Self Confidence – Inspiring others.

2) **Communication**

Verbal Communication – Non – verbal Communication.

3**) Management Skills**

Anger Management – Stress Management – Time Management.

4) Team Building & Leadership

Team Building traits: Forming – Storming – Norming – Performing – Adjourning Leadership traits: Vision – Integrity – Decisiveness – Confidence – Empathy – Resilience – Flexibility –Innovation.

	5) Etiquettes Social Etiquette – Business Etiquette – Telephone Etiquette – Dining Etiquette – Conclusion. **6) Mastering Note-Making & Note-Taking** Note - Making: Linear Method – Zettelkasten Method – Digital Gardening – Mind Mapping Tips Note - Taking: Cornell Note Taking Method. **7) Pre-Placement Tests** Synonyms – Antonyms – One-word Substitutes – Correction of Sentences – Vocabulary Analogies – spotting Errors – Sentence Correction. **8) Corporate Grooming** Personal attire – Personal Hygiene – Professional Conduct – Personal Branding – Networking Skills – Workplace Diversity. **9) Group Discussions** Communication Skills – Subject Knowledge – Listening Power – Attitude – Confidence – Leadership Skills – Ways of Presentation – views – Interaction Skills – Decision making ability – Problem solving ability –Critical Thinking ability – Analytical Thinking – Open-mindedness. **10) Interview Skills** Preparation – Professionalism – Communication – Body Language – Problem Solving skills Motivational Enthusiasm – Closing the interview
Text books and Reference books	**Text Book:** [T1] Personality Development Lab Manual **Reference Books:** [R1] Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011. [R2] S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010. [R3] R. S. Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand & Company Ltd., 2018. [R4] Raman, Meenakshi & Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011
E-resources and other digital material	1. www.Udemy.com 2. www.skillshare.com 3. www.coursera.com

23MC5107 - Humanities Elective

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

Third Year
(VI Semester)

23EI6301- Embedded Systems

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

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Understand the basic concepts of an embedded system and its design														
	CO2	Describe the architectural features and instructions of 32-bit microcontroller ARM Cortex M4														
	CO3	Apply the knowledge gained for Programming ARM Cortex M4 for different applications														
	CO4	Apply the real time operating systems concepts in designing applications on ARM Cortex M4														
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3													3	
	CO2	3													3	
	CO3		3												2	
	CO4		3												2	

Course Content

UNIT – I

Introduction to Embedded Systems: 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

ARM Cortex - M Processors: ARM Cortex-M processors, Advantages of the Cortex-M processors, Applications of the ARM Cortex-M processors, Software development flow, Compiling applications, Software flow, The Cortex microcontroller software interface standard (CMSIS), Cortex M4 Processor architecture and block diagram, Features of the cortex M processors

UNIT – III

ARM Programmer's model: Memory system, Exceptions and interrupts, Understanding the assembly language syntax, Instruction set, Cortex M4-specific instructions, Barrel

	shifter, Overview of memory system features, Memory map, Connecting the processor to memory and peripherals. **UNIT – IV** **Overview of Exceptions And Interrupts**: Interrupt management, Exception sequence, NVIC registers for interrupt control, SCB registers for exception and interrupt control, special registers for exception or interrupt masking. **Overview of OS Support Features**: Shadowed stack pointer, SVC exception, Context switching in action, Introduction to embedded OSs, Keil RTX Real-Time Kernel, CMSIS-OS examples, Troubleshooting.
Text books and Reference books	**Text Book:** [T1] Shibu.K.V, "Embedded Systems" 3rd Ed., Tata McGraw Hill Education Private Ltd. 2013 [T2] Joseph Yiu, "The Definitive Guide to Arm® Cortex®-M3 and Cortex®-M4 Processors", 3rd Ed., Newnes, Elsevier, 2024 [T3] Muhammad Ali Mazidi, Shujen Chen, Eshragh Ghaemi, "STM32 Arm Programming for Embedded Systems", 1st Ed., MicroDigitalEd, 2018. **Reference Books:** [R1] Joseph Yiu, "System-on-Chip Design with Cortex-M Processors", ARM Education Media, 2020
E-resources and other digital material	1. https://community.arm.com/arm-community-blogs/b/architectures-and-processors-blog 2. https://www.st.com/en/embedded-software/development-tool-software.html **3.** https://nptel.ac.in/courses/106105193 Embedded System Design with ARM, IIT Kharagpur

23EI6302- Digital Signal Processing

Course Category:	Professional Core	**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	Analyze the discrete signals and systems using Z- transform													
	CO2	Compute the Discrete Fourier Transform using 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		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		3												3	2
	CO2		3			2									3	2
	CO3			3		2									3	2
	CO4			3		2									3	2

Course Content

UNIT – I

Classification of signals and systems, Basic elements of digital signal processing system, Sampling of analog signals, Sampling theorem.

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

Fourier Representation of Finite Duration Sequences - The Discrete Fourier Transform (DFT), Properties of DFT, Linear convolution using DFT, Fast Fourier Transforms (FFT) - Radix-2 Decimation in time and Decimation in frequency FFT algorithms, Inverse FFT.

UNIT – III

Analog filter approximations- Butter worth and Chebyshev, Design of IIR digital filters from analog filters - Impulse invariance method, Bilinear transformation method, Design Examples, Basic Structures for IIR systems: Direct-Form structures, Cascade-Form structures and Parallel-Form structures

UNIT – IV

	Design of linear phase FIR filters using Windows, Design of Linear phase FIR filters by the Frequency Sampling method, Comparison of FIR and IIR filters, Basic structures for FIR systems: Direct-Form structures and Cascade-Form structures
Text books and Reference books	**Text Book:** [T1] V.Oppenheim and R.W.Schafer, "Digital Signal Processing" 2nd Ed., Pearson, 2004 [T2] J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", 4th Ed., Pearson, 2007 **Reference Books:** [R1] Sanjit K Mitra, "Digital Signal Processing A Computer Based Approach", 1st Ed., Tata McGraw Hill, 1998. [R2] Jhony R Jhonson, "Introduction to Digital Signal Processing", 1st Ed., Prentice Hall, 1989
E-resources and other digital material	1. http://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011. 2. nptel.ac.in/digital signal processing/

23EI6303- Industrial Automation

Course Category:	Professional Core	**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	Illustrate the overview of automation technologies used in industries
	CO2	Apply the concepts of PLC and DCS in automation
	CO3	Design ladder logic and function block diagrams for simple applications
	CO4	Illustrate the applications of automation technologies in various industries

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1		3													2
CO2	2														1
CO3			2												1
CO4	3														2

Course Content

UNIT – I

Overview of Programmable Logic Controllers (PLC): Definition, Parts of PLC, Principles of operation, PLC versus computer, PLC size and applications, PLC hardware, Discrete I/O modules, Analog I/O modules, Programming device, Program SCAN, Field I/O devices, Safety Circuitry.

UNIT – II

Programming of PLC: Basics of PLC programming - Programming languages, Relay type instruction, Branch instructions, Programming timers and counters, Program control instructions, Data manipulation instructions, Math instructions

UNIT – III

Overview Distributed Control Systems (DCS): Evolution, Resulting system architectures, Generalized distributed control system architecture, Functional components of DCS. Local Control Unit (LCU), Function blocks, Overview of security design approaches, Control output configurations, Operator displays

UNIT – IV

Applications of DCS: Application of DCS in thermal power plants, Iron and steel making process, Bio-technology plant control, Cement plants, Pulp and paper process control,

	Onshore oil and gas field automation, Offshore oil and gas field automation.
Text books and Reference books	**Text Book:** [T1] Frank D.Petruzella,"Programmable Logic Controllers", 2nd Ed, Glencoe McGraw Hill [T2] Michael P. Lucas, "Distributed Control Systems-Their Evaluation and Design", Van Nostrand Reinhold Company Inc.1986. [T3] Dobrivoje Popovic and Vijay P.Bhatkar, "Distributed Computer Control", CRC Taylor & Fransis group.1990 **Reference Books:** [R1] B R Mehtha, Y J Reddy, "Industrial Process Automation Systems", Butterworth Heinmann imprint of Elsevier, 2015
E-resources and other digital material	1. http://ee.sharif.edu/~industrialcontrol/LADDER_LOGIC_Tutorial.pdf **2.** https://www.elprocus.com/distributed-control-system-features-and-elements/

23EI6404A- Biomedical Instrumentation

Course Category:	Professional 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	Infer the physical foundations of biological systems and bioelectric potentials in medical field
	CO2	Elucidate the methods to monitor different electrical and non-electrical parameters in the human body and Biomaterials used in medicine
	CO3	Illustrate the concepts of medical assisting and therapeutic equipment for intensive and critical care
	CO4	Outline medical imaging techniques and equipment for certain diagnosis and therapies and applications of Biotelemetry in medical care

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3														
CO2	3													2	
CO3		3												2	
CO4	3													2	

Course Content

UNIT – I

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

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

Bio-electric Potentials: Resting potential concept, Characteristics of resting potential, Action potential concept, Propagation of action potential. Bio-electric potential, Electro physiology of nerve and nerve to muscle function, Transmission of impulse from nerve to muscle, Evoked potentials

UNIT – II

Bio-electric Potentials Acquisition and Measurement: Electrodes, ECG, EEG, EMG Lead systems and recording methods, Analysis of typical waveforms, Measurement of blood pressure, Blood flow, Cardiac output, Heart sounds

UNIT – III

	Instruments in Clinical Laboratory: Blood pH, pCO2 and pO2 measurement, Complete Blood gas analyzer, Blood cell counters. **Assisting and Therapeutic Instruments**: Pacemakers, Defibrillators, Ventilator, Anesthesia machine, Heart lung machine, Dialyzers, Diathermy, Audiometers **UNIT – IV** **Imaging Modalities in Bio-Medical Field:** Use of X-Rays in medicine, X-ray machine, CT scan, MRI scans, SPECT, PET, and Ultrasonography. Biotelemetry: Introduction, Components of a Biotelemetry system, Applications of telemetry in patient care
Text books and Reference books	**Text Book:** [T1] Leslie Cromwell, Fred. J, Weibell and Erich A. Pleiffer, "Biomedical Instrumentation and Measurements", 2nd Ed., Prentice Hall of India, 2020. [T2] Dr M. Arumugam, "Biomedical Instrumentation", 2nd Ed., Anuradha publications, 2019 **Reference Books:** [R1] R.S.Kandpur. "Handbook of Biomedical Instrumentation", 2nd Ed., Tata McGraw Hill, 2011
E-resources and other digital material	1. http://www.eeeuniversity.com/2013/08/ei2311-biomedical-instrumentation.html

23EI6404B- Drives and Control for Industrial Automation

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply the concepts of hydraulic and pneumatic drives in servo control applications													
	CO2	Apply the concepts of electric and piezoelectric drives in industrial automation applications													
	CO3	Illustrate the operation of basic and servo control structures used in industrial automation													
	CO4	Use the programming standards for servo control systems in industrial automation													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3												3		
	CO2	3												3		
	CO3	2														2
	CO4		2													2

Course Content

UNIT – I

Overview of Servo Control: Introduction, Objectives of servo control, Elements of servo control - Measurement, Actuation, Power moderation, Control.

Servo Hydraulic and Pneumatic Drives: Overview, Configuration of servo hydraulic and pneumatic drive, Fundamentals of hydraulic and pneumatic drives, Components of fluidic drives system, Basic hydraulic circuits

UNIT – II

Electric and Piezoelectric drives: Overview of electric drives, configuration of an electric drive, Electric motors-DC motors, AC motors and stepper motors, Torque speed characteristics of DC and AC motors, Power electronics, Sensors, Configuring an electric drive application, Solid state actuators and piezoelectric actuators, Example of application - Micro dispensing system

UNIT – III

Control System in Servo Drives : Servo control challenges - System design, Nonlinear dynamics, Disturbances, Basic Control Structures- Cascaded velocity and position loops, Single-loop PID position control, and Cascaded loops with feedforward control.Servo

	control structures - Trajectory generator, Feedback control, Feed forward compensator, States feedback with observers, Notch filter, **UNIT – IV** **IEC61131-3 Programming standards**: Introduction, Features of IEC61131 standards, Instruction List(IL), Structured Text(ST), Sequential Functional Chart(SFC), Functional Block Diagrams(FBD) and Continuous Function Chart(CFC) **Motion Control System and Applications**: Components of a Motion Control System, Single axis motion –Jogging, Homing, Multi axis motion - Electronic Gearing, Electronic Camming, Spool winding, Triggered camming., Tension control
Text books and Reference books	**Text Book:** [T1] Tan Kok Kiong and Andi Sudjana Putra, "Drives and Control for Industrial Automation", 1st Ed., AIC, Springer-Verlag London Limited, 2011 [T2] Hakan Gurocak, " Industrial Motion Control", 1st Ed., John Wiley & Sons, Ltd, UK, 2016 **Reference Books:** [R1] Teresa Orlowska Kowalska, Frede Blaabjerg, "Advanced and Intelligent Control in Power Electronics and Drives", 1st Ed., Studies in Computational Intelligence, Springer International Publishing Switzerland 2014.
E-resources and other digital material	1. https://nptel.ac.in/courses/108105062/ 2. https://nptel.ac.in/courses/108102046/

23EI6404C- Process Modeling and Simulation

Course Category:	Professional 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 fundamental principles of process modeling and the operations of various industrial control techniques													
	CO2	Model chemical processes mathematically and design controllers using theoretical and practical methods													
	CO3	Analyze the dynamic behavior and characteristics of processes under different control strategies													
	CO4	Utilize modern software tools for the design, analysis, and simulation of process controllers													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	3													3	
	CO3		3												3	
	CO4					2									2	
Course Content	**UNIT – I** **Introduction to Process Modeling**: Definitions, Model representation, Types of modeling equations, Mathematical models for Chemical Engineering systems, 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, Stability of linear state space 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, Reformulation of the desired response, Autotuning techniques, Examples of mathematical models of Chemical Engineering systems, constant volume CSTRs, two heated tanks **UNIT – III** **Internal Model Control:** Introduction to model-based control, Practical open-loop.														

	uncertainty and disturbances, The Internal Model Control (IMC) structure, The IMC design procedure, Effect of model uncertainty and disturbances, Improved disturbance rejection design, batch reactor, Case Studies and Industrial Applications **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), Derivation of DMC, Effect of tuning parameters, Data-Driven and Machine Learning–Based Control, Case Studies and Industrial Applications
Text books and Reference books	**Text Book:** [T1] B.Wayne Bequette, Process Control - Modeling, Design and Simulation, Prentice Hall International Series in the Physical and Chemical Engineering Sciences, 1st Ed., 2003 [T2] Amiya K.Jana, Chemical Process Modeling and Computer Simulation, PHI, 2nd Ed., 2011 **Reference Books:** [R1] B. Wayne Bequette, Process Dynamics - Modeling, Analysis, and Simulation, Prentice Hall International Series in the Physical and Chemical Engineering Sciences, 1st Ed., 1998 [R2] Luyben. W. L., "Process Modeling Simulation and Control for Chemical Engineers", 2nd Ed., McGraw Hill, New York, 1990
E-resources and other digital material	1. https://nptel.ac.in/courses/103103037/module4/lec7/3.html 2. https://nptel.ac.in/courses/103101003/26 3. https://nptel.ac.in/courses/103103037/24

23EI6404D- Industrial Communication Networks

Course Category:	Professional 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	Understand the concepts of data communication and networks													
	CO2	Illustrate the architecture of various fieldbuses used in process industries													
	CO3	Outline the functions of layers in various fieldbus communication models													
	CO4	Select appropriate communication protocols for process automation													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2														
	CO2	2														2
	CO3		2													2
	CO4		3													3

Course Content

UNIT – I

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

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

Networks in Process Automation and Fieldbuses: Introduction, Communication hierarchy in factory automation, I/O bus networks-Network and Protocol standards, Networking at various levels-Networking at I/O and field Levels, Networking at control level, Networking at Enterprise/Management level; Expanded network view with fieldbus, Fieldbus benefits

UNIT – II

Highway Addressable Remote Transducer (HART): HART - Introduction, Evolution and Adaption of HART protocol, HART encoding and waveform, HART Character, HART addressing, Arbitration Communication modes, HART networks; HART communication layers-Physical, Data link and Application layer

UNIT – III

	Foundation Field Bus: Introduction, Definition and features, Field bus data types, Architecture, H1 benefits, HSE benefits, OSI reference model of foundation fieldbus, Physical Layer, Data link Layer, Application Layer, User application blocks-Linking and scheduling of Blocks. Device information system configuration **UNIT – IV** **PROFIBUS:** Introduction, Transmission technology, Communication protocols, Device classes, PROFIBUS in Automation, PROFIBUS-DP Characteristics, Version DP-V0, Version DP-V1 and Version DP-V2, Communication profile of PROFIBUS-DP, PROFIBUS-PA characteristics, Redundancy, PROFIsafe, PROFIdrive, PROFInet
Text books and Reference books	**Text Book:** [T1] S. Sunit Kumar, "Fieldbus and Networking in Process Automation", 2nd Ed., CRC Press, Taylor and Francis Group, 2021 [T2] S.Mackay, E.Wrijut, D.Reynders and J.Park, "Practical Industrial Data Networks: Design, Installation and Troubleshooting", 1st Ed., Newnes Publication, Elsevier, 2004 **Reference Books:** [R1] S. Mackay, J. Park and E. Wright, "Practical Data Communication for Instrumentation and Control", Newnes Elsevier, 2003 [R2] R. Bowden," HART communication application Guide", HART Communication Foundation,2013
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 **4.** http://www.nptel.ac.in/courses/106105195 **5.** http://www.nptel.ac.in/courses/108105088

23EI6405A- Power Plant Instrumentation

Course Category:	Professional Elective - III	**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	Understand the operation and safety measures in thermal power plants													
	CO2	Select suitable measuring techniques for pollution, impurity and turbine parameters													
	CO3	Select suitable control techniques for water, air fuel circuits and turbines in power plant													
	CO4	Analyze boiler efficiency in thermal power plants													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3												1		
	CO2	3												2		
	CO3		2													2
	CO4		1											2		
Course Content	**UNIT – I** **Overview of Thermal Power Generation**: Introduction to thermal power plants, Comparison of various conventional power plants, Classification of instruments in a power plant, Objectives of instrumentation and control in thermal power plants, Layout of typical thermal power plants, Piping and instrumentation diagram. **Instrumentation and Control in Water Circuit**: Water circuit, Boiler feed water circulation, Controls in water circuit, Impurities in water and steam, Effects of impurities, Measurement of impurities **UNIT – II** **Instrumentation and Control in Air-Fuel Circuit**: Air fuel circuit- Fuels, Combustion air, Flue gases, Waste gases, Controls in air fuel circuit- Combustion control, Furnace draft control, Analytical measurement- Oxygen measurement in flue gas, Measurement of carbon dioxide in flue gas, Combustibles analyzer, Infrared flue gas analyzers, Smoke detector, Dust monitor, Fuel analyzers, Chromatography, Pollution monitoring instruments. **UNIT – III** **Power Plant Management**: Introduction, Master control, Combustion Process-														

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

23EI6405B- Instrumentation and Control in Food Processing

Course Category:	Professional Elective - III	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Industrial Instrumentation	**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 food process in food processing industries													
	CO2	Select a suitable measuring technique for quality control in food processing													
	CO3	Identify a suitable control technique for food preservation and grading.													
	CO4	Illustrate the role of computers in monitoring and control in food processing industries													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	3												3		
	CO3	2												1		
	CO4		1											1		

Course Content

UNIT – I

Food Processing Industries: Sugar and Black tea

Introduction to Process Instrumentation and Control: An industrial process, Process parameters, Batch and Continuous process, Overview on controllers and Selection of controller.

Moisture Content Measurement in Food Processing: Role of moisture content in quality of food, Microwave absorption method, Radio frequency impedance technique, Moisture release during drying of food

UNIT – II

Humidity in the Food Processing Environment: Role of humidity in quality of food, Conventional type and Electrical type of humidity meters.

Temperature Measurement in Food Processing: Temperature of food on a conveyor, Food tempering monitoring and Precision temperature measurement.

Food Flow Metering: Turbine flow meter, Positive displacement flow meter, Solid flow metering and Gravimetric feeder meters.

Turbidity and Color of Food: A basic Turbidity meter, Standards and Units of turbidity, Light scattering type turbidity meter, Color reflectance and Digital color image processing

	in food grains. **UNIT – III** **Viscosity of Liquid Foods**: Definition, Newtonian and Non Newtonian food flow, Rotating cylinder viscometer. **Brix of Food**: Brix Standards, Refractometers – Refraction angle refractometer and Critical angle refractometer. **PH Values of Food**: PH scale, PH electrodes and Potential, Ion sensitive field effect transistor PH sensors. **Flavor Measurement**: Sources of flavor in food, Electronic Nose – Basic electronic nose, Sensor types and Signal processing **UNIT – IV** **Controllers:** Introduction, Temperature control in food dehydration and drying, Electronic Controllers, Atmosphere control in food preservation, Food sorting and Grading control. **Computer Based Monitoring and Control**: Introduction, Importance of monitoring and control with computers, Hardware features of a data acquisition and control computer, Examples of computer based measurement and Control in food processing
Text books and Reference books	**Text Book:** [T1] Manabendra Bhuyan "Measurement and Control in Food Processing", Taylor & Francis Group.2007. **Reference Books:** [R1] Erika Kress Rogers and Christopher J. B. Brimelow, "Instrumentation and sensors for the food Industry", 2nd Ed., Woodhead Publishing Limited
E-resources and other digital material	1. https://nptel.ac.in/courses/126105011/

23EI6405C- Industrial Internet of Things

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Classify the industry environments and scenarios covered by IIOT													
	CO2	Use of IIOT in the key technologies													
	CO3	Model the Industrial Internet Systems by selecting suitable middleware platforms and WAN technologies													
	CO4	Analyse the deployment of IIOT in Industry 4.0													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		3													
	CO2	3														
	CO3	3														
	CO4		2													

Course Content

UNIT- I

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

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

UNIT- II

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

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

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

23EI6405D- Wireless Sensor Networks

Course Category:	Professional Elective - III	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Sensors and Transducers, Wireless communications	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply the concepts of wireless sensor network architecture, components, characteristics, and MAC protocols for efficient network design and communication													
	CO2	Evaluate routing protocols, performance metrics, and strategies for effective data communication in sensor networks													
	CO3	Analyze Quality of Service (QoS) requirements and energy management techniques to enhance WSN performance													
	CO4	Apply WSN design concepts to develop energy-efficient and reliable sensor network solutions for real-world applications													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3												3		
	CO2		3											2		
	CO3		3											2		
	CO4	3												3		
Course Content	**UNIT – I** **Introduction to Wireless Sensor Networks**: Components of a wireless sensor node, Motivation for a Network of Wireless Sensor Nodes, Classification of sensor networks, Characteristics of wireless sensor networks, Challenges of wireless sensor networks, Comparison between wireless sensor networks and wireless mesh networks, Limitations in wireless sensor networks, Design challenges, Hardware architecture. **UNIT – II** **Basic Architectural Frame-work**: Physical Layer, Basic Components, Source Encoding, Channel Encoding, Modulation. Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. **Medium Access Control:** Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC Protocols, Contention-Based MAC Protocols, and Hybrid MAC Protocols. Location discovery, quality, other issues, S-MAC, IEEE 802.15.4														

	UNIT – III **Network Layer:** Routing Metrics, Issues in designing a routing protocol, Flooding and Gossiping, Data Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing, power aware routing protocols **UNIT – IV** **QoS and Energy Management**: Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes
Text books and Reference books	**Text Book:** [T1] Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice‖", Wiley 2010. [T2] Mohammad S. Obaidat, Sudip Misra, "Principles of Wireless Sensor Networks, Cambridge", 2014. [T3] C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks", Pearson Education, 2008. **Reference Books:** [R1] Ian F. Akyildiz, Mehmet Can Vuran , "Wireless Sensor Networks", Wiley 2010.
E-resources and other digital material	1. https://nptel.ac.in/courses/106105160

23EI6206A- Artificial Intelligence and Machine Learning in Healthcare

Course Category:	Open Elective - III	**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	Understand the concepts of AI in disease management													
	CO2	Apply machine learning algorithms in diagnosis of diabetes mellitus													
	CO3	Select a machine learning algorithm for cancer diagnosis													
	CO4	Describe AI techniques used in detection of COVID 19													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2														
	CO2			3												
	CO3		3													
	CO4			2												

Course Content

UNIT – I

Application of AI in Disease Management: Overview, Disease prognosis and diagnosis, AI in identification of biomarker of disease.

Public Data Repositories: List of public data repositories – Kaggle , Archives, UCI machine learning repository

AI Models on Disease Data: Logistic regression model, Artificial neural network model, Support vector machine model

UNIT – II

Transfer Learning in Health Care: Introduction, Transfer Learning Models, Methodology: Steps to retrain a pretrained model using transfer learning 802.15.4

Automated Diagnosis of Diabetes Mellitus Based on Machine Learning: Introduction, Role of machine learning in diabetes mellitus management, Methodology for development of diabetes prediction application based on ML

UNIT – III

Application of Machine Learning Algorithms in Cancer Diagnosis: Introduction, Analysis in medical diagnostics, Machine Learning and Cancer Prediction: Types of cancer, Machine learning techniques for cancer prediction, Dataset for cancer study, Flow

	chart for cancer prediction using ML, Tool selection for cancer prediction, Methodology, Selection of ML algorithm, Metrics for performance measurement. Future possibilities and challenges in cancer prognosis **UNIT – IV** **Machine Learning Approaches in Detection and Diagnosis of COVID-19**: Introduction, Methods Used in Predicting COVID-19: Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM) and its variant, Deep LSTM/Stacked LST, Bidirectional LSTM (Bi-LSTM), Deep learning model framework, ResNet model, Inception and Xception models, The data imbalance challenge, Performance measurement metrics
Text books and Reference books	**Text Book:** [T1] Ankur Saxena, Shivani Chandra, "Artificial Intelligence and Machine Learning in Healthcare", 1st Ed., Springer Singapore, 2021 [T2] Tom M. Mitchel "Machine Learning", 1st Ed., McGraw-Hill International Editions Computer Science Series, 2017 **Reference Books:** [R1] Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Ed., Pearson Series in Artifical Intelligence, 2020
E-resources and other digital material	1. https://nptel.ac.in/courses/106105078

23EI6206B- Safety Instrumentation Systems

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the concepts of design life cycle of safety Instrumentation system													
	CO2	Differentiate the process control versus safety control													
	CO3	Apply different procedures of protection layers in safety instrumentation systems													
	CO4	Analyze different methods of safety integrity level													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2														
	CO2			2												
	CO3			2												
	CO4			3												

Course Content

UNIT – I

Introduction: Safety instrumentation system; Findings of the HSE; Design life cycle; Hazard & risk analysis; Allocation of safety functions to protective layers; Develop safety requirements specification; SIS design & Engineering, Installation, Commissioning and validation, Operations and maintenance, Modifications, decommissioning

UNIT – II

Process Control vs. Safety Control: Control and safety defined; Process control active/dynamic; The need for making frequent changes; Safety control, passive/dormant; The need for restricting changes; Demand mode vs. continuous mode; Separation of control and safety systems; HSE; AIChECCPS; IEC 61508; ISA SP84; API, RP 14C APIRP554; NFPA85; IEEE 803; Common cause and systematic / functional failures; Human issues

UNIT – III

Protection Layers: Prevention layers; Process plant design; Process control system; Alarm systems; Human reliability; Procedures; Shutdown/interlock systems; Physical protection; Mitigation layers; Containment systems; Scrubbers & flares; Fire &gas systems; Evacuation procedures; Diversification

	UNIT – IV **Safety Integrity Level (SIL):** Evaluating risk; Hazard; Risk; Fatality rates; Risks inherent in modern society; Voluntary vs. Involuntary risk; Tolerable Levels of risk; Tolerable risk in the process industries; Safety integrity levels; Method1: As Low As Reasonably Practical (ALARP); Method2: Risk matrix; Evaluating the frequency; Evaluating the consequences; Evaluating the overall risk; Evaluating the effectiveness of additional layers; Method3: Risk graph; Method4: Layers of protection analysis (LOPA); Tolerable Risk; Initiating event frequencies; Performance of each safety layer; Example using LOPA
Text books and Reference books	**Text Book:** [T1] Safety Instrumented Systems - Design, Analysis, and Justification, 2nd Ed., Springer Singapore, 2021 [T2] Tom M. Mitchel "Machine Learning", 1st Ed., McGraw-Hill International Editions Computer Science Series, 2017 **Reference Books:** [R1] Overview of Safety Instrumented Systems, IDC Technologies, 2012. [R2] Plant Hazard Analysis and Safety Instrumentation Systems, Swapan Basu
E-resources and other digital material	

23EI6206C- Principles of Process Control
(Open for all Departments except EIE students)

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the technical terms and concepts associated with process control domain													
	CO2	Understand the concepts of modeling, controllability and stability													
	CO3	Select suitable controller mode and final control elements for a given application													
	CO4	Analyze various control schemes and control systems in an industry													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3														
	CO2	3														
	CO3		3													
	CO4		3													

Course Content

UNIT – I

Introduction to Processes: Introduction to processes, control loop study , sources of disturbances , Control actions , block diagram representation , transient response of systems , controlled process block diagrams and transfer functions

UNIT – II

Modeling, Controllability and Stability : Need of mathematical modeling, characteristics of physical systems, Controllability , Self -regulation , stability studies' compensators

UNIT – III

Basic Control Schemes and Controllers: Introduction to feedback control, basic control actions - characteristic of on-off, proportional, time proportional control, Typical PID controller characteristics, control actions comparison.

Controlling Elements: Pneumatic controllers, hydraulic controllers, electronic controllers and programme controllers

UNIT – IV

Final control elements: Cascade control, feed forward control, ratio control, Pneumatic

	actuator, Electric actuator **Process Control systems** : Boiler control, Steel plant control system, control in paper industry, Distillation coloumn, Belt conveyor control
Text books and Reference books	**Text Book:** [T1] D Patranabis, "Principles of Process Control" 2nd Ed., TMH, 2007. [T2] Donald P. Eckman, "Automatic process control", Wiley India Pvt. Ltd. [T3] Donald R. Coughanowr, "Process Systems Analysis and Control", 2nd Ed., Mc Graw- Hill International edition. **Reference Books:** [R1] Stephanopoulos G, "Chemical Process Control", 3rd Ed, PHI, 1994 [R2] Seborg, D E., Mellichamp, D.A,. Edger, T.F., " Process dynamics and control" John Wiley, 2nd Edition, 2009.
E-resources and other digital material	1. www.freevideolectures.com /Course/3126/Process-Control-and-Instrumentation 2. www.nptel.ac.in/courses/103105064/

23EI6351 - Embedded Systems Lab

Course Category:	Professional Core	**Credits:**	1.5
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 0- 3
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	Apply the instruction set and architecture of ARM Cortex-M microcontrollers to solve engineering problems													
	CO2	Analyze the output of various interfacing peripherals with ARM Cortex-M Microcontrollers.													
	CO3	Conduct the experiments as individual or team by using modern tools													
	CO4	Identify and record the results of experiments on ARM Cortex-M microcontrollers													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3													3	
	CO2		3												3	
	CO3				3					2					3	
	CO4										2				2	
Course Content	**Experiments to be done with ARM Cortex M4** 1. Programming with GPIO 2. Interfacing of Seven Segment Display 3. Interfacing of LCD 4. Interfacing of Stepper Motor 5. Interfacing of ADC 6. Interfacing of DAC 7. Interfacing of Keyboard 8. Serial Data Communication 9. Interfacing of DC Motor 10. Program based on timer programming 11. Interfacing of Optoisolator 12. Interfacing of RTC **Any 10 experiments from the above list**														

Text books and Reference books	**Text Book:** [T1] Muhammad Ali Mazidi, Shujen Chen, Eshragh Ghaemi, "STM32 Arm Programming For Embedded Systems", 1st Ed., Micro Digital Ed. 2018. [T2] Joseph Yiu, "The Definitive Guide to Arm® Cortex®-M3 and Cortex®-M4 Processors", 3rd Ed., Newnes, (Elsevier) 2024
E-resources and other digital material	1. https://community.arm.com/arm-community-blogs/b/architectures-and-processors-blog 2. https://www.st.com/en/embedded-software/development-tool-software.html 3. Embedded System Design with ARM, IIT Kharagpur https://nptel.ac.in/courses/106105193

23EI6352 - Advanced Instrumentation Lab I

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply the knowledge of LabVIEW programming to develop VI for signal analysis tasks													
	CO2	Apply the knowledge of LabVIEW programming to Develop VI to acquire the data from analog and digital sensors													
	CO3	Analyze outputs and interpret the data for a given problem													
	CO4	Conduct experiments as individual or team													
	CO5	Prepare an effective report based on experiments													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			3											3	3
	CO2			3											3	3
	CO3				3										3	3
	CO4									3			2			
	CO5										3					
Course Content	**List of Experiments** 1. Develop a VI to Simulate Dynamic Signal Analyzer using LabVIEW 2. Develop a VI to detect echoes in a signal using LabVIEW 3. Develop a VI to estimate the peak frequency and power in a power spectrum. 4. Develop a VI to detect edges in an image with 2D convolution 5. Develop a VI to analyze the time-frequency spectrogram 6. Develop a VI to compute the averaged power spectral density 7. Develop a VI to detect peaks and valleys in a signal 8. Develop a VI to demonstrate how to continuously acquire signals using analog input 9. Develop a VI to demonstrate how to continuously re-generate analog output data 10. Develop a VI to demonstrate configuring of counter input and counter output of a DAQ														

	11. Develop a VI to demonstrate configuring of digital input and digital output of a DAQ 12. Developing Signal Generator using DAQ Card 13. Develop a VI to Simulate Nyquist Plot of a Filter using LabVIEW 14. Develop a VI to demonstrate FIR Windowed Filter Design using LabVIEW 15. Develop a VI to demonstrate IIR Filter Design using LabVIEW **Any 10 experiments from the above list**
Text books and Reference books	**Text Book:** [T1] Jovitha Jerome, "Virtual Instrumentation using LabVIEW", Prentice Hall India, 1st edition, 2010
E-resources and other digital material	1. www.ni.com

23EI6153 - Advanced Communication Skills Lab

Course Category:	HSS -Skill Enhancement course	**Credits:**	1
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 0- 2
Prerequisites:	Notable level of skill in language proficiency, including listening, speaking, reading, and writing, reaching a semi-advanced 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	Relate effective listening and reading skills essential for professional contexts													
	CO2	Demonstrate clear and persuasive spoken communication for argumentation and proficiency in public speaking													
	CO3	Apply sophisticated and creative written communication suitable for administrative and corporate documentation													
	CO4	Analyze comprehensive life skills by adeptly communicating in various personal and professional settings for career and personal growth opportunities													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1										3					
	CO2								1	2	3					
	CO3										3					
	CO4									2	3					

Course Content

COURSE CONTENT

1) Reading Comprehension : Understanding Main Idea – Analyzing Supporting Details – Drawing Inferences – Recognizing Text Structure – Critical Reading – Active Reading Strategies

2) Listening Skills

Active Listening Techniques **–** Empathetic Listening – Avoiding Distractions – Clarification and Confirmation – Responding Appropriately – Reflective Listening– Note-taking Techniques – Summarizing and Analyzing – Ted Talks.

3) Relationship Building

Assertiveness – Adaptability – Emotional Intelligence – Conflict Management.

4) Professional Presentations:

	Planning and Preparation – Audience Analysis – Structuring Presentation – Visual Aids and Multimedia – Delivery Techniques – Handling Q&A Sessions – Overcoming Presentation Anxiety. **5) Cover Letter & Resume Writing :** Cover Letter – Resume Formatting and Design – Creating a Professional and Eye-Catching Document – Highlighting Achievements – Tailoring Your Resume – Including Relevant Keywords**.** **6) Video Resume:** Introduction – Professional Background – Visual Presentation – Personal Branding – Achievements and Accomplishments – Call to Action – Editing and Production. **7) Statement of Purpose (SOP):** Introduction – Educational Background and Training – Subject Matter Expertise – Relevant Skills and Attributes – Research Interests – Fit with the Program – Future Contribution. **8) Book/Film Review:** Overview and Summary **–** Plot Analysis – Cinematography / Writing Style – Acting / Characterization – Themes and Messages – Audience Appeal – Final Thoughts and Recommendation. **9) Kinesics & Para Linguistic Features:** Understanding Nonverbal Communication – Body Language – Vocal Cues – Cultural Variations – Emotional Expression – Deception Detection. **10) Life Skills – Poster Presentation:** Introduction to Life Skills – Creative Thinking – Critical Thinking – Emotional Intelligence — Communicating Ideas Visually and Effectively
Text books and Reference books	**Text Book:** [T1] Advanced communication skills lab manual
E-resources and other digital material	

23TP6107- Quantitative Aptitude

Course Category:	Soft Skills - 4	**Credits:**	1
Course Type:	Learning by Doing	**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	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		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2														
	CO2		2													
	CO3	2														
	CO4				2											
Course Content	**UNIT – I** **Numerical ability l:** Number system, HCF & LCM, Average, Ratio & Proportion **Numerical ability II:** Problems on ages, Partnership, Percentages, Profit & Loss, Allegation **UNIT – II** **Arithmetical Ability I:** Time & Work, Pipes & Cistern, Chain Rule **Arithmetical Ability ll:** Time & Distance, Problems on Trains, Boats &Steams **UNIT – III** **Arithmetical ability lll:** Simple interest and compound interest, Calendar and Clock **Logical Ability:** Permutations and Combination, and Probability, Cubes															

	UNIT – IV **Mensuration:** Areas, Volumes **Data interpretation**: Tabulation, Bar graphs, Pie charts, line graphs
Text books and Reference books	**Text Book:** [T1]R. S. Aggarwal "Quantitative Aptitude", Revised., S Chand publication, 2017, ISBN:8121924987
E-resources and other digital material	

23MC6108B - Technical Paper Writing & IPR

Course Category:	Audit Course	**Credits:**	-
Course Type:	Learning by Doing	**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	Understand the basics of writing technical reports, technical sentence formation, using transitions, and appropriate tenses for technical writing.
	CO2	Understand the use of drafts, illustrations, grammar, spelling, readability, and writing in plain English for effective technical documentation
	CO3	Apply the use of word processor tools such as Table of Contents, citations, foot-notes, comments, macros, and document protection
	CO4	Understand the nature of Intellectual Property and explain the process of patenting and international cooperation on Intellectual Property

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1		1						2	2		2		1		
CO2		2						1	2		2		1		
CO3		2						2	3		3		1		
CO4		1						3	2		2		1		

Course Content

UNIT – I

Introduction: An introduction to writing technical reports, technical sentences formation, using transitions to join sentences, Using tenses for technical writing.

Planning and Structuring: Planning the report, identifying reader(s), Voice, Formatting and structuring the report, Sections of a technical report, Minutes of meeting writing

UNIT – II

Drafting Report and Design Issues: The use of drafts, Illustrations and graphics

Final Edits: Grammar, spelling, readability and writing in plain English: Writing in plain English, Jargon and final layout issues, Spelling, punctuation and Grammar, Padding, Paragraphs, Ambiguity

Proofreading and Summaries: Proofreading, summaries, Activities on summaries

Presenting final reports: Printed presentation, Verbal presentation skills, Introduction to proposals and practice

UNIT – III

	Using Word Processor: Adding a Table of Contents, Updating the Table of Contents, Deleting the Table of Contents, Adding an Index, Creating an Outline, Adding Comments, Tracking Changes, Viewing Changes, Additions, and Comments, Accepting and Rejecting Changes, Working with Footnotes and Endnotes, Inserting citations and Bibliography, Comparing Documents, Combining Documents, Mark documents final and make them read only., Password protect Microsoft Word documents., Using Macros **UNIT – IV** **Nature of Intellectual Property**: Patents, Designs, Trade and Copyright. **Process of Patenting and Development**: Technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. **Data interpretation**: Tabulation, Bar graphs, Pie charts, line graphs
Text books and Reference books	**Text Book:** [T1 Kompal Bansal & Parshit Bansal, "Fundamentals of IPR for Beginner's", 1st Ed., BS Publications, 2016. [T2] William S. Pfeiffer and Kaye A. Adkins, "Technical Communication: A Practical Approach", Pearson. [T3] Ramappa,T., "Intellectual Property Rights Under WTO", 2nd Ed., S Chand, 2015 **Reference Books:** [R1] Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011. [R2] Day R, How to Write and Publish a Scientific Paper, Cambridge University Press, 2006
E-resources and other digital material	1. Tony Buon—a psychologist, university lecturer, https://www.udemy.com /course/report writing/. 2. https://www.udemy.com/course/professional-business-english-and-technical-report-writing/. 3. Mark Morris—professional speech writer, https://www.udemy.com/course/better business writing/.

Fourth Year
(VII Semester)

23EI7301- Computer Control of Processes

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Explain the role of computers in industrial automation													
	CO2	Model the various processes in discrete time domain													
	CO3	Analyze the time response and stability of computer control system using pulse transfer function													
	CO4	Design an appropriate digital control algorithm for industrial processes													
	CO5	Use the concepts of intelligent controllers in real time applications													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	1														
	CO3		3			3										
	CO4			3												
	CO5	2														

Course Content

UNIT – I

Introduction to Computers in Process Control: Need of computer in a control system, Advantages and disadvantages, 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 time 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, 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, Adaptive controllers, Artificial intelligence(AI) based systems, Expert control system, Introduction to fuzzy control, Fuzzy control system, Artificial neural networks – introduction, Neural controllers and Neuro Fuzzy control system
Text books and Reference books	**Text Book:** [T1] M.Gopal, "Digital Control and State Variable Methods", 4th Ed.,TMH, New Delhi, 2017 [T2] C.D. Johnson, "Process Control Instrumentation Technology", 8th Ed., Prentice Hall Inc, 2020 [T3] Krishna Kant, "Computer based Industrial Control", 2nd Ed., PHI, Delhi, 2010 **Reference Books:** [R1] Pradeep B.Deshpande and Raymond H Ash, "Elements of Computer Process Control with Advanced Control Applications", 2nd Ed., Instrument Society of America.,1981 [R2] Chidambaram, M " Computer Control of Processes",1st Ed., Narosa publications, 2001
E-resources and other digital material	1. http://nptel.ac.in/courses/112103174/4 2. http://nptel.ac.in/courses/112103174/3

23EI7302- Analytical Instrumentation

Course Category:	Professional Core	**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	Understand the basic concepts of analytical instruments.														
	CO2	Apply the analytical instruments for the measurement of qualitative and quantitative analysis of the samples.														
	CO3	Identify suitable analytical detectors for various applications.														
	CO4	Compare various analytical instruments in industrial applications.														
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	3												3		
	CO3	1												1		
	CO4		2											2		
Course Content	**UNIT – I** **Spectrophotometers**: Introduction to analytical instruments, Electromagnetic radiation, Radiation sources, Filters, Monochromators and detectors, UV-VIS Spectrophotometers, Single beam null type, Double beam ratio recording, FTIR spectrophotometer, Applications **UNIT – II** **Mass Spectroscopy**: Principle, Types of mass spectrometers, Magnetic deflection, The time of flight. **NMR and ESR Spectroscopy:** Principle of NMR spectroscopy, Types of NMR spectrometers, Continuous wave and FT NMR, Principle of ESR spectroscopy, ESR spectrometer **UNIT – III** **Nuclear 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 **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
Text books and Reference books	**Text Book:** [T1] R.S.Khandpur, " Handbook of Analytical Instruments", 2nd Ed., TMH, 2006 [T2] Willard H.H, Merrit L.L, Dean J.A,"Instrumental Methods of Analysis", 7th Ed., CBS publishers and Distributors, 1988 **Reference Books:** [R1] D.A.Skoog and James J.Leary, "Principles of Instrumental Analysis", 5th Ed., Holt-Saunders, 1997 [R2] James.W.Robinson, Eileen.M.Skelly.Frame, Georgia.Frame, "Undergraduate Instrumental Analysis", 7th Ed., CRC Press, 2014
E-resources and other digital material	1. http://nptel.ac.in/courses/103108100 2. http://instruct.uwo.ca/chemistry/532/lectures.htm

23EI7303A- Advanced Sensors

Course Category:	Professional Elective – IV	**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	Understand the principles, materials, and working of semiconductor sensors													
	CO2	Analyze chemical sensing mechanisms and compare thin and thick film sensor technologies.													
	CO3	Apply concepts of MEMS and microfabrication techniques to design and evaluate micro sensors for various physical and chemical measurements.													
	CO4	Evaluate advanced magnetic sensors and justify their applications in real-world systems.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3	2			1								3	1	
	CO2	3	2											3		
	CO3	2	3			3								3	3	
	CO4	2	3			2								3	2	2
Course Content	**UNIT- I** **Semiconductor Sensors**: Introduction to semiconductor sensors, Semiconductor materials- Titania, Tin Oxide, Zinc Oxide, Insulating materials and Ferroelectric materials, Negative Temperature Coefficient (NTC) ceramic thermistors, Metal Oxide Semiconductor (MOS) sensors. Micromachining technology Silicon sensors for sensing radiation, mechanical, magnetic, chemical and other signals, IC sensors **UNIT- II** **Chemical Sensors**: Polymers in chemical sensing Chemically modified electrodes. Membrane electrodes, Ion-selective sensors, Gas sensors. **Thin and Thick Film Sensors**: Thick film sensors and thick film processes (screen printing),Thin film processes, Thin film deposition methods (PVD, CVD),Thin film characterization methods, Thin film delineation techniques, Compatibility issues, Applications of thin and thick film sensors														

	UNIT- III **Micro Sensors**: Introduction to micro sensors and MEMS technology, Microfabrication techniques, Micro sensors for sensing-Thermal and radiation signals-Mechanical signals-Magnetic signals-Chemical signals. Thin film sensors and their role in micro sensors. Integration of thin and thick film sensors in microsystems **UNIT- IV** **Integrated Magnetic Sensors**, Overview of magnetic field sensor technology. AMR, GMR, SQUID sensors, Optoelectronic magnetic field sensors, Semiconductor magnetic effects, materials and figure of merit, Standard magnetic field sensor technologies, limitations and applications. **Sensor Applications:** Automotive sensors, Environmental sensors, Sensors for medical diagnosis and patient monitoring, Aerospace sensors
Text books and Reference books	**Text Book:** [T1] Jacob Fraden, "Handbook of Modern Sensors Physics, Designs, and Applications", 5th Ed., Springer, 2015. [T2] S.M.Sze "Semiconductor Sensors", wiley Interscience Publishers, 1994. **Reference Books:** [R1] Patranabis D "Sensors and Transducers", Wheeler Publishing. [R2] Ian R.Sinclair "Sensors and Transducers", 3rd Ed., Elsevier
E-resources and other digital material	**1.** www.advansedsensors.co.uk **2.** www.wtec.org/loyola/opto/c6_s3.htm

23EI7303B- Intelligent Systems and Control

Course Category:	Professional 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	Design fuzzy logic controllers for real-world control problems.
	CO2	Develop neural network models for system identification and control applications.
	CO3	Compare various neuro fuzzy system configurations.
	CO4	Apply evolutionary and swarm optimization techniques to engineering problems.

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3														
CO2	3														
CO3		2													
CO4	2														

Course Content

UNIT – I

Fuzzy Logic: Introduction, Fuzzy sets, Membership functions (MFs), Features of MFs, Operations on fuzzy sets, Linguistic variables, Linguistic hedges, Fuzzy relations, Fuzzy If–Then rules, Fuzzification, Defuzzification, Inference mechanism – Mamdani and Sugeno fuzzy models, Fuzzy control

UNIT – II

Neural Networks and Applications: Introduction, Artificial neuron model, Activation functions, Feed forward networks, Multilayer perceptron networks, Backpropagation algorithm, Supervised learning and unsupervised learning, Recurrent neural networks, Deep neural networks, Neural systems, System identification and control, Neural networks for control

UNIT – III

Neuro Fuzzy Systems: Introduction, Combination of neural and fuzzy systems, Cooperative neuro-fuzzy systems – Cooperative FS-NN and cooperative NN-FS systems, Concurrent neuro-fuzzy systems, Hybrid neuro-fuzzy systems, ANFIS architecture, Fuzzy Net (FUN), Fuzzy neurons, Practical applications.

	UNIT – IV **Evolutionary and Swarm Intelligence Algorithms**: Introduction, Terminologies of evolutionary computing, Chromosome representation, Encoding schemes, Population, Fitness functions, Genetic operators – Selection operators, Crossover operators and Mutation operators, Performance measures of evolutionary algorithms, Evolutionary algorithms - Genetic Algorithm (GA) and Differential Evolution (DE), Applications in control tuning, Swarm intelligence algorithms - Basic Particle Swarm Optimization (PSO), Real-world optimization problems.
Text books and Reference books	**Text Book:** [T1] Nazmul Siddique and Hojjat Adeli, "Computational Intelligence -Synergies of Fuzzy Logic, Neural Networks and Evolutionary Computing", Wiley, 1st Ed., 2013. [T2] Andries. P. Engelbrecht, "Computational Intelligence-An introduction", Wiley, 2nd Ed., 2007 **Reference Books:** [R1] Robert E. King, "Computational Intelligence in Control Engineering", Marcel Dekker Inc., 1st Ed., 1999. [R2] Witold Pedrycz, "Computational Intelligence-An introduction", CRC Press, 1st Ed., 1997
E-resources and other digital material	1. http://nptel.ac.in/courses/108104049/27# 2. http://uni-obuda.hu/users/fuller.robert/nfs.html 3. http://nptel.ac.in/courses/112106064/3

23EI7303C- Digital Image Processing

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

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Explain the fundamentals of digital image processing														
	CO2	Apply image enhancement techniques in spatial and frequency domains														
	CO3	Analyze various restoration techniques for image quality.														
	CO4	Analyze the performance of compression techniques and segmentation methods.														
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	2				1										
	CO3		3			1										
	CO4		3			1										

Course Content

UNIT – I

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

UNIT – II

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

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

UNIT – III

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

	squares filtering **UNIT – IV** **Image Compression:** Fundamentals, Image compression models, Error free compression, Lossless predictive, Lossy compression. **Image Segmentation:** Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation
Text books and Reference books	**Text Book:** [T1] Gonzalez and Woods, "Digital Image Processing", 4th Ed., Pearson Education, 2019. **Reference Books:** [R1] Anil K. Jain, "Fundamentals of Digital Image Processing", 3rd Ed., Pearson Education, 2003 [R2] William K Pratt, "Digital Image Processing", 4th Ed., A Wiley-Interscience Publication 2007
E-resources and other digital material	1. http://www.imageprocessingplace.com/

23EI7303D- Database Management Systems

Course Category:	Professional Elective – IV	**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	Understand the basic elements of a relational database management system.													
	CO2	Draw entity relationship and convert entity relationship diagrams into RDBMS													
	CO3	Create a relational database using SQL.													
	CO4	Apply normalization techniques for logical schema model.													
	CO5	Solves concurrent issues and problems through locking mechanism.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		3												3	
	CO2		3												3	
	CO3			3		2									3	
	CO4			3		2									3	
	CO5			3		2									3	

Course Content

UNIT – I

Database System Architecture: Introduction, The three levels of architecture, (External level, Conceptual level, Internal level), Mapping, The database administrator, The database management systems, Client/Server architecture.

E-R Models: The E-R models, The relational model, Relational calculus, Introduction to database design, Database design and ER diagrams, Entities attributes, Entity sets, Relationship and relationship sets, Conceptual design with the ER models, The relational model integrity constraints over relations, Key constraints, Foreign key constraints, General constraints

UNIT – II

Relational Algebra: Relational algebra, Selection and projection, Set operation, Renaming, Joins, Division, More examples of queries, Relational calculus, Tuple relational calculus, Domain relational calculus

Queries, Constraints, Triggers: The form of basic SQL query, Union, Intersect, and except, Nested queries, Aggregate operators, Null values, Complex integrity constraints in

	SQL, Triggers and active database **UNIT – III** **Normalization:** Purpose of normalization or schema refinement, Concept of functional dependency, Normal forms based on functional dependency (1NF, 2NF and 3 NF), Concept of surrogate key, Boyce-Codd normal form (BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF). **UNIT – IV** **Transaction Management:** Transaction, Properties of transactions, Transaction log, and transaction management with SQL using commit rollback and save point. Concurrency control for lost updates, Uncommitted data, Inconsistent retrievals and the Scheduler. **Concurrency Control with Locking Methods**: Lock granularity, Lock types, Two phase locking for ensuring serializability, Deadlocks, Concurrency control with time stamp ordering: Wait/Die and Wound/Wait Schemes, Database recovery management: Transaction recovery
Text books and Reference books	**Text Book:** [T1] CJ Date, "Introduction to Database Systems", Pearson, 8th Ed., 2006 [T2] Raghurama Krishnan, Johannes Gehrke, "Database Management Systems", 3rd Ed., Tata McGraw Hill, 2002. **Reference Books:** [R1] H G Molina, J D Ullman, J Widom, "Database Systems - The Complete Book", Pearson, 2nd Ed., 2011 [R2] Ramez Elmasri, Shamkant B. Navathe, "Database Management Systems", Pearson, 6th Ed., 2010.
E-resources and other digital material	

23EI7304A- Real World Instrumentation with Python

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

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Understand the basic concepts of Python language														
	CO2	Implement an instrument system using Python concepts														
	CO3	Implement control systems using Python simulators														
	CO4	Illustrate various data I/O interfaces for real world applications														
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	2				2										
	CO3	2				2										
	CO4	2														

Course Content

UNIT – I

The Python Programming Language: Installing Python, Command - Line options and environment, Objects in Python, Data types in Python, Expressions, Operators, Statements, Strings, Program organization, Importing modules, Loading and running a Python program, Basic input and output, Hints and tips, Python development tools, Debuggers

UNIT – II

Project Definition: Defining the project, Requirements, Traceability, Capturing requirements, Designing the software, Functional testing, Test cases, Testing error handling, Implementation, Code reviews, User documentation, Implementing Control Systems in Python

UNIT – III

Building and Using Simulators: What is simulation, Using Python to create a simulator, Data I/O simulator, Serial terminal emulators, Displaying simulation data, Plotting creating your own simulators, Simulation scope, Time and effort

	UNIT – IV **Instrumentation Data I/O:** Data I/O interface software, Interface formats and protocols, Python interface support packages, Data I/O: Acquiring and writing data, Basic data I/O, Blocking versus nonblocking calls, Data I/O methods, Handling data I/O errors, Handling inconsistent data
Text books and Reference books	**Text Book:** [T1] J.Hughes, "Real World Instrumentation with Python" 1st Ed., O'Reilly Media. 2010. [T2] Mark. Lutz, "Learning Python", 5th Ed., O'Reilly Media. 2013 **Reference Books:** [R1] E. Balaguruswamy, "Introduction to Computing and Problem Solving Using Python", 1st Ed., Mc Graw Hill, Jul 2017 [R2] Sheetal Taneja, Naveen Kumar, "Python Programming: A modular approach", 1st Ed., Pearson Education, Sep 2017
E-resources and other digital material	**1.** https://nptel.ac.in/courses/106/106/106106145/

23EI7304B- Instrumentation and Control in Paper Industries

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Explain the pre-processing stages of raw material in paper making process													
	CO2	Select suitable sensors used in wet and dry end instrumentation and quality measurement of paper making industry													
	CO3	Identify the paper quality and appropriate control strategies for thick and thin stock system													
	CO4	Analyze the role of computers in pulp and paper industries													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	3												3		
	CO3	2												2		
	CO4		2											2		
Course Content	**UNIT – I** **Papermaking Process**: Process fundamentals, Raw materials, Pulping and preparation, Screening, Bleaching, Cooking, Chemical addition, Papermaking machine, Drying section, Calenders, Drive, Finishing, Other-after treatment processes, Coating, Elementary properties of liquids - Hydrostatics, Liquids in motion. Properties of paper making Suspension – Composition and Behavior of Paper Stock, The Flow Properties of Paper Stock. **UNIT – II** **Wet and Dry End Instrumentation:** Overview of basic sensors used in wet and dry end measurements, Measurement of pH and ORP, Primary viscosity measurement devices, Continuous consistency measuring devices, Liquid density and specific gravity measurement, Granular and wood chip moisture measurements, Paper moisture measurements - Electrical, Energy absorption. Freeness measurement, Grammage or basis weight measurement, Thickness measuring systems - Contacting and non-contacting types, Digester														

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

23EI7304C- HMI & SCADA

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the architecture and components of SCADA systems.													
	CO2	Analyze communication protocols and remote control mechanisms in SCADA.													
	CO3	Design HMI systems based on industrial standards and best practices.													
	CO4	Select suitable SCADA and HMI configurations for real-time applications.													
	CO5	Develop basic HMI/SCADA interfaces using industrial tools.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
	CO1															
	CO2	2														2
	CO3	2														2
	CO4		1													1
	CO5					2										1
Course Content	**UNIT – I** **Introduction and Overview:** What is SCADA, Definition of SCADA, Applicable processes, Elements of a SCADA system, A brief history of SCADA- Development from telemetry, Dependence on communication and computers, Real time systems - What is real time system, Communication access, Determining scan intervals **UNIT – II** **Remote Control:** Murphy's law and remote control, Safety instrumented systems, Regulatory requirements, Communications - Communication system components, Protocol, Remote Terminal Units (RTUs) - Communication interface, Protocol detail, Signal control, Signal monitoring, Master Terminal Units (MTUs) - Communication, Configuration **UNIT – III** **History and Current Status of HMI:** Earlier control panels, Early and current HIMs,														

	Related challenges, Need of change of HMI, HMI best practices - Hierarchy based display, Fundamentals of HMI design, Assessing HMI performance - HMI evaluation methodology, Users of HMI, HMI style guides **UNIT – IV** **High Performance HMI**: Basic principles - Overview, Implementation of trends, General consideration for displays, Depicting lines, Vessels and static equipment, Depicting text, Values, Depicting alarm behaviour, Alarm indication methods, Audible alarms, Process controllers, Valves, Instrument lines, Shutdown actuation
Text books and Reference books	**Text Book:** [T1] Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004 [T2] Bill Hollifield, Dana OliverLanNimmo and Eddie Habibi "The High performance Hand Book", 1st Ed., PAS,Houston, 2008. [T3] Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004 **Reference Books:** [R1] David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003 [R2] R Mehra, V. Vij, PLCs & SCADA - Theory and Practice, Laxmi Publications, 2nd Ed., 2017. [R3] Jean YvesFiset, "Human-Machine Interface Design for Process Control Applications", ISA, 2009
E-resources and other digital material	1. Real-Time HMI and SCADA for C/C++/C#.NET, Java, HTML5 & JavaScript, Linux, Windows, Web, Emdedded and Mobile (genlogic.com) 2. PLC and HMI Programming Course with Example Problems (automationcommunity.com)

23EI7304D- Computer Networks

Course Category:	Professional Elective - V	**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	Outline Network models and Transmission media.													
	CO2	Analyze the functions of Network Layer i.e. Logical addressing, subnetting & Routing Mechanism													
	CO3	Analyze different Transport Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism													
	CO4	Analyze different protocols used at application layer													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2														
	CO2		3													2
	CO3		3													2
	CO4	2														2

Course Content

UNIT- I

Introduction: Uses of computer networks, Network hardware, Network software, Reference models – Open System Interconnect (OSI), Transmission Control Protocol (TCP)/Internet Protocol (IP).

Physical Layer: Guided transmission media, Wireless Communication, Local Loop, Communication Satellites, Trunks and Multiplexing, Switching.

UNIT- II

Data Link Layer: Design issues, Error correction and detection, Elementary data link Protocols, Sliding window protocols

Medium Access Control (MAC) Sub Layer: Channel allocation problem, Multiple access protocols, Ethernet, Cabling-Manchester coding, MAC sub layer protocol, Binary exponential back off algorithm. Wireless LANs, Broad band wireless, Bluetooth-Architecture applications-Protocol stack, Data link layer switching, Bridges from 802.x to 802.y, Spanning tree bridge, Remote Bridge.

	UNIT- III **Network Layer**: network layer design issues, Routing algorithms – Shortest path Routing, flooding distance vector routing, Link state routing – Hierarchical routing – Broadcast routing – Multicast routing – Routing for mobile hosts, Congestion control algorithms - Congestion prevention policies, Quality of service, Techniques for achieving good quality of service, Over provisioning, Buffering, Traffic shaping, Leaky bucket algorithm, Token bucket algorithm, Internetworking. IP protocol **UNIT- IV** **Transport Layer**: Transport service, Elements of transport protocol – Addressing, Internet transport protocols – User Datagram Protocol (UDP), TCP transmission control protocol – TCP segment header, TCP connection establishment, TCP connection release, Congestion control in TCP. **Application Layer:** Domain name system (DNS), SNMP, Electronic Mail; the World WEB, HTTP, Streaming audio and video.
Text books and Reference books	**Text Book:** [T1] Andrew.S. Tanenbaum, "Computer Networks", 6th Ed., Pearson, 2022. [T2] Behrouz A. Forouzan, "Data Communications and Networking", 6th Ed.,, McGraw Hill, 2022 **Reference Books**: [R1] William Stallings, "Data and Computer Communication", 10th Ed., Pearson, PHI, 2017 [R2] Douglas Comer, "Internetworking with TCP/IP", 6th Ed., PHI, 2015.
E-resources and other digital material	1. http://www.pearsonhighered.com/educator/product/Data-and-Computer Communications 2. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-829 computer-networks 3. https://nptel.ac.in/courses/106105183/ 4. webcast.berkeley.edu

23EI7205- MOOCS

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

23EI7351- Industrial Automation Lab

Course Category:	Professional Core	**Credits:**	1.5
Course Type:	Laboratory	**Lecture - Tutorial - Practice:**	0 - 0- 3
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	Apply the concepts of ladder diagram and function block programming methods to control industrial process.													
	CO2	Implement simple programs for the automation of various industrial processes.													
	CO3	Conduct experiments as individual or team on various industrial processes.													
	CO4	Make an effective report based on experiments.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3													3	3
	CO2	3													3	3
	CO3					3				2			1			
	CO4										2					

Course Content

List of Experiments

1. Implementation of Basic Logic using PLC
2. Implementation of PLC Timer and Counter
3. ON-OFF Control of Level using PLC
4. ON-OFF Control of Pressure using PLC
5. PID control of Temperature using PLC
6. PID Control of Motor speed using PLC
7. Automation of material handling system using PLC
8. Elevator control using PLC
9. Batch process reactor control using PLC
10. Automatic drilling system using PLC
11. Automatic pneumatic stamping machine using PLC
12. Study of distributed control system -Honeywell DCS C200
13. Basic programming of DCS through Experion PKS server
14. Level control of single tank liquid system using DCS
15. Level control of multi tank liquid system using DCS

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

23EI7352- Advanced Instrumentation Lab II

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply the knowledge of Lab-VIEW programming to develop VI for embedded sensor interfacing with NI- myRIO													
	CO2	Apply the knowledge of Lab-VIEW programming to develop VI for vernier biomedical sensors interfacing with NI- ELVISmx													
	CO3	Analyze outputs and interpret the data for a given problem													
	CO4	Conduct experiments as individual or team													
	CO5	Prepare an effective report based on experiments													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			3											3	3
	CO2			3											3	3
	CO3				3										3	3
	CO4									3			2			
	CO5										2					
Course Content	**List of Experiments** 1. Develop a VI to interface DC motor with myRIO 2. Develop a VI to interface Photo interrupter with myRIO 3. Develop a VI to interface Hall-effect sensor with myRIO 4. Develop a VI to interface Servo motor with myRIO 5. Develop a VI to interface Geared motor with myRIO 6. Develop a VI to interface Webcam with myRIO 7. Develop a VI to interface Gyroscope with myRIO 8. Develop a VI to interface Accelerometer with myRIO 9. Develop a VI to interface Compass with myRIO 10. Develop a VI to interface Vernier's Hand Grip Heart Rate Monitor with NI ELVIS II+ 11. Develop a VI for Acquiring and Analyzing ECG using EKG sensor 12. Develop a VI for the Acquisition of Bio Potentials and Removing Noise from the Acquired Signals 13. Develop a VI to study the muscle activity and fatigue using hand dynamometer														

Text books and Reference books	**Text Book:** [T1] Jovitha Jerome, "Virtual Instrumentation using LabVIEW", Prentice Hall India, 1st Ed., 2010.
E-resources and other digital material	1. www.ni.com

23EI7653 - Real Time Operating Systems

Course Category:	Skill Enhancement Course	**Credits:**	2
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 2
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 algorithms for data protection, synchronization and Intertask Communication using RTOS													
	CO2	Construct device drivers using Free RTOS													
	CO3	Analyze outputs and interpret the data for a given problem													
	CO4	Conduct experiments as an individual or team													
	CO5	Prepare an effective report based on experiments													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			3		2									3	3
	CO2			3		2									3	3
	CO3				3										3	3
	CO4									3			2			
	CO5										3					
Course Content	**List of Experiments** 1. Creating tasks and starting the scheduler, Task memory allocation, understanding task states using Free RTOS, Ozone, Systemview and STM32cube IDE. 2. Protecting Data and Synchronizing tasks using semaphores. 3. Protecting Data and Synchronizing tasks using polling. 4. Synchronizing tasks using priority inversion. 5. Syncronizing tasks using mutexes. 6. Synchronize tasks and protect shared data using software timers. 7. Intertask communication using queues. 8. Intertask communication using direct task notifications. 9. Device driver development using interrupts. 10. Device driver development using polling. 11. Device driver development using DMA. 12. Sharing hardware peripherals across tasks using stream buffers. 13. Creating queues using static variables. 14. Memory management- Comparing Free RTOS heap implementations 15. Intertask communication using mail box.														

Text books and Reference books	**Text Book:** [T1] Trevor Martin, "The Designers Guide to the Cortex-M Processor Family", 2nd Ed., Elsevier, 2018. [2] Warren Gay, "Beginning STM32: Developing with Free RTOS, Libopencm and GCC", 1st Ed., Apress, 2018. [3] Jiacun Wang, "Real-Time Embedded Systems", 1st Ed., Wiley, 2017.
E-resources and other digital material	1. https://www.freertos.org/Documentation/RTOS_book.html

23MC7106 - Constitution of India

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

23EI7551 - Evaluation of Industry Internship

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

Fourth Year
(VIII Semester)

23EI8551 - Internship & Project Work

Course Category:	Internship & Project Work	**Credits:**	12
Course Type:		**Lecture - Tutorial - Practice:**	0 - 0- 24
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100