VELAGAPUDI RAMAKRISHNASIDDHARTHA ENGINEERING COLLEGE

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME

VR20

Syllabus for

Ist- VIIIth Semesters

Effective from 2020-21

VELAGAPUDI RAMAKRISHNASIDDHARTHA ENGINEERING COLLEGE

ELECTRONICS & INSTRUMENTATION ENGINEERING

Vision

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

Mission

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

Program Educational Objectives(PEOs)

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

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

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

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

Velagapudi Ramakrishna Siddhartha Engineering College

ELECTRONICS & INSTRUMENTATION ENGINEERING

Program Outcomes

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

Program Specific Outcomes

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

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

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

Dr G.N.Swamy

Velagapudi Ramakrishna Siddhartha Engineering College

ELECTRONICS & INSTRUMENTATION ENGINEERING

Scheme of Instructions for Four Year B.Tech Programme-VR20

SEMESTER I **CONTACT HOURS: 26**

S. No	Course Code	Course	Subject	L	T	P	Credits
1.	20BS1101	Basic Science Course	Matrices and Differential Calculus	3	0	0	3
2.	20BS1102	Basic Science Course	Engineering Physics	3	0	0	3
3.	20ES1103	Engineering Science Course	Programming for Problem Solving	3	0	0	3
4.	20ES1104	Engineering Science Course	Basics of Electrical Engineering	3	0	0	3
5.	20HS1105	Humanities and Social Science	Technical English and Communication Skills	2	0	0	2
6.	20BS1151	Basic Science Course	Engineering Physics Laboratory	0	0	3	1.5
7.	20ES1152	Engineering Science Course	Programming for Problem Solving Laboratory	0	0	3	1.5
8.	20HS1153	Humanities and Social Science	Technical English and Communication SkillsLaboratory	0	0	3	1.5
9.	20ES1154	Engineering Science Course	Computing and Peripherals Laboratory	0	0	2	1
10.	20MC1106	Mandatory Course	Technology and Society	1	0	0	-
Total				**15**	**0**	**11**	**19.5**
11.	20MC1107	Mandatory Course	Induction Program				-

Category	Credits
Basic Science Courses	7.5
Engineering Science Courses	8.5
Humanities and Social Science	3.5
Mandatory Courses	0
TOTAL CREDITS	**19.5**

SEMESTER II **CONTACT HOURS: 27**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	20BS2101	Basic Science Course	Laplace Transforms and Integral Calculus	3	0	0	3
2.	20BS2102	Basic Science Course	Engineering Chemistry	3	0	0	3
3.	20ES2103	Engineering Science Course	Object Oriented Programming using Python	3	0	0	3
4.	20ES2104C	Engineering Science Course	Network Theory	3	0	0	3
5.	20ES2105	Engineering Science Course	Engineering Graphics	1	0	4	3
6.	20BS2151	Basic Science Course	Engineering Chemistry Laboratory	0	0	3	1.5
7.	20ES2152	Engineering Science Course	Object Oriented Programming using Python Laboratory	0	0	3	1.5
8.	20ES2153	Engineering Science Course	Engineering Workshop	0	0	3	1.5
9.	20MC2106	Mandatory Course	Professional Ethics and Practice	1	0	0	-
Total				**14**	**0**	**13**	**19.5**

Category	Credits
Basic Science Courses	7.5
Engineering Science Courses	12
Mandatory Courses	0
TOTAL CREDITS	**19.5**

SEMESTER III **CONTACT HOURS: 28**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	20BS3101	Basic Science	Complex Analysis & Numerical Methods	3	0	0	3
2.	20ES3102	Engineering Science	Electronic Devices and Circuits	3	0	0	3
3.	20EI3303	Program Core	Digital Circuits and Systems	3	0	0	3
4.	20EI3304	Program Core	Sensors and Transducers	3	0	0	3
5.	20EI3305	Program Core	Electrical and Electronic Measurements	3	0	0	3
6.	20ES3151	Engineering Science Lab	Electronic Circuits Lab	0	0	3	1.5
7.	20EI3352	Program Core Lab 1	Digital System Design Lab	0	0	3	1.5
8.	20EI3353	ProgramCore Lab 2	Measurements Lab	0	0	3	1.5
9.	20TP3106	Soft Skills – 1	Logic and Reasoning	0	0	2	1
10.	20MC3107A	Mandatory Course (AICTE suggested)	Environmental Studies	2	0	0	-
			Total	**17**	**0**	**11**	**20.5**

Category	Credits
Basic Science Courses	3
Engineering Science Courses	4.5
Program Core Courses	12
Soft OrientedCourses	1
Mandatory Courses	0
TOTAL CREDITS	**20.5**

SEMESTER IV **CONTACT HOURS:32**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	20BS4101	Basic Science	Analog Electronic Circuits	3	0	0	3
2.	20EI4302	Program Core	Linear Integrated Circuits and Applications	3	0	0	3
3.	20EI4303	Program Core	Control Systems	3	0	0	3
4.	20EI4304	ProgramCore	Industrial Instrumentation	3	0	0	3
5.	20HS4105	Humanities and Social Sciences	Universal Human Values	3	0	0	3
6.	20EI4351	Program Core Lab1	Transducers Lab	0	0	3	1.5
7.	20EI4352	Program Core Lab 2	Control Systems Lab	0	0	3	1.5
8.	20EI4353	Program Core Lab 3	LinearIntegrated Circuits Lab	0	0	3	1.5
9.	20TP4106	Soft Skills – 2	English for Professionals	0	0	2	1
10.	20EI4607	Skill Oriented Course -1	Virtual Instrumentation	0	0	4	2
11.	20MC4108B	Mandatory Course (AICTE suggested)	Indian Constitution	2	0	0	-
Total				**17**	**0**	**15**	**22.5**
	Summer Internship six weeks (Mandatory) during summer vacation (EPICS)						
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				**4**	**0**	**0**	**4**

Category	Credits
Basic Science Courses	3
Program Core Courses	13.5
Engineering Science Courses	0
Skill Oriented Courses	3
Humanities and Social Science Courses	3
Mandatory Courses	0
TOTAL CREDITS	**22.5**

SEMESTER V **CONTACT HOURS: 34**

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20EI5301	Program Core	Analytical Instrumentation	3	0	0	3
2	20EI5302	Program Core	Process Control	3	0	0	3
3	20HS5103	Humanities and Social Sciences	Engineering Economics and Management	2	0	0	2
4	20EI5404	Program Elective 1		3	0	0	3
5	20EI5205	Open Elective /Job oriented Elective -1		2	0	2	3
6	20EI5351	Program Core Lab 1	Advanced Instrumentation Lab I	0	0	3	1.5
7	20EI5352	Program Core Lab 2	Process Control Lab	0	0	3	1.5
8	20HS5153	Humanities and Social Sciences	English Communication Skills Lab	0	0	2	1
9	20TP5106	Soft Skills – 3	Personality Development	0	0	2	1
10	20EI5354	Internship/Project (6 Weeks)	EPICS/Internship	0	0	3	1.5
11	20EI5607	Skill Oriented Course -2	Digital System Design with FPGA	0	0	4	2
12	20MC5108A	Mandatory Course (AICTE suggested)	Humanities Elective	2	0	0	-
Total				**15**	**0**	**19**	**22.5**
Honors/Minor Courses (the hours distribution can be 3-0-2 0r 3-1-0 also)				**4**	**0**	**0**	**4**

List of Humanities Elective Courses			
20MC5108A1	Foreign Languages (German/French)	20MC5108A5	Law for Engineers
20MC5108A2	Biology for Engineers	20MC5108A6	Sanskrit Bhasa
20MC5108A3	Human Rights & Legislative Procedures	20MC5108A7	Yoga & Meditation
20MC5108A4	Philosophy	20MC5108A8	Psychology

Category	Credits
Program Core Courses	9
Humanities and Social Sciences	3
Program Elective Courses	3
Open Elective Courses	3
Skill Oriented Courses	3
Internship/Project	1.5
Mandatory Course (AICTE)	0
TOTAL CREDITS	**22.5**

S.No	Course Code	Program Elective – 1	L	T	P	Credits
1.	20EI5404/A	VLSI Design	3	0	0	3
2.	20EI5404/B	Sensor Signal Conditioning	3	0	0	3
3.	20EI5404/C	Robotics and Control	3	0	0	3
4.	20EI5404/D	Industrial Electronics	3	0	0	3

S.No	Course Code	Open Elective – 1	L	T	P	Credits
1.	20EI5205/A	Essential Principles of Image Sensors	3	0	0	3
2.	20EI5205/B	Wireless Technologies	3	0	0	3
3.	20EI5205/C	Industry Based Elective	3	0	0	3

SEMESTER VI **CONTACT HOURS:30**

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20EI6301	Program Core	Microcontrollers and Embedded Systems	3	0	0	3
2	20EI6302	Program Core	Digital Signal Processing	2	1	0	2
3	20EI6303	Program Core	Industrial Automation	3	0	0	3
4	20EI6404	Program Elective 2		3	0	0	3
5	20EI6205	Open Elective /Job oriented elective-2		3	0	0	3
6	20EI6351	Program Core Lab 1	Microcontrollers and Embedded Systems Lab	0	0	3	1.5
7	20EI6352	Program Core Lab 2	Industrial Automation Lab	0	0	3	1.5
8	20EI6353	Program Core Lab 3	Advanced Instrumentation Lab II	0	0	3	1.5
9	20TP6106	Soft Skills-4	Quantitative Aptitude	0	0	2	1
10	20EI6554	Internship/Project	Mini Project –I	0	0	2	1
11	20MC6107B	Mandatory Course (AICTE suggested)	Innovation, Incubation & Startup	2	0	0	0
			Total	**15**	**0**	**15**	**20.5**
Industrial/Research Internship six weeks (Mandatory) during summer vacation							
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				**4**	**0**	**0**	**4**

Category	Credits
Program Core Courses	12.5
Humanities and Social Sciences	0
Program Elective Courses	3
Open Elective Courses	3
Skill Oriented Courses	1
Mandatory Course (AICTE)	0
Internship/ Project	1
TOTAL CREDITS	**20.5**

S.No	Course Code	Program Elective – 2	L	T	P	Credits
1.	20EI6404/A	Biomedical Instrumentation	3	0	0	3
2.	20EI6404/B	Industrial Communication Networks	3	0	0	3
3.	20EI6404/C	Process Modeling and Simulation	3	0	0	3
4.	20EI6404/D	Power Plant Instrumentation	3	0	0	3

S.No	Course Code	Open Elective – 2	L	T	P	Credits
1.	20EI6205/A	Artificial Intelligence and Machine Learning in Healthcare	3	0	0	3
2.	20EI6205/B	Safety Instrumentation Systems	3	0	0	3
3.	20EI6205/C	CLAD Certification	3	0	0	3

SEMESTER VII **CONTACT HOURS:29**

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20EI7301	Program Core	Computer Control of Processes	3	0	0	3
2	20EI7402	Program Elective 3		3	0	0	3
3	20EI7403	Program Elective 4		3	0	0	3
4	20EI7404	Program Elective 5		3	0	0	3
5	20EI7205	Open Elective /Job Oriented Elective -3		2	0	2	3
6	20EI7206	Open Elective /Job Oriented Elective -4		2	0	2	3
7	20EI7607	Skill Advanced Course	Real Time Operating Systems	0	0	4	2
8	20EI7551	Internship/Project	Mini Project – II	0	0	3	1.5
9	20EI7552	Internship/Project	Industrial/Research Internship	0	0	3	1.5
			Total	**16**	**0**	**14**	**23**
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 0r 3-1-0 also)				**4**	**0**	**0**	**4**

Note: Open Elective Courses 3 and 4 are self-learning. Students may opt from any MOOCs platform. They have to submit the certificate before the last instruction day of VII semester.

Category	Credits
Program Core	3
Program Electives	9
Open Electives	6
Skill Oriented Courses	2
Internship/Project	3
TOTAL CREDITS	**23**

S.No	Course Code	Program Elective – 3	L	T	P	Credits
1.	20EI7402/A	Instrumentation and Control in Food Processing	3	0	0	3
2.	20EI7402/B	Industrial Internet of Things	3	0	0	3
3.	20EI7402/C	Wireless Sensor Networks	3	0	0	3
4.	20EI7402/D	Drives and Control for Industrial Automation	3	0	0	3

S.No	Course Code	Program Elective – 4	L	T	P	Credits
1.	20EI7403/A	Advanced Sensors	3	0	0	3
2.	20EI7403/B	Database Management Systems	3	0	0	3
3.	20EI7403/C	Intelligent Systems and Control	3	0	0	3
4.	20EI7403/D	Digital Image Processing	3	0	0	3

S.No	Course Code	Program Elective – 5	L	T	P	Credits
1.	20EI7404/A	Instrumentation and Control in Paper Industries	3	0	0	3
2.	20EI7404/B	Computer Networks	3	0	0	3
3.	20EI7404/C	HMI & SCADA	3	0	0	3
4.	20EI7404/D	Real World Instrumentation with Python	3	0	0	3

S.No	Course Code	Open Elective – 3	L	T	P	Credits
1.	17EI7205	MOOCS	3	0	0	3
2.	17EI7205/C	Automation in Manufacturing	3	0	0	3

S.No	Course Code	Open Elective – 4	L	T	P	Credits
1.	17EI7206	MOOCS	3	0	0	3
2.	17EI7206/E	Industrial Safety and Environmental Management				

SEMESTER VIII **CONTACT HOURS: 24**

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20EI8551	Internship/Project	Major Project & Internship (6 Months)	0	0	24	12
Total				**0**	**0**	**24**	**12**

The student should undergo internship and parallelly he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report**.**

CREDIT DISTRIBUTION

Year	Semester I Credits	Semester II Credits	Total Credits
I	19.5	19.5	39
II	20.5	22.5[82]	43
III	22.5	20.5[125]	43
IV	23	12	35
Total			160
Non-Credit Courses			
Mandatory Courses (7)		1. Induction Program 2. Technology and Society 3. Professional Ethics & Human Values 4. Environmental Studies 5. Indian Constitution 6. Biology for Engineers 7. Innovation, IPR and Entrepreneurship	
Mandatory Student Practice Courses (2)		(1) Co-curricular participation (2) NCC / NSS / Games and Sports / Art and Cultural / Professional Society activities / Industry training certificate.	

Contact Hours:

	ODD Semester	EVEN Semester
1st Year	26	27
2nd Year	28	31
3rd Year	33	30
4^{th} year	29	24

First Year
(I Semester)

20BS1101 – Matrices and Differential 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	Determine Eigen values, Eigen vectors of a matrix														
	CO2	Estimate Maxima and Minima of Multivariable functions														
	CO3	Solve the Linear differential equations with constant coefficients.														
	CO4	Solve the Linear differential equations with variable coefficients														
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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: Consistency of linear system of equations, Linear transformations, Vectors, Eigen values and Eigen vectors, Properties of Eigen values, Finding inverse and powers of a matrix by Cayley-Hamilton theorem. Reduction to diagonal form, Reduction of quadratic form to canonical form, Nature of aquadratic form,Complex matrices

UNIT- II

Differential Calculus: Fundamental theorems -Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem and Taylor's theorem, Expansions of functions-Maclaurin's series and Taylor's series.

Application: Curvature, Radius of curvature**.**

Functions of Two or More Variables: Taylor's theorem for function of two variables, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers

	UNIT- III **Differential Equations of First Order:** Exact differential equations, Equations reducible to exact equations. **Applications:** Orthogonal trajectories, Newton's law of cooling. **Linear Differential Equations of Higher Order:** Definitions, OperatorD, Rules for finding the complementary function, Inverse operator, Rules for finding particular integral, Working procedure to solve the equation **UNIT- IV** Method of variation of parameters, Method of undetermined coefficients, Equations reducible to linear equations with constant coefficients: Cauchy's homogeneous linear equation, Legendre's linear equation, Linear dependence of solutions, Simultaneous linear equations with constant coefficients. **Application:** L-C-RCircuits.
Text books and Reference books	**Text Book:** [T1] B.S.Grewal, Higher Engineering Mathematics, 44th Ed., KhannaPublishers,2019. **Reference Books:** [R1] Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Ed., John Wiley & Sons,2015 [R2] B.V.Ramana, "Higher Engineering Mathematics", 1st Ed., Tata MC Graw Hill, 2007 [R3] N.P.Bali, Dr.Manish Goyal, "A Tex tBook of Engineering Mathematics, 9th Ed., Laxmi Publications, 2014
E-resources and other digital material	1. https://www.nptelvideos.com/mathematics/ 2. https://nptel.ac.in/courses/122/104/122104017/ 3. https://nptel.ac.in/courses/111/105/111105035/

20BS1102 – Engineering Physics

Course Category:	Basic Science	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	10+2levelPhysics	**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	Employ physical laws of electrostatics and compute problems related to static electric fields													
	CO2	Illustrate the laws of magneto statics and solve various problems involving static magnetic fields													
	CO3	Describe various types of electric and magnetic materials													
	CO4	Understand the time varying electric and magnetic fields by applying appropriate Maxwell's equations													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3	2													
	CO2	3	2													
	CO3	3														
	CO4	3	1													
Course Content	**UNIT- I** **Electrostatics:** Coulomb's law and field intensity, Electric field due to continuous charge distributions, Electric flux density ,Gauss's law, Applications of Gauss law-Line charge, Surface charge, Volume charge, Electric potential, Relation between E and V, Maxwell's equation for static electric fields (qualitative), Potential and field of electric dipole, Energy Density in electrostatic fields **UNIT- II** **Magnetostatics:** Biot-Savart's law, Ampere's circuit law - Maxwell's equation, Applications of Ampere's law- Infinite line current, Infinite sheet of current, Magnetic flux density-Maxwell's equation for static magnetic field, Magnetic vector and scalar potentials, Force due to magnetic fields - Force on a charged particle, Current element, Force between two current elements, Magnetic dipole, Magnetic energy **UNIT- III**														

	Types of Electric and Magnetic Materials: Properties of electric materials - Conductors and dielectrics, Convection and conduction currents, Polarization in dielectrics, Dielectric constant and strength, Continuity equation and relaxation time, Poisson's and Laplace's equations, Electro static boundary conditions, Dielectric-Dielectric, Conductor-Dielectric, Conductor-Free space. Types of magnetic materials, Magnetization in materials, Magnetic boundary conditions. **UNIT- IV** **Time Varying Fields and Electro Magnetic Waves:** **Time Varying Fields:** Faraday's law, Transformer and motional electromotive forces, Displacement current, Maxwell's equations in final forms, Time harmonic fields. **Electro Magnetic Waves**: Wave propagation in lossy dielectrics, Lossless dielectrics, Free space, Good conductors, Poynting theorem
Text books and Reference books	**Text Book:** [T1] Resnick, Halliday and Krane, "Physics", 5th Ed., Wiley India Pvt. Ltd, New Delhi, 2016. [T2]Matthew.N.O.Sadiku,"PrinciplesofElectromagnetics",4thEd., Oxford University Press, New Delhi,2009 **Reference Books:** [R1] R.K.Gaurand, S.L.Gupta,"Engineering Physics", 8th Ed., Reprint, Dhanpat Rai Publications Ltd ,NewDelhi,2013 [R2] W.H.Hayt and J.A.Buck, "Engineering Electromagnetics",7th Ed., Tata McGrawHill, NewDelhi, 2006 [R3] Joseph. A.Edminister, "Electromagnetics – Theory and problems", 2nd Ed., Schaum's outline series, MCGraw Hill,1993
E-resources and other digital material	1. http://www.mike-willis.com/Tutorial/PF2.htm

20ES1103 – Programming for Problem Solving

Course Category:	Engineering Science	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	10+2levelPhysics	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the different types of problem solving approaches													
	CO2	Apply the selections, loops, arrays and string concepts in C to solve problems.													
	CO3	Apply functions and pointer concepts in C to solve problems.													
	CO4	Solve problems using num, structures, unions and file handling functions.													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3	1													
	CO2		2	3												
	CO3		2	3												
	CO4		2	3												

Course Content

UNIT- I

Introduction to Computer – Based Problem Solving: Requirement of problem solving by computers, Problem definition, Use of examples for problem solving, Similarities between problems, Problem solving strategies, Steps involved in problem solving.

Program Design and Implementation Issues: Programs and algorithms, Top-down design and step-wise refinement, Construction of loops – Basic programming constructs, Implementation, Programming environment.

Algorithms for Problem Solving: Exchanging values of two variables, Summation of a set of numbers, Decimal to binary base conversion, Reversing the digit of an integer, To find greatest common divisor (GCD) of two numbers, To verify whether an integer is prime or not, Organize a given set of numbers in ascending order, Find the square root of an integer, Factorial of a given number, Generate the Fibonacci sequence for n terms, Evaluate sin(x) as sum of series, To find the value of the power of a number raised by another integer, Reverse order elements of an array, Find largest number in an array, Print elements of upper triangular matrix, Multiplication of two matrices, To compute to roots of aquadraticequation$ax^2+bx+c=0$.

	UNIT- II **Introduction to the C Language:** Background of C program, Identifiers, Types, Variables, Constants, Memory layout, Input/Output, Programming examples. **Structure of a C Program:** Logical data and operators, Expressions, Precedence and associatively, Evaluating expressions, Type conversion, Statements, Storage class. **Selection:** Two-way selection, Multiway selection, More standard functions. **Repetition:** Concept of a loop, Loops in C, Loop examples, Recursion, The calculator program. **Arrays:** Array concepts in C, Inter function communication, Array applications, Two dimensional arrays, Multi-dimensional arrays **UNIT- III** **Strings:** String concepts, C strings, String Input/output functions, Arrays of strings, String manipulation functions, String – Data conversion. **Functions:** Functions in C, User defined functions; Call by value, Call value reference, Inter-Function communication, Standard functions, Sco pe. **Pointers*:*** Introduction to pointer, Pointers for inter-function communications, Pointers to pointers, Compatibility, L value and R value. **Pointer Applications:** Arrays and pointers, Pointer arithmetic and arrays, Passing an array to a function, Memory allocations, Functions, Array of pointers. **UNIT- IV** **Enumerations:** The type definition (Type def), Enumerated types: Declaring an enumerated type, Operations on enumerated types, Enumeration type conversion, Initializing enumerated constants, Anonymous enumeration constants, Input/Output operators. **Structures:** Structure type declaration, Initialization, Accessing structures, Operations on structures, Complex structures, Structures and functions, Sending the whole structure, Passing structures through pointers. **Unions:** Referencing unions, Initializers, Unions and structures, Internet address, Programming applications. **File Handling:** Files, Streams, Standard library input/output functions, Formatting input/output functions and character input/output functions, Command – Linear arguments.
Text books and	**Text Book:**

Reference books	[T1]Harsha Priya, R.Ranjeet, " Programming and Problem Solving Through "C" Language", Firewall media2006 [T2] Behrouz.A.Forouzan, Richard.F.Gilberg, "Computer Science A Structured Programming Approach Using C", 3rd Ed., Cengage Learning **Reference Books:** [R1] Anil.B.Chaudhuri, "Flow chart and Algorithm Basics: The Art of Programming", Mercury Learning & Information, 2020. [R2] R.G.Dromey, "How to Solve it by Computer", Prentice – Hall International Series in Computer Science, 1982. [R3] Yashwant Kanetkar, "Let us C", 16th Ed., BPB Publications, 2017. [R4] Kernighan and Ritchie, "The C programming language", The (Ansi C Version), 2nd Ed., PHI. [R5] Paul.J.Dietel and Harvey.M.Deitel,"C: How to Program", Prentice Hall, 8th Ed., 2021. [R6] K.R.Venugopal, Sundeep.R.Prasad, "Mastering C", 2nd Ed., McGraw Hill, 2015
E-resources and other digital material	1.https://nptel.ac.in/courses/106/105/106105171/ 2.https://-nptel.ac.in/courses/106/104/106104128/ 3.https://www.coursera.org/learn/c-structured-programming 4.https://www.udemy.com/-course/advanced-c-programming-course/

20ES1104 – Basics of Electrical Engineering

Course Category:	Engineering 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	Analyze electric circuit fundamentals.														
	CO2	Understand the basic concepts of alternating quantities and magnetic circuits.														
	CO3	Analyze the basic concepts of electric machines														
	CO4	Understand measuring instruments & solar photo voltaic system concepts														
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3	3			2										
	CO2	3	3													
	CO3	2	1			2										
	CO4	2	1													
Course Content	**UNIT- I** **Introduction to Electrical Engineering:** Electric current, Electromotive force, Electric power and energy, Basic circuit components – Resistors - Inductors-Capacitors. Electromagnetic phenomenon and related laws, Kirchhoff's laws. **Network Analysis:** Network sources- Ideal independent voltage source, Ideal independent current source, Dependent sources, Practical voltage and current sources, Source conversion, Voltage and current division rule, Series and parallel connection of R,L and C, Star – Delta or Delta – Star transformation. Mesh and nodal analysis (within dependent sources only). **UNIT- II** **Alternating Quantities**: Introduction, Generation of A.C voltages, Waveforms and basic definitions, Relationship between frequency, speed and number of poles, Root mean square and average values of alternating current and voltages, Form factor and peak factor, Phasor representation of alternating quantities															

	Magnetic Circuits: Introduction, Magnetic circuits, Magnetic field strength (H), Magnetomotive force, Permeability, Reluctance, Analogy between electric and magnetic circuits, Magnetic potential drop, Magnetic circuit computations, Self and mutual inductance, Energy in linear magnetic systems (Derivation for pure inductor). **UNIT- III** **DC Machines:** Introduction, Construction of DC machines, Armature windings, Generation of DC voltage and Torque production in a DC machine, Operation of a DC machine as a generator, Operation of DC machine as a motor. **Induction Motors:** Introduction, Constructional features of three phase induction motors, Principle of operation of three-phase induction motor - Slip and rotor frequency, Voltage and current equations and Equivalent circuit of an induction motor. **UNIT- IV** **Measuring Instruments:** Introduction, Classification of instruments, Operating principles, Essential features of measuring instruments, Ammeters and voltmeters, Measurement of power. **Solar Photo Voltaic Systems:** Solar cell fundamentals, Characteristics, Classification, module, Panel and array construction, Maximizing the solar PV output and load matching, Maximum power point tracker basic algorithm and flow chart, PV system components, Solar PV systems and solar PV applications
Text books and Reference books	**Text Book:** [T1]T.K.Nagasarkar and M.S.Sukhja, "Basic Electric Engineering", 2nd Ed., Oxford University Press2011 **Reference Books:** [R1] B.H.Khan, "Non-Conventional Energy Resources", 2nd Ed., Mc.Graw Hill Education Pvt Ltd.,New Delhi,2013. [R2] Ashfaq Hussain, Haroon Ashfaq, "Fundamentals of Electric Engineering", 4th Ed., DhanpatRai&Co,2014. [R3] I.J.Nagarathand Kothari, "Theoy and Problems of Basic Electric Engineering",2nd Ed., PHI Pvt. Ltd., 2016.
E-resources and other digital material	1. https://nptel.ac.in/courses/108/108/108108076/

20HS1105 – Technical English and Communication Skills

Course Category:	Humanities and Social Science	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0- 0
Prerequisites:	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Develop administrative and professional compilations with felicity of expression													
	CO2	Demonstrate proficiency in advanced reading and context oriented writing													
	CO3	Apply the elements of functional English with sustained understanding for authentic use of language in any given academic and/or professional environment													
	CO4	Execute tasks in technical communication with competence													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1						2				3					
	CO2						2			2	3					
	CO3						2			2	3					
	CO4										3					

Course Content

UNIT- I

Professional Writing Skills

Professional Letters: Business complaint and transmittal–Purpose, Style and format with special reference to block format and modified block format

Paragraph and Essay Writing: Linkers, Descriptive and Analytical with Illustrations

Effective Writing Practice: Appropriateness, Brevity, Clarity, Cogency and coherence with guided and semi-controlled compilations including the use of idiomatic expressions.

UNIT- II

Reading Comprehension and Discourse Development Skills

Analytical and Critical Reading: Critical, Creative and lateral thinking – Language and

	thinking – Thinking process and language development. **Effective Reading Strategies:** Skimming, Scanning, Eye span, Fixation, Taming regression, Issues and challenges of vocalization and sub-vocalization. **Context-Oriented Dialogue/Argument Writing:** Extending invitation, Reciprocation, Acceptance, Concurrence, disagreeing without being Disagreeable-Discourse/Dialogue, Development and identification of inconsistencies in pre-prepared dialogues **UNIT- III** **Vocabulary and Functional English** **Vocabulary for Competitive Examinations:** (A list of 500 high frequency words) Synonyms, Antonyms, Matching homonyms, Homophones and nearer words along with root words **Verbal Analogies: (**Single Unit) – Synonym relation, Antonym relation, Object- Operator relation, Object - Obstacle/Obstruction relation, Sequence relation, Place – Monument relation, Science – Area of activity relation, Profession – Tool relation, Gender relation, Diminutive relation, etc. **Functional Grammar:** With special reference to tense, Concord, Articles, Pronoun referent, Prepositions, Use of Gerund, Parallelism etc (A representative collection of 100 sentences). **UNIT- IV** **Technical Communication Skills:** **Technical Proposal Writing:** Characteristics, Proposal, Superstructure, Checklist, Formal proposal **Technical Vocabulary**: Basic explanations and description **Technical Report Writing:** Informational reports and feasibility report-Types, Components, Style and formats
Text books and Reference books	**Text Book:** [T1] Martin Cutts, "Oxford Guide to Plain English", 7th Impression, Oxford University Press,2011 [T2] M.Ashraf Rizvi, "Effective Technical Communication", Tata McGraw-Hill, New Delhi, 2005. [T3] John Langan, "College Writing Skills", 9th Ed., McGrawHill,2014 [T4] Eclectic Learning Materials Offered by the Department **Reference Books:**

	[R1] Erwin Kreyszig, Randolph Quirk, "Use of English Longman", 1st Ed., 2004. [R2] Thomson.A.J and A.V,Martinet, "Practical English Grammar", 3rd Ed., Oxford University Press,2001. [R3] V.Sethi and P.V.Dhamija, "A Course in Phonetics and Spoken English", 2nd Ed., PHI, 2006
E-resources and other digital material	1. Learn English | British Council 2. www.natcorp.ox.ac.uk/Wkshops/Materials/specialising.xml?ID=onlin 3. www.uni-marburg.de/de/sprachenzentrum

20BS1151 – Engineering Physics Laboratory

Course Category:	Basic Science	**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	Test optical components using principles of interference and diffraction of light													
	CO2	Use spectrometer, travelling microscope and function generator in various experiments													
	CO4	Determine the V-I characteristics of photocells and appreciate the accuracy in measurements													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1				1											
	CO2				1											
	CO3	2			1											
	CO4				1											
Course Content	**List of Experiments:** 1. Figure of merit of a galvanometer 2. LCR circuit – Study of resonance 3. Variation of magnetic field along the axis of current – Carrying circular coil 4. Wedge method – Measurement of thickness of a foil 5. Solar cell – Determination of Fill factor 6. AC Sonometer – Verification of vibrating laws 7. B – H curve unit – Determination of hysteresis loss 8. Hall effect – Hall coefficient measurement 9. Diffraction grating – Measurement of wavelength 10. Torsional pendulum – Measurement of rigidity modulus 11. Photocell – Study of V-I characteristics, Determination of work function 12. Optical fiber – Determination of numerical aperture														
Text books and Reference	**Text Books:** [T1] Madhusudhan Rao, "Engineering Physics Lab Manual", 1st Ed., Scitech Publications,														

books	2015 [T2] Ramarao Sri, Choudary Nityanand and Prasad Daruka, "Lab Manual of Engineering Physics", 5th Ed., ExcellBooks,2010
E-resources and other digital material	1. www.physicsclassroom.com/The-Laboratory 2. http://facstaff.cbu.edu/~jvarrian/physlabs.html 3. https://vlab.amrita.edu/?sub=1&brch=201&sim=366&cnt=1 4. https://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1 5. https://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1

20ES1152 – Programming for Problem Solving Laboratory

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

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Implement the use of programming constructs in a structural programming language.														
	CO2	Apply the selections, loops, arrays and string concepts in C to solve problems.														
	CO3	Apply functions, pointer and Enum concepts in C to solve problems.														
	CO4	Solve problems using structures, unions and file handling functions.														
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	1		3												
	CO2		1	3												
	CO3		1	3												
	CO4		1	3												

Course Content

List of Experiments

Week–1:IntroductiontoCProgramming

a) The structure of C program with a sample program
b) Use identifiers, data types, format specifiers, constants and variables declaration and initialization to write simple c programs
c) Write simple C programs using preprocessor commands and simple I/O statements

Week–2:DataTypesandVariableDeclarations

a) Use void, integral and floating point data types in different scenarios to write programs.
b) Use various primitive data types for performing different mathematical operations
c) Programs to perform mathematical operations using various operators in C

Week–3: Selection Making Decisions

a) Write Programs using the If...Else selection statements
b) Use nested If...Else statement to solve problems that need multi-level selection making decisions**.**
c) Write programs that use Switch...Case and Else...If multiway statements to select one out of several options

Week–4: Looping Constructs and Their Applications

a) To have a clear idea on loop initialization, validation and updation
b) Write programs using the While, For or Do...While loops
c) To understand the logic and adopt best looping construct for different kinds of problems
d) Design and develop programs based on iterative loops using While, Do While, For, Nested For

Week–5: Unconditional Control Transfer Statements

a) Write programs using of (break and continue) unconditional control transfer statements
b) Use the Go To statement to transfer the control from one part to another part of a program and the use of return statement to end the execution of a called function

Week–6: Arrays and Their Applications

a) To utilize one dimensional and multi-dimensional arrays to solve problems that use set(s) of similar type input data
b) To write programs that performs multiple classical operations like searching, sorting, up dation or deletion on array elements**.**

Week–7: Strings, String I/O and Manipulation Functions

a) To write programs that work on read, write and manipulate fixed length and variable- length strings and/or arrays of strings
b) To write programs that use predefined string i/o functions
c) To write programs that use string manipulation functions from the string library

Week–8: Concepts of User Defined Functions

a) Design and develop programs depending on functions both user defined and standard library functions in c with different approaches.
b) To write a program using more than one function with or without parameters and function return type

Week–9: Pointers and Their Applications

a) Programs on declaration of pointers and their usage in c.
b) Programs to relate between arrays and pointers and use them efficiently in a program

	c) To pass pointers as an argument to a function and use it efficiently in a program. d) To write programs using static and dynamic memory allocation. **Week–10: Structure, Union and Enumeration** a) Programs to define, declare and access structure and union variables b) Design and develop programs to work with pointers to access data within a structure c) Programs to pass structure as an argument to a function d) To write c programs using enumeration data types, an easiest way of mapping symbolic names to integer values**.** **Week–11: File Handling Operations** a) Programs to open and close text and binary files using file i/o commands. b) Write programs to perform read and write operations using the formatting I/O and character I/O functions. c) Apply file positioning, status and system commands based on a problem requirement **Week–12: Command Line Arguments** a) To use command line arguments to pass inputs in a single line while executing a program through the dos command promptor linux terminal. b) To use ATOI function to convert a default string value argument to an integer value inside the main function in a program. c) To use ATOF function to convert a default string value argument to a float value inside the main function in a program
Text books and Reference books	**Text Book:** [T1] Behrouz. A. Forouzan and, Richard.F. Gilberg, "Computer Science a Structured Programming Approach Using C", 3rd Ed., Cengage Learning. **Reference Books:** [R1] Anil B.Chaudhuri, "Flowchart and Algorithm Basics: The Art of Programming", Mercury Learning & Information, 2020. [R2] R.G.Dromey, "How to Solve it by Computer", Prentice-Hall International Series in Computer Science, 1982. [R3] Yashwant Kanetkar, "Let Us C", 16th Ed., BPB Publications,2017. [R4] Kernighan and Ritchie,"The C Programming Language", The (Ansi C Version), 2nd Ed., PHI. [R5] Paul. J.Dietel and Harvey.M.Deitel,"C: How to Program", 8th Ed., Prentice Hall, 2021. [R6] K.R.Venugopal, Sundeep.R.Prasad,"Mastering C", 2nd Ed., Mc Graw Hill, 2015.
E-resources	1. Computer Science and Engineering -Noc: Problem Solving Through Programming in C

and other digital material	https://nptel.ac.in/courses/106/105/106105171/ 2. Computer Science and Engineering - Noc: Introduction to Programming in C https://-nptel.ac.in/courses/106/104/106104128/ 3. C For Everyone: Structured Programming https://www.coursera.org/learn/c-structured-programming 4. Advanced C Programming Course Tim Academy – Jason Fedin. https://www.udemy.com/-course/advanced-c-programming-course/

20MC1106 – Technology and Society

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

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Understand the origins of technology and its role in the history of human progress.														
	CO2	Know the industrial revolution and its impact on society														
	CO3	Interpret the developments in various fields of technology till twentieth century.														
	CO4	Distinguish the impacts of technology on the environment and achievements of great scientists.														
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3							1							
	CO2	3				2		1								
	CO3	3							1							
	CO4	3				2		1								

Course Content

UNIT- I

Introduction: Origins of technology, The agriculture revolution, Technological contributions of ancient civilizations- Mesopotamians, Egyptians, Greeks, Romans, Indians and Chinese.

UNIT- II

Industrial Revolution: The social and political background, The technical background, Steam: The power behind the industrial revolution, The revolution in textile industry, The impact of industrial revolution on society

UNIT- III

The Flowering of Modern Technology: Manufacturing technologies, Prime movers, Internal combustion engines, Production of metals and alloys, The birth of electrical technology, Twentieth century: The flowering of modern technology like information technology and biotechnology and its implications on society.

	UNIT- IV **Technology, Science and Society**: Impact of technology on society, The impacts of technology on the environment, Sustainable development. **Achievements of Famous Scientists**: (**World**): Einestein, Newton, Faraday, Graham Bell, Edison, S. Hawking (**India**):CVRaman, S.Chandrasekhar, Aryabhatta, Homi.J.Bhabha, VikramSarabhai, APJAbdul Kalam, S.Ramanujan, M.Visweswarayya
Text books and Reference books	**Text Book:** [T1] Dr.R.V.G Menon,"TechnologyandSociety",PearsonEducation,2011. **Reference Books:** [R1] Quan-Haase, A, "Technology and Society: Inequality, Power and Social Networks", Oxford University Press,2013
E-resources and other digital material	

20MC1107 – Induction Program

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

First Year
(II Semester)

20BS2101 – Laplace Transforms and Integral Calculus

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

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Solve the linear differential equations using Laplace Transforms.														
	CO2	Evaluate areas and volumes using double, triple integrals.														
	CO3	Evaluate Grad, Div & Curl of scalar and vector point functions.														
	CO4	Convert line integrals to area integrals and surface integrals to volume integrals.														
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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** **Laplace Transforms**: Introduction, Definition, Conditions for the existence, Transforms of elementary functions, Properties of Laplace transforms, Transforms of periodic functions, Transforms of derivatives, Transforms of integrals, Multiplication by t^n, division by 't', Inverse transforms – Method of partial fractions, Other methods of finding inverse transform, Convolution theorem, Unit step and unit impulse functions. **Applications**: Evaluation of integrals, Solving differential equations by Laplace transforms. **UNIT- II** **Integral Calculus**: Double integrals, Change of order of integration, Double integrals in polar coordinates, Triple integrals, Change of variables. **Applications:** Area enclosed by plane curves, Volumes of solids															

	UNIT- III **Vector Differential Calculus**: Scalar and vector point functions, Del applied to scalar point functions- Gradient, Del applied to vector point functions, Physical interpretation of divergence and curl, Del applied twice to point functions, Del applied to products of point functions **UNIT- IV** **Vector Integral Calculus**: Integration of vectors, Line integral, Surface integral, Green's theorem in the plane, Stokes's theorem, Volume integral, Gauss divergence theorem, Irrotational fields.
Text books and Reference books	**Text Book:** [T1] B.S.Grewal, Higher Engineering Mathematics, 44th Ed., KhannaPublishers,2019. **Reference Books:** [R1] Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Ed., John Wiley & Sons, 2015 [R2] B.V.Ramana, "Higher Engineering Mathematics", 1st Ed., Tata MC Graw Hill, 2007 [R3] N.P.Bali, Dr. Manish Goyal, "A Text Book of Engineering Mathematics, 9th Ed., Laxmi Publications, 2014
E-resources and other digital material	1. https://www.nptelvideos.com/mathematics/ 2. https://nptel.ac.in/courses/122/104/122104017/ 3. https://nptel.ac.in/courses/111/105/111105035/

20BS2102 – Engineering Chemistry

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Analyze various water treatment methods and boiler troubles.													
	CO2	Apply the concept of phase equilibrium to different materials and the knowledge of working of electrodes and batteries in various technological fields.													
	CO3	Evaluate corrosion processes as well as protection methods.													
	CO4	Apply the knowledge of conventional fuels and mechanistic aspects of conducting polymers for their effective and efficient utilization.													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		3													
	CO2	2														
	CO3			3												
	CO4					2										
Course Content	**UNIT- I** **Water Technology-I:** WHO Standards – Water treatment for drinking purpose - Sedimentation, Coagulation, Filtration, Disinfection by chlorination, Breakpoint chlorination and its significance – Desalination of brackish water – Principle and process of electro dialysis and reverse osmosis, Advantages and disadvantages. **Water Technology-II:** Boiler troubles – Scales- Formation, Disadvantages and internal conditioning methods – Phosphate conditioning, Calgon conditioning and sodium aluminate, Caustic embrittlement- Reasons, Mechanism and its control and boiler corrosion causes and control **UNIT- II** **Phase Rule and Applications:** Definition and explanation of the terms – Phase, component and degree of freedom, Phase rule equation, Phase equilibria of single component system – Water system, Two component system– Silver – Lead system, Applications of phase rule. **Electrochemistry:** Construction and working of Calomel electrode, Silver-Silver														

	Chloride electrode and principle, Construction and working of glass electrode, Determination of ph using glass electrode. Chemistry of modern batteries-LI/$SOCL_2$ battery and $LI_XC/LICOO_2$ battery– Construction, Working and advantages. Fuelcells: General working principle of a fuel cell, Examples, ChemistryofH_2-O_2fuel cell. **UNIT- III** **Corrosion Principles:** Introduction, Definition, Reason for corrosion, Examples – Types of electrochemical corrosion – Hydrogen evolution and oxygen absorption –Corrosion due to dissimilar metals, Galvanic series– Differential aeration corrosion– Pitting corrosion and concept of passivity. **Corrosion Control Methods:** Cathodic protection- Principle and types - Impressed current method and sacrificial anode method, Anodic protection – Principle and method, corrosion inhibitors– Types and mechanism of inhibition– Principle, Process and advantages of electroplating and electroless plating. **UNIT- IV** **Conducting Polymers:** Definition, Examples, Classification – Intrinsically conducting polymersand extrinsically conducting polymers – Mechanism of conduction of undoped polyacetylene, Doping of conducting polymers- Mechanism of conduction of p-doped and n-doped polyacetylenes – Applications of conducting polymers. **Fuel Technology:** Fuel- Definition, Calorific value- Lower and higher calorific values and numericals on calculation of HCV and LCV relation, Analysis of coal – Proximate analysis and ultimate analysis, Flue gas analysis byorsat's apparatus, Numericals basedon calculation of air required for combustion.
Text books and Reference books	**Text Book:** [T1] Shikha Agarwal, "Engineering Chemistry – Fundamentals and Applications", 1st Ed., Cambridge University Press, NewDelhi, 2015. **Reference Books:** [R1] Sunita Rattan, "A Text Book of Engineering Chemistry", 1st Ed., S.K. Kataria & Sons, NewDelhi, 2012. [R2] P.C. Jain, "Engineering Chemistry", 15th Ed., Dhanpat Rai Publishing Company (P) Limited ,NewDelhi. [R3] B.S.Bahl, G.D.Tuliand Arun Bahl, "Essentials of Physical Chemistry", S.Chandand Company Limited, NewDelhi. [R4] O.G.Palanna, "Engineering Chemistry", Tata McGraw Hill Education Pvt. Ltd.,NewDelhi.
E-resources and other digital material	1. http://nopr.niscair.res.in/bitstream/123456789/5475/1/JSIR%2063%289%29%20715-728.pdf 2. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Electrochemistry/Basics_of_Electrochemistry 3. https://www.filtronics.com/blog/tertiary-treatment/stages-in-typical-municipal-water-treatment/

20ES2103 – Object Oriented Programming using Python

Course Category:	Engineering Science	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Programming for Problem Solving Programming for Problem Solving Laboratory	**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	Interpret the python syntax and semantics of control flow statements													
	CO2	Apply functions and modules in python to solve a problem													
	CO3	Apply 3rd party packages for developing solutions for real time problems													
	CO4	Implement the problems in terms of real world objects using OOPs concept													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3	2	2						2			3			
	CO2	2	2	2						2			3			
	CO3	2	2	2						2			3			
	CO4	2	2	2						2			3			

Course Content

UNIT- I

Introduction: History- Origins of Python, Features of Python- Why choose Python, what can I do with Python, Installing, Python 2 &3 installation on windows

Variables, Expressions & Statements: Variables, Variable names & keywords, Operators & operands, Expressions, Order of operations, Modulus operator, String operations.

Conditional Execution: Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Exceptions using try and except, Short circuit evaluation of logical expressions.

Iterations: The while statement, Infinite loops, "Infinite loops" and break, Finishing iterations with continue, Definite loops using for.

UNIT- II

Functions: Function calls, Built-in functions, Type conversion functions, Random

	numbers, Math functions, Adding new functions, Definition and uses, Flow of Execution, Parameters & arguments, Fruitful and void functions, Why functions?, Recursion, Scope of a variable. **Modules**: Packages small description about modularity, Third party packages, A brief tour of standard library, Command line arguments, Error output redirection and program termination, String pattern matching, Mathematics, Internet access, Dates & times, Data Compressions **UNIT- III** **Lists**: Syntactically, Accessing element from list, Slicing a list, Lists are mutable sequences, Deleting items in a list and deleting list, Methods, Searching **Dictionaries:** Creating a dictionary, Dictionary operations, Dictionary methods, Aliasing and copying **Tuples:** Tuples are immutable, Comparing tuples, Tuple assignment, Dictionaries and tuples, Multiple assignment with dictionaries, Using tuples as keys indictionaries **Strings**: A string is a sequence, Getting the length of a string using len, Traversal through a string with aloop, String slices, Strings are immutable, Looping and counting, The in operator, String comparison, String methods **Sets**: Modifying a set, Removing items from set, Set operations. **UNIT- IV** **Object Oriented Programming in Python**: Python classes, Methods, Constructors, Class variables & instance variables, Basic inheritance, Special methods, Data hiding
Text books and Reference books	**Text Books:** [T1] Vamsi Kurama, "Python Programming: A Modern Approach", Pearson India, 2017. [T2] Charles Severance, "Python for Informatics –Exploring Information", 1stEd., Shroff Publishers, 2017. **Reference Books:** [R1] Mark Lutz,"Learning Python", 5th Ed., Orielly,2013. [R2] Allen Downey "Think Python, How to Think Like a Computer Scientist", 2nd Ed., Green Tea Press, 2015. [R3] W.Chun,"Core Python Programming", 2nd Ed., PrenticeHall,2006. [R3] Kenneth.A.Lambert, "Introduction to Python", 1st Ed., Cengage Learning,2011
E-resources and other digital material	1.Charles Severance: University of Michigan, "Python for Everybody"-Courserahttps://www.coursera.org/ 2.Prof. Sudarshan Iyengar, IIT Ropar, Prof. Yayati Gupta, IIIT Dharwad, "The Joy of Computing using Python–Nptel https://nptel.ac.in/courses/106/106/106106182/#

20ES2104C – Network Theory

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply the basic network concepts to solve electric circuit problems.													
	CO2	Analyze DC and AC electrical circuits using various network problems.													
	CO3	Analyze the Transient behavior and Resonant condition of electrical circuits.													
	CO4	Derive the two port network parameters and their relationship.													
Contribution of Course Outcomes towards 00achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2														
	CO2		3													
	CO3		2													
	CO4		2													

Course Content

UNIT- I

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

UNIT- II

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

UNIT- III

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

	power, Power factor **UNIT- IV** **Resonance and Transients:** Series and parallel resonance, Selectivity, Bandwidth and Q factor, Series and parallel RLC circuits. Transient analysis of RL, RC, RLC circuits with DC using Laplace transforms. Two-port networks: Calculation of Z, Y and h parameters and their conversions.
Text books and Reference books	**Text Book:** [T1]A.Sudhakar and S.P.Shyam Mohan, "Circuits and Networks: Analysis and Synthesis", 2nd Ed., TMH, 2002 **Reference Book:** [R1] Fraklin F.Kuo, "Network Analysis and Synthesis", 2ndEd., John Wiley & Sons, 2003 [R2] William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", 6thEd., TMH, 2002
E-resources and other digital material	

20ES2105 – Engineering Graphics

Course Category:	Engineering Science	**Credits:**	3
Course Type:	Theory& Practice	**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 scales and conics													
	CO2	Draw orthographic projections of points, lines and planes													
	CO3	Draw orthographic projections of solids and to understand basics of AutoCAD													
	CO4	Understand the sections, development of solids and draw isometric views using AutoCAD													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3		3				3								
	CO2	2		3				3								
	CO3	2		3				3								
	CO4	1		3				3								
Course Content	**UNIT- I** **Introduction to Engineering Drawing:** Principles of engineering graphics and their significance **Scales**: Construction of plain and diagonal scales **Conic Sections**: Construction of ellipse, parabola and hyperbola (Treatment is limited to eccentricity or general method only) **UNIT–II** **Orthographic Projections:** Principles of orthographic projections – projections of points, Lines (Treatment is limited to first angle projection) and projections of plane regular geometric figures (Up to plane inclined to both of the reference planes) **UNIT–III** **Projections of Solids**: Projections of simple solids such as cubes, Prisms, Pyramids, Cylinders and Cones with varying positions (Limited to solid inclined to one of the														

	reference planes) **Introduction to AutoCAD:** Basic introduction and operational instructions of various commands in AutoCAD.**(**Internal evaluation only**)** **UNIT–IV** **Sections and Development of Surfaces of Right Angular Solids**: Sections and sectional views of rightangular solids of Prism, Pyramid and Cone, Development of surfaces of right regular solids of prism, Pyramid and cone. **Isometric Projections**: Conversion of isometric views into orthographic projections of simple castings using AutoCAD. (Treatment is limited to simple objects only, Internal Evaluation only).
Text books and Reference books	**Text Books:** [T1] Basanth Agrawal & C.M.Agrawal, "Engineering Drawing", McGraw Hill Education Private Limited, NewDelhi. [T2] N.D.Bhatt "Engineering Drawing", 53rd Ed., Charotar Publishing House, Anand, 2019 **Reference Books:** [R1] K.L.Narayana & P.Kannaiah,"Text Book on Engineering Drawing", 2nd Ed., Scitech publications (India) Pvt.Ltd., Chennai, 2006. [R2] K.Venugopal, "Engineering Drawing and Graphics + AutoCAD", New Age International, NewDelhi. [R3] D.M.Kulkarni, A.P.Rastogi, A.K.Sarkar, "Engineering Graphics with AutoCAD", PHI Learning Private Limited, Delhi, 2013.
E-resources and other digital material	1.http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html#isodrawing. 2.https://onlinecourses.nptel.ac.in/noc20_me79/preview 3.https://nptel.ac.in/courses/112/103/112103019/

20ES2152 – Object Oriented Programming using Python Laboratory

Course Category:	Engineering Science	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:	Programming for Problem Solving, Programming for Problem Solving Laboratory	**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	Implement python programming constructs to build small to large applications.													
	CO2	Implement the problems in terms of real world objects using OOPs concept													
	CO3	Evaluate and handle the errors during run time involved in a program													
	CO4	Extract and import packages for developing different solutions for realtime problems													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3		2						2			3			
	CO2	3	2	2						2			3			
	CO3	2	2	2						2			3			
	CO4	2	2	2						2			3			
Course Content	**List of Experiments:** **Week 1: Fundamental Programs** Running instructions in interactive interpreter and a Python script Write a program to purpose fully raise indentation error and correct it **Week 2: Operations** Develop Python programs using basic operations in Python **Week 3 & 4: Conditional & Control Flow** Develop Python programs that make use of conditional and control flow structures. **Week 5: Functions** Develop Python programs using recursive and non-recursive functions **Week 6, 7 & 8:Data Structures**														

	Develop Python programs using suitable data structures **Week 9: Modules** Illustrate installing packages via PIP and develop Python programs using modules **Week 10 & 11:** Application oriented case studies **Week 12: Classes, Inheritance** Illustrate class variables and instance variable Develop Python programs to exemplify the concepts of inheritance and overloading
Text books and Reference books	**Text Books:** [T1] Vamsi Kurama, "Python Programming: A Modern Approach", Pearson India, 2017. [T2] Charles Severance, "Python for Informatics – Exploring Information",1st Ed., Shroff Publishers,2017 **Reference Books:** [R1] Mark Lutz,"Learning Python", 5th Ed., Orielly,2013. [R2] Allen Downey, "Think Python, How to Think Like a Computer Scientist", 2nd Ed., Green Tea Press, 2015. [R3] W.Chun,"Core Python Programming", 2nd Ed., PrenticeHall,2006. [R4] Kenneth.A.Lambert,"Introduction to Python", 1st Ed., CengageLearning,2011.
E-resources and other digital material	1.Charles Severance: University of Michigan, "Python for Everybody", Coursera https://www.coursera.org/ 2.Prof .Sudarshan Iyengar, IIT Ropar, Prof. Yayati Gupta, IIIT Dharwad, "The Joy of Computing Using Python" NPTEL https://nptel.ac.in/courses/106/106/106106182/# 3.Charles Russell Sevarance, University of Michigan, "Python for Everybody", 2019. https://www.coursera.org/learn/python

20ES2153 – Engineering Workshop

Course Category:	Engineering Science	**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	Understand the basic joints using wood and familiarize with various fundamental aspects of house wiring.													
	CO2	Prepare basic models using sheet metal and practice joining of metals using arc welding technique.													
	CO3	Familiarize with various manufacturing processes such as injection moulding and 3D printing													
	CO4	Understand the preparation of PCB													
	CO5	Understand simple IOT applications using Arduino													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			2					1			3	2			
	CO2			2					1			3	2			
	CO3			2					1			3	2			
	CO4						1									
	CO5							2								

Course Content

List of Experiments:

Part-A

Carpentry:

Demonstration of cross hal flap and T joints. (1class)

Demonstration of power tools.

Electrical Wiring:

Fundamentals of electric wiring and practice of series wiring. (1class)

Practice of staircase wiring and connecting a fluorescent tube.

Sheet Metal & Soldering:

Preparation of complete funnel using sheet metal and practice of soldering. (2classes)

	Preparation of a square box using sheet metal and practice of soldering. **Welding:** Preparation of corner joint using arc welding process. (1class) Preparation of "T" joint using arc welding process. **Manufacturing Processes:** Preparation of a small plastic part using injection moulding process. (1class) Demonstration of manufacturing a simple model using 3D printing process. **Electronic Circuits:** **To prepare PCB for the given electronic circuit** To prepare the layout and printing it on copper clad board To etch and drill the holes on PCB (2classes) **To solder the components on the PCB prepared and test the circuit** To identify and solder the components on the PCB prepared To test the operation of the circuit. **Basic IOT:** **Demonstration of Arduino board** Demonstrate different components & pin configuration of Arduino To setup Arduino IDE for programming. **To measure Temperature & Humidity** Interfacing of temperature & humidity sensor with Arduino. (2classes) Execute the program on Arduino IDE & display the measured values. T**o measure Distance** Interfacing of ultrasonic sensor with Arduino Execute the program on Arduino IDE & display the measured value. **Part-B** **Group Activity**(4classes) Students must prepare a working model / assembly using the knowledge gained from the above trades.
Text books and Reference books	**Text Books:** [T1] Kannaiah.P & Narayana.K.C, "Manualon Workshop Practice", Scitech Publications, Chennai,1999. [T2] Venkatachalapathy.V.S., "First year Engineering Workshop Practice", Ramalinga Publications, Madurai,1999. **Reference Books:** [T1] Gopal.T.V,Kumar.T and Murali.G, "A First Course on Workshop Practice – Theory, Practice and Work Book", Suma Publications, Chennai, 2005

E-resources and other digital material	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/index.htm

20MC2106 – Professional Ethics & Practice

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

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	Know the moral autonomy and uses of ethical theories.														
	CO2	Understand engineering as experimentation														
	CO3	Understand about safety, risk and professional rights.														
	CO4	Know the ethics regarding global issues related to environment, computers and weapons development. Understand general principles of contracting.														
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2														
	CO2								2							
	CO3						3									
	CO4											2				

Course Content

UNIT- I

Engineering Ethics: Senses of 'Engineering Ethics' - Variety of moral issues- Types of inquiry – Moral dilemmas – Moral autonomy- Kohlberg's theory - Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and religion – Uses of ethical theories.

UNIT- II

Engineering as Social Experimentation: Engineering as experimentation – Engineers as responsible experimenters – Codes of ethics – A balanced outlook on law –The challenger case study

UNIT- III

Safety, Responsibilities and Rights: Safety and risk-assessment of safety and risk-risk benefit analysis and reducing risk – The three mile island and chernobyl case studies. Collegiality and loyalty – Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime – Professional rights – Employee rights- Intellectual Property Rights (IPR)- Discrimination

	UNIT- IV **Global Issues**: Multinational corporations – Environmental ethics – Computer ethics – Weapons development- Engineers as managers- Consulting engineers- Engineers as expert witnesses and advisors - Moral leadership – Sample code of ethics (Specific to a particular engineering discipline). **General Principles of Contracts Management:** Indian contract act,1972 and amendments covering general principles of contracting.
Text books and Reference books	**Text Books:** [T1] Mike Martin and Roland Schinzinger, "Ethics in Engineering", Mc Graw Hill, NewYork (1996). [T2] Govindarajan. M, Natarajan. S, Senthil Kumar.V.S., "Engineering Ethics", Prentice Hall of India, NewDelhi (2004). **Reference Books:** [R1] Baum, R.J. and Flores, A., "Ethical Problems in Engineering, Center for the studyof the Human Dimensions of Science and Technology", Rensellae Polytechnic Institute, Troy, NewYork,1978. [R2] Beabout.G.R, Wennemann.D.J, "Applied Professional Ethics: A Developmental Approach for Use with Case Studies", University Press of America Lanham, MD, 175pp , 1994. [R3] Dutt, "Indian Contract Act", Eastern Law House, 1994.
E-resources and other digital material	

Second Year
(III Semester)

20BS3101 – Complex Analysis & Numerical Methods

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Determine analytic, non-analytic functions and evaluate complex integrals													
	CO2	Analyze Taylor, Laurent series and evaluate real definite integrals using residue theorem													
	CO3	Solve algebraic, transcendental, system of equations and estimate functions using polynomial interpolation													
	CO4	Solve initial value problems numerically													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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** **Complex Analysis:** Introduction, Continuity, Cauchy-Riemann equations. Analytic functions, Harmonic functions, Orthogonal systems, Application 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**: Solution of algebraic and transcendental equations with Newton - Raphson method, Solution of simultaneous linear equations with Gauss - Seidel iterative 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 4^{th}order.
Text books and Reference books	**Text Book:** [T1] B.S.Grewal, "Higher Engineering Mathematics", 44^{th} Ed., Khanna Publishers, 2019. **Reference Books:** [R1] Erwin Kreyzig, "Advanced Engineering Mathematics", 10^{th} Ed', John Wiley& Sons, 2015. [R2] R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5^{th}Ed., Narosa Publishers, 2016. [R3] N.P.Bali, Manish Goyal, "A Textbook of Engineering Mathematics", 9^{th}Ed., Lakshmi Publications (P) Limited, 2016. [R4]H.K.Das, Er.Rajnish Verma, "Higher Engineering Mathematics", 3^{rd}R Ed., S.Chand & Co., 2014. [R5]S.S.Sastry,"Introductory Methods of Numerical Analysis", 5^{th} Ed., PHI Learning, 2012
E-resources and other digital material	1. Prof. Pranav Haridas, Kerala School of Mathematics, Complex Analysis https://onlinecourses.nptel.ac.in/noc21_ma39/preview 2. Prof. Ameeya Kumar Nayak, Prof. Sanjeev Kumar, IIT Roorkee, Numerical methods https://onlinecourses.nptel.ac.in/noc21_ma45/preview 3. Jeremy Orloff, Massachusetts Institute of Technology: MIT Open Course Ware, Complex Variables with Applications https://ocw.mit.edu. 4. Henrik Schmidt, Massachusetts Institute of Technology: MIT Open Course Ware, Introduction to Numerical Analysis for Engineering https://ocw.mit.edu

20ES3102 – Electronic Devices and Circuits

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply the basic concept of semiconductor devices													
	CO2	Analyze the operation of V-I characteristics of semiconductor devices													
	CO3	Analyze various stability biasing techniques in BJT and FET													
	CO4	Design diode circuit for various applications													
	CO5	Use SPICE simulator to implement a circuit for diode applications													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2														
	CO2		2													
	CO3		2												2	
	CO4		3												1	
	CO5					2										1

Course Content

UNIT- I

Conduction in Semiconductors: Conductivity of a semiconductor, Carrier concentrations in an intrinsic semiconductor, Donor and acceptor impurities, Charge densities in a semiconductor, Diffusion.

Semiconductor Diode Characteristics: Qualitative theory of P-N junction, p-n Junction as a Diode, The Volt Ampere Characteristics, The temperature dependence of P-N Characteristics, Diode Resistance, Space Charge or Transition Capacitance, Diffusion capacitances. Breakdown Diodes. Volt Ampere Characteristics of Zener diode

UNIT- II

Diode Applications: Diode approximations, Series diode configurations with DC inputs, Parallel and series – Parallel configurations with DC inputs, Clippers, Clampers.

Rectifiers: Diode as a rectifier, Half wave, Full wave - Centre-tapped, Bridge rectifiers

	without filter and with filters - Inductor filter, Capacitor filter, L section, Zener regulator. **UNIT- III** **Transistor Characteristics:** The Junction transistor**,** Characteristics of common base, Common emitter and Common collector configuration. **Transistor Biasing & Thermal Stabilization:** The operating point, Bias stability, Collector to base bias, Self- bias, Bias compensation, Thermistor & Sensistor compensation, Thermal runaway and thermal stability **UNIT- IV** **Field Effect Transistors:** Construction and Characteristics of JFETs, Transfer characteristics, Specification sheets (JFETs), Depletion-type MOSFET and Enhancement-type MOSFET. **FET Biasing**: Introduction, Fixed bias configuration, Self- bias configuration, Voltage divider biasing, Depletion-type MOSFET and Enhancement-type MOSFET
Text books and Reference books	**Text Books:** [T1] Jacob Millman, Christos C Halkias & Satyabrata JIT, "Millman's Electronic Devices and Circuits", 4th Ed., TMH, 2015. (Unit I, II& III) [T2] Robert L Boylested and Louis Nashelsky, "Electronic Devices and Circuit Theory", 10th Ed., Pearson India, 2009. (UNIT IV). **Reference Books:** [R1] Nandita Das Gupta and Amitava Das Gupta, "Semiconductor Devices Modelling and Technology", PHI Learning Pvt. Ltd., 2013 [R2] David A Bell., "Electronic Devices and Circuits", 5th Ed., Oxford University Press, 2008
E-resources and other digital material	1. http://www.nptelvideos.in/2012/12/basic-electronics-drchitralekha-mahanta.html 2. https://nptel.ac.in/courses/117/103/117103063/ 3. https://nptel.ac.in/courses/117/106/117106033/ 4. https://nptel.ac.in/courses/117/102/117102061/

20EI3303 – Digital Circuits & Systems

Course Category:	Program 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	Demonstrate proficiency in codes and number system converting circuits													
	CO2	Analyze digital electronic circuits using analytical tools													
	CO3	Design digital electronic circuits with and without memory elements.													
	CO4	Select suitable memories and logic families for digital system design													
	CO5	Use the spice software to design the digital electronic circuits													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2													1	
	CO2		3												1	
	CO3		3												2	
	CO4	2													1	
	CO5					2										2

Course Content

UNIT- I

Digital Fundamentals: Number systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s complements, Codes – BCD, Excess 3, Gray, Boolean laws &theorems, Logic gates, Universal gates, Canonical forms, Standard forms, Simplification of Boolean functions using algebraic techniques, Karnaugh map minimization and Quine-Mc Cluskey method of minimization

UNIT- II

Combinational Logic Design: Half-Adder, Full-Adder, Half-Subtractor, Full-Subtractor, BCD to 7 segment decoder, Design of a binary to gray and gray to binary code converters.

Combinational Logic Design Using MSI Circuits: Multiplexer, Combinational logic design using multiplexers, Demultiplexers / Decoders and their use in combinational logic design.

UNIT- 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. **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. **Digital Integrated Circuits:** Characteristics of Digital ICs, Logic Families: MOS and CMOS logic families. **Computer Aided Design of Digital Systems:** Computer Aided Design (CAD) concepts, CAD tools, Introduction to VHDL, Combinational Circuits using VHDL, Sequential circuits using VHDL.
Text books and Reference books	**Text Book:** [T1] R P Jain "Modern Digital Electronics", 4th Ed., TMH. **Reference Books:** [R1] A.Anand Kumar, "Fundamentals of Digital Circuits", PHI, 2006 [R2] M.Morris Mano, "Digital Logic and Computer Design", PHI,2003
E-resources and other digital material	

20EI3304 – Sensors and Transducers

Course Category:	Program 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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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, Photovoltaic cell, 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

20EI3305 – Electrical and Electronic Measurements

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply suitable null or deflection type technique to measure prescribed electrical parameter													
	CO2	Select a suitable digital instrument to measure physical and electrical parameters													
	CO3	Compare the operation of various oscilloscopes and probes													
	CO4	Explain the principles of various signal generators and wave analyzers													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3												2		
	CO2		3											2		
	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, The Owen bridge, De-sauty 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, Electrostatic deflection, 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, Measure of frequency by lissajous method. **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, Digital tachometer, Digital pH meter
Text books and Reference books	**Text Books:** [T1] W D Cooper & A D Helfrick, "Electronic Instrumentation and Measurement Techniques", PHI, 1998 (Unit-I) [T2] H.S.Kalsi, "Electronic Instrumentation", 2nd Ed., TMH. (Units-II, III and IV) **Reference Books**: [R1]A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co [R2] Oliver & Cage, "Electronic Measurements and Instrumentation", Mc Graw Hill, 1975
E-resources and other digital material	1. https://www.youtube.com/watch?v=3eYmFjHnQjY&list=PLbRMhDVUMngcoKrA4sH-zvbNVSE6IpEio

20ES3151 – Electronic Devices and Circuits Lab

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Design various analog electronic circuits using discrete components and NI Multisim.													
	CO2	Analyze the outputs and interpret the data generated by electronic circuits, such as waveforms and characteristics of devices.													
	CO3	Conduct experiments as an individual or team.													
	CO4	Prepare an effective report based on experiments.													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			3		3									2	
	CO2				3										2	
	CO3									2			2			
	CO4										2					
Course Content	**List of Experiments** **A. Hardware Module:** 1. Characteristics of PN Junction diode and Zener diode. 2. Characteristics of transistor in common emitter configuration. 3. Design of transistor self-bias circuit. 4. Drain and transfer characteristics of junction field effect transistor. 5. Design of unbiased clampers. 6. Design of clippers. **B. Software (Multisim) Module:** 7. Design Voltage regulator using Zener diode. 8. Verification of half-wave rectifier operation with and without filter. 9. Verification of full-wave rectifier operation with and without filter. 10. Frequency response of CE amplifier. 11. Frequency response of CS Amplifier.														

	12. Design of Voltage Series Feedback amplifier
Text books and Reference books	--
E-resources and other digital material	--

20EI3352 – Digital System Design Lab

Course Category:	Program 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	Apply the knowledge of Boolean algebra to demonstrate the truth table of logic circuits													
	CO2	Design various combinational and sequential logic circuits													
	CO3	Analyze outputs for a logic circuit													
	CO4	Conduct experiment with an individual or team by using modern tools like Multisim, VHDL													
	CO5	Prepare an effective report based on an experiment													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2													2	
	CO2			3											2	
	CO3		3												2	
	CO4				3	3				2			1			3
	CO5										2					
Course Content	**List of Experiments** **A. Digital Electronics Module:** 1. Realization of logic gates using universal gates. 2. Verification of Flip-Flops using gates 3. Design of synchronous counters IC 74163 4. Design of MUX and DEMUX **B. P-Spice Module:** 1. Implement the given Boolean function using logic gates in SOP and POS forms. 2. Design binary to gray and gray to binary code converters. 3. Design BCD-to 7 segment decoder 4. Realization of shift registers														

	C. VHDL Module: 1. Implement the full adder and verify the functionality using VHDL 2. Design of multiplexer and demultiplexer using VHDL 3. Implement the 3 bit up/down counter using VHDL 4. Implement priority encoder using VHDL
Text books and Reference books	--
E-resources and other digital material	--

20EI3353 – Measurements Lab

Course Category:	Program 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	Apply the basic measurement techniques to measure the electrical parameters													
	CO2	Analyze the outputs and interpret the data generated from the null and deflection techniques													
	CO3	Conduct various experiments as an individual or team.													
	CO4	Prepare an effective report based on experimental outcome													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3												3		
	CO2		3											3		
	CO3				3					1			1			1
	CO4										2					
Course Content	**List of Experiments** 1. DC meters using D'Arsonval galvanometer and their range extension. 2. AC meters using D'Arsonval galvanometer and their range extension. 3. Measurement of voltage, frequency, phase angle and phase shift using a CRO. 4. 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 Schearing bridge. 8. Simulation of spectrum analyzer using analog discovery kit. 9. Measurement of amplitude and frequency of different types of waveforms using function generator. 10. Measurement of inductance of high Q coils using Hay bridge. 11. Measurement of frequency using a Wien bridge. 12.Calibration of voltmeter using potentiometer														

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

20TP3106 – Logic and Reasoning

Course Category:	Soft Skills	**Credits:**	1
Course Type:	Learning by Doing	**Lecture - Tutorial - Practice:**	0 - 0- 2
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 0 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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/

20MC3107A – Environmental Studies

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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.

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

(c)**Mineral Resources**: Use and exploitation, Environmental effects of extracting and using mineral resources.

(d)Food Resources: World food problems, Changes caused by agriculture and overgrazing, Effects of modern agriculture, Fertilizer-pesticide problems, Water logging, Salinity.

	(e)Energy Resources: Growing energy needs, Renewable and non-renewable energy sources, Use of alternate energy sources. **(f)Land Resources:** Land as a resource, Land degradation, Man induced landslides, Soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles **UNIT- II** **Ecosystems:** Concept of an ecosystem. Structure and function of an ecosystem. Producers, Consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, Food webs and ecological pyramids. Introduction, Types, Characteristic features, Structure and function of the following ecosystem: (a) Forest ecosystem (b)Grassland ecosystem (c)Desert ecosystem (d)Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) **Biodiversity and its Conservation** Introduction, Definition: Genetic, Species and ecosystem diversity. Biogeographically classification of India. Value of biodiversity: Consumptive use, Productive use, Social, Ethical, Aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: Habitat loss, Poaching of wildlife, Man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity **UNIT- III** **Environmental Pollution:** Definition, Causes, Effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards **Solid waste management:** Causes, Effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. **Disaster management**: Floods, Earthquake, Cyclone and landslides **UNIT- IV** **Social Issues and the Environment:** From unsustainable to sustainable development. Urban problems related to energy. Water conservation, Rain water harvesting, Watershed management. Resettlement and rehabilitation of people; Its problems and concerns. **Environmental ethics** Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation, Consumerism and waste products. **Environment Protection Act:** Air (Prevention and control of pollution) act. Water

	(Prevention and control of pollution) act. Wildlife protection act. Forest conservation act. Issues involved in enforcement of environmental legislation. **Public awareness:** Human population and the environment, Population growth, Variation among nations, Population explosion - Family Welfare Programme. **Environment and Human Health:** Human rights, Value education, HIV/AIDS, Women and child welfare, Role of information technology in environment and human health. **Field Work/ Case Studies:** 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	

Second Year
(IV Semester)

20BS4101 – Analog Electronic Circuits

Course Category:	Basic 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	Analyze amplifier circuits at low & high frequencies													
	CO2	Determine various parameters of the amplifier circuits													
	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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		3													
	CO2	3														
	CO3			2												
	CO4		2													
	CO5					2										

Course Content

UNIT- I

Transistor Amplifiers at Low frequencies

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

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

UNIT- II

Transistor Amplifiers at High frequencies: The hybrid-pi (π) Common Emitter Transistor Model, hybrid-pi (π) conductances, the hybrid-pi (π) capacitances, validity at hybrid-pi (π) model, variation of Hybrid-pi (π) parameters, the CE short circuit current gain, current gain with Resistive load, single stage CE transistor amplifier response, the Gain-Bandwidth product, Emitter follower at high frequencies.

	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 Books:** [T1] Jacob Millman and Christos C Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems", 12thEd., TMH, 1991. [T2] G.K.Mithal, "Electronic Devices and circuits", 23rd Ed., Khanna Publishers 2010. **Reference Books:** [R1] A.P.Godse and U.A.Bakshi "Electronic Circuit Analysis", 1stEd., fourth reprint, Technical Publications,2010. [R2] Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 6th Ed., PHI 2000
E-resources and other digital material	

20EI4302 – Linear Integrated Circuits and Applications

Course Category:	Program Core	**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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2													2	
	CO2	3													2	
	CO3		3			2									3	
	CO4	3													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** **Nonlinear applications of Op-Amp:** Sample and hold circuit, Precision diode, Applications - Precision full wave rectifier, Clippers, Peak detector and Absolute value output 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 multiple feedback band pass filters; Band stop filters - Wide band stop and notch filter; State variable filter. **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- I** **Special Purpose ICs and Applications:** 555 Timer - 555 as Monostable and Astable operation, Applications, Schmitt trigger; Voltage controlled oscillator (IC566),ICL8038 Function generator, Frequency to voltage converters. IC voltage regulators- Fixed voltage regulators- LM78XX, LM79XX; Variable voltage regulators – LM 317, LM 723 IC
Text books and Reference books	**Text Books:** [T1] D. Roy Choudhry and Shail B. Jain, "Linear Integrated Circuits", 4th Ed., 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", 6th Ed,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. Kanchana Bhaskaran, Linear Integrated Circuits, TMH, 2nd Ed., 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

20EI4303 – Control Systems

Course Category:	Program 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	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	Use the modern tools to analyze the stability of the given control system													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	2														1
	CO3		3													2
	CO4					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, Time domain specifications, Steady state error and error constants, Effect of adding poles and zeros to transfer function, 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 Books:** [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/

20EI4304 – Industrial Instrumentation

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Sensors and Transducers	**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 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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	3														2
	CO3	3														2
	CO4		2													2
Course Content	**UNIT- I** **Temperature Measurement:** Introduction, Classification of temperature sensors based on change in dimensions - Bimetals; Change in electrical properties – RTD, Thermistor; Thermo electricity – Thermocouples; IC sensors, Radiation pyrometers, Fiber-optic sensors, SAW thermometer, Ultrasonic thermometer, Problems **UNIT- II** **Pressure Measurement:** Introduction, pressure standards, Manometers; Force summing devices – Diaphragms, Bellows, Bourdon tubes; Secondary transducers – Resistive, Inductive, Capacitive, Piezoelectric; Low pressure measurement **-** Mcleod, Knudsen, Pirani & Ionization gauges**;** Calibration of pressure gauges using dead weight tester, Problems. **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, Anemometers; Mass flow measurement type – Coriolis; Positive displacement flow meters - Nutating disc and lobed impeller; Open channel flow meters- Weirs, Flumes, Problems **UNIT- IV** **Level Measurement:** Introduction, Mechanical level indicators - Differential pressure type; Optical – Laser sensors; Electrical type - Resistive, inductive and Capacitive; Radiative methods - Ultrasonic, Gamma; Problems. **Humidity, Density & Viscosity Measurement:** Introduction, hygrometers-Wet and dry bulb, Electrolytic hygrometers; Moisture analyzer-Neutron back scatter moisture analyzer; Densitometers- Electromagnetic suspension, Ultrasonic densitometers; Viscometers- Saybolt and Float viscometers.
Text books and Reference books	**Text Book:** [T1] A.K.Ghosh, "Introduction to Measurements & Instrumentation", IIIrd Ed., PHI, 2009 **Reference Books:** [R1] A.K.Sawhney & Puneet Sawhney,"A Course in Mechnanical Measuremnets & Instrumentation", 12th Ed., Dhanapat Rai & Co., 2012. [R2] Ernest O Doebelin/Dhanesh, N Manik, "Measurement systems", 6th Ed., Tata Mc Grawhill. [R3] C.S.Rangan, G.R.Sarma & V.S.V.Mani "Instrumentation Devices &Systems", 2nd Ed., TMH, 2011
E-resources and other digital material	1. http://nptel.ac.in/courses/108105064 2. http://nptel.ac.in/courses/108106074

20HS4105 – Universal Human Values

Course Category:	Humanities and Social Sciences	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:		**Continuous Evaluation:**	50
		Semester end Evaluation:	50
		Total Marks:	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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
	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

20EI4351 – Transducers Lab

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Use sensors and transducers for measurement of various parameters.													
	CO2	Analyze the characteristics of various transducers.													
	CO3	Conduct experiments as individual or team.													
	CO4	Write an effective report based on experiments.													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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. Temperature measurement using RTD and thermistor 2. Temperature measurement using thermocouple and IC temperature sensor 3. Characteristics of LDR, photodiode and phototransistor 4. Measurement of magnetic flux density using Hall transducer 5. 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 LVDT 9. Interfacing a PIR sensor with Arduino for motion detection 10. Interfacing a soil moisture sensor with Arduino and display on LCD 11. Interfacing an inductive proximity sensor with Arduino for object detection 12. Interfacing a gas sensor with Arduino and display on Serial Monitor **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	**Text 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	1. https://store.arduino.cc/digital/create 2. https://www.allaboutcircuits.com/

20EI4352 – Control Systems Lab

Course Category:	Program 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	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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	2				2										1
	CO2				3	2										2
	CO3									2			1			
	CO4										2					
Course Content	**List of Experiments** **<u>Part-A</u>** 1.Dynamic characteristics of first order systems 2. Time response of second order systems 3. Characteristics of synchro transmitter and receiver 4. Speed torque characteristics of DC servomotor 5.Characteristics of magnetic amplifier **<u>Part-B</u>** **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.** Mathematical modeling of physical systems using MATLAB/LabVIEW **3.** Block diagram reduction techniques for determination of transfer function of a given system 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 **9.** Study the effect of addition of zeros to the forward path transfer function of a closed loop system **10.** Study the effect of addition of poles to the forward path transfer function of a closed loop system **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] I.J.Nagrath & M.Gopal, "Control systems Engineering", New Age publisher, 5th Ed. [T2] A.Ananda Kumar, "Control Systems", PHI **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

20EI4353 – Linear Integrated Circuits Lab

Course Category:	Program 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 and non-linear applications of op-amp circuits, 555 timer and IC voltage regulators.													
	CO2	Analyze the outputs generated by an electronic circuit and interpret the data from output waveforms.													
	CO3	Conduct the experiment as an individual or a team													
	CO4	Prepare an effective report based on experimental results													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			3											2	
	CO2				3										2	
	CO3									2			2			
	CO4										2					
Course Content	**List of Experiments** 1. Measurement of Op-amp parameters 2. Design inverting amplifier, Adder circuit and comparator using Op-Amp IC741. 3. Design a precision full wave rectifiers using Op-Amp 741IC 4. Design an instrumentation amplifier using 741IC 5. Design an integrator using 741IC 6. Design a waveform generation using 741IC (square, triangular) 7. Design a Wein bridge oscillator using 741IC 8. Design of first order active low pass and high pass filter using 741IC 9. Design an IC 555 timer astable circuit 10. Design a schmitt trigger using IC 555 Timer 11. Design a voltage regulator using IC 723 12. Design a D/A converters using 741IC using 3 bit R-2R ladder circuit technique **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	**Text Books:** [T1] D. Roy Choudhry and Shail B. Jain, "Linear Integrated Circuits", 4th Ed., NewAge International Pvt. Ltd, 2011. [T2] Rama Kant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th Ed., PHI, 2012
E-resources and other digital material	1. www.analog.com 2. https://nptel.ac.in/courses/108106068/ 3. https://www.allaboutcircuits.com/

20TP4106 – English for Professionals

Course Category:	Soft Skills	**Credits:**	1
Course Type:	Learning by Doing	**Lecture - Tutorial - Practice:**	0 - 0- 2
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 0 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Present themselves effectively in the professional world 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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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	

20EI4607 – Virtual Instrumentation

Course Category:	Skill Oriented Course	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	0 - 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	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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1					3										3
	CO2				2	3										3
	CO3				2	3										3
	CO4				2	3								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 loops 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
Text books and Reference books	**Text Book:** [T1] Jovitha Jerome, "Virtual Instrumentation using LabVIEW", 1st Ed., PHI, 2013 **Reference Books**: [R1] Sanjay Gupta, Joseph John, "Virtual Instrumentation using LabVIEW", 1st Ed., Tata McGraw-Hill, 2005 [R2] Gary Johnson, Richard Jennings, "LabVIEW Graphical Programming", Tata McGraw-Hill, 2006
E-resources and other digital material	1. http://www.ni.com

20MC4108B – Indian Constitution

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Know the fundamental law of the land													
	CO2	Understand how fundamental rights are protected													
	CO3	Perceive the structure and formation of the Indian government system													
	CO4	Explain when and how an emergency can be imposed and what are the consequences													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1						2									
	CO2						2									
	CO3						2									
	CO4						2									

Course Content

UNIT- I

Introduction to Constitution of India: Meaning of the constitution law and constitutionalism, Historical perspective of constitution of India, Salient features of constitution of India.

UNIT- II

Fundamental rights: Scheme of the fundamental rights, Scheme of the fundamental right to equality, Scheme of the fundamental right to certain freedoms under Article 19, Scope of the right of life and personal liberty under Article 21, writs jurisdiction

UNIT- III

Nature of the Indian constitution: Federal structure and distribution of legislative and financial powers between the union and states

Parliamentary form of Government in India: The constitution powers and status of the President of India, Amendment of the constitutional powers and procedure, Historical perspectives of the constitutional amendments in India

	Local Self Government: Constitutional scheme in India **UNIT- IV** **Emergency Provisions:** National emergency, President rule, Financial emergency
Text books and Reference books	**Text Book:** [T1] Dr. J.N. Pandey, "Constitutional Law of India" published by Central law Agency, Allahabad, Edition 2018 **Reference Books:** [R1] V.N Shukla's, "Constitution of India" Eastern Book Company, Lucknow. [R2] M.P. Jain, "Indian Constitution Law", Wadhwa and Company, Nagpur. [R3] D.D. Basu, "Constitution of India", Wadhwa and Company, Nagpur
E-resources and other digital material	

Third Year
(V Semester)

20EI5301 – Analytical Instrumentation

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

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	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. **Raman Spectrometer:** Raman effect, Resonance enhanced Raman scattering, Surface enhanced Raman scattering, Principle of Raman spectrometer, Laser based Raman 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
Textbooks and Reference books	**Text Book:** [T1] R.S.Khandpur, " Handbook of Analytical Instruments", 2nd Ed., TMH, 2006 [T2] Willard H.H, Merrit L.L, Dean J.A,"Instrumental Methods of Analysis", 7th Ed., CBS publishers and Distributors, 1988 **Reference Books:** [R1] D.A.Skoog and James J.Leary, "Principles of Instrumental Analysis", 5thEd., Holt-Saunders, 1997 [R2] James.W.Robinson, Eileen.M.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

20EI5302 – Process Control

Course Category:	Program 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 system													
	CO3	Select suitable controller, mode, final control element and control schemes for a given application													
	CO4	Analyse various control schemes and tuning methods													
	CO5	Use simulation software to analyse the control system													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	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, continuous and batch processes, The 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. **Control Valves**: Sliding stem control valves, Rotating shaft control valves, Control valve sizing. **UNIT – IV** **Controller Tuning**: PID controller design and tuning, Criteria for good control, Tuning methods - Ziegler-Nichols method of tuning, Cohen-Coon method of tuning. **Advanced Control Strategies:** Cascade control, Feed forward control, Ratio control, Smith predictor control, Internal model control
Textbooks 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/

20HS5103 – 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 **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	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/ 4.https://speechfoodie.com/cash-flow-diagrams/

20EI5404/A – VLSI Design

Course Category:	Program Elective 1	**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 and BiCMOS circuits.													
	CO4	Understand the basic circuit concepts and scaling of MOS circuits.													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3													2	
	CO2		2												2	
	CO3		3												2	
	CO4	2													2	

Course Content

UNIT- I

Introduction to MOS Technology: Introduction to IC technology, 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 I_{ds} versus Voltage (V_{ds}), relationships, Aspects of MOS transistor threshold voltage (V_t), Trans conductance gm and output conductance g_{ds}, Figure of merit (ωo), The pass transistor, NMOS inverter, Pull-up to Pull-down ratio for NMOS inverter driven by another NMOS inverter. Alternative forms of pull-up, The CMOS inverter, MOS transistor circuit model, BiCMOS inverter, Latch-up in CMOS circuits and BiCMOS latch-up susceptibility.

UNIT – III

MOS Circuit Design Processes: MOS layers, Stick diagrams, Design rulesand layout.General observations on the design rules, 2μm Double metal, Double poly, CMOS/BiCMOS rules, 1.2μm Double metal, Double poly CMOS rules, Layout diagrams

	of NAND and NOR gates and CMOS inverter, Symbolic diagrams-Translation to mask form. **UNIT – IV** **Basic Circuit Concepts:** Sheet Resistance Rs, Standard unit of capacitance, The delay unit, inverter delays, Driving large capacitive loads, Propagation delays. **Scaling of MOS Circuits:** Scaling models andscaling factors, Scaling factorsfor device parameters. **Subsystem Design and Layout:** Architectural issues, Switch logic, Gate logic, Examples of structured design (combinational logic)- A parity generator, Multiplexers (data selectors).
Textbooks and Reference books	**Text Book:** [T1] Douglas A. Pucknell, "Basic VLSI Systems and Circuits", 3rd Ed., Prentice Hall of India, 2008. [T2] Neil.H.E.Weste,DavidHarris,AyanBanerjee,"CMOSVLSIDesign",3rdEd., Pearson Education2009. [T3] John F Wakerly, "Digital Design Principles & Practices", 3rd Ed., Pearson Education, 2002 **Reference Books:** [R1] Weste & Eshraghian,"Principles of CMOS VLSI Design", Addison [R2] John P.Uyemura,"Introduction to VLSI Circuits and Systems",John Wiley& Sons, Reprint 2009.
E-resources and other digital material	1. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm% 20Engg / VLSI % 20 Design/Course % 20 Objective.html 2. http://nptel.iitm.ac.in/video.php?subjectId=117106092

20EI5404/B – Sensor Signal Conditioning

Course Category:	Program Elective 1	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Sensors and Transducers, Industrial Instrumentation 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	Explain the basic concepts of for resistive ,reactive and self generating sensors														
	CO2	Select suitable signal conditioning circuits for resistive and 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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2		3											3		
	CO3		2											2	1	
	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
Textbooks 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

20EI5404/C – Robotics and Control

Course Category:	Program Elective 1	**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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	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.
Textbooks 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

20EI5404/D – Industrial Electronics

Course Category:	Program Elective 1	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Basics of Electrical Engineering, Electronic Devices and Circuits	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the principles and characteristics of different power electronic devices.													
	CO2	Analyze the operation of SCR converters, Inverters ,Choppers andCyclo 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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1														2	
	CO2		2												2	
	CO3		2												2	
	CO4	3													2	
Course Content	**UNIT- I** **Thyristors:**SCR structure and operation, Characteristics of SCR: StaticV-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 and LASCR **UNIT – II** **AC-DC Converters – Thyristor Converters:** Introduction, Single phase converters: Halfwave converters, Fullwave converters, Bridge converters. **DC-AC Converters –Thyristor Inverters:** Introduction, Single phase inverters, McMurray Inverter, McMurray 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 cycloconverters **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
Textbooks 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

20EI5205/A – Essential Principles of Image Sensors

Course Category:	Open /Job Oriented Elective 1	**Credits:**	3
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	Analyze 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 the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		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
Textbooks 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. [2]Junichi Nakamura, "Image Sensors and Signal Processing for Digital Still Cameras", Taylor & Francis,2006
E-resources and other digital material	

20EI5205/B – Wireless Technologies

Course Category:	Open /Job Oriented Elective 1	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial - Practice:**	2 - 0- 0
Prerequisites:	Computer Networks	**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 of protocols and networks													
	CO2	Analyze the various channels and data transfers													
	CO3	Understand the basic concepts of interference in various systems													
	CO4	Analyse the various multiple access categories													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3														
	CO2			2												
	CO3	2														
	CO4			2												
Course Content	**UNIT- I** **Introductions:** Introduction, Intelligent network, Network architecture, Protocol architecture, Channel structure, RF Channel, Physical channel, Logical channel, Narrowband and wideband systems, Multiple access, Space division multiple access **UNIT- II** **Wireless Data Technology:** Introduction, General packet radio service, Data flow and data structure, Physical channels and logical channels, EIA/TIA/IS-95B, High data rate, HDR solution, Medium access, Handoff features, Throughput performance **UNIT- III** **Cellular principle:** Cellular hierarchy, System management, Link quality measurement, System performance, Interference control, Cellular reuse pattern, Macrocellular reuse pattern, Interference in narrowband and wideband systems, Interference in narrowband, Downlink interference—Omnidirectional antenna, Interference in narrowband microcellular systems, Interference in wideband systems, Network capacity **UNIT- IV** **Multiple Access:** Signal domains, Frequency domain, Time domain, Code domain, Space														

	domain, Brief remarks on signal domains, Duplexing, Frequency division duplexing, Time division duplexing, Code division duplexing, Space division duplexing Brief remarks on duplexing techniques, Multiple-access categories, Scheduled multiple access, Frequency division multiple access, Time division multiple access, Code division multiple access, Space division multiple access, Random multiple access
Textbooks and Reference books	**Text Book:** [T1] Michel Daoud Yacoub, "Wireless Technology: Protocols, Standards, andTechniques", CRC Press, 2001 **Reference Books:** [R1]Avnip Deora, Pooja Dhand, Roopali Sood, "Introduction to Wireless Technology", 2011. [R2]"Wireless TechnologiesConcepts, Methodologies, Tools andApplications Volume 1, 2012.
E-resources and other digital material	

20EI5205/C – Industry Based Elective

Course Category:	Open /Job Oriented Elective 1	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial - Practice:**	2 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

20EI5351 – Advanced Instrumentation Lab-1

Course Category:	Program Core Lab 1	**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	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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			3											3	3
	CO2			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 simulate the Sound Level Meter 5. Develop a VI to detect edges in an image with 2D convolution 6. Develop a VI to analyze the time-frequency spectrogram 7. Develop a VI to compute the averaged power spectral density 8. Develop a VI to detect peaks and valleys in a signal 9. Develop a VI to demonstrate how to continuously acquire signals using analog input. 10. Develop a VI to demonstrate how to continuously re-generate analog														

	output data 11. Develop a VI to demonstrate configuring of counter input and counter output of a DAQ 12. Develop a VI to demonstrate configuring of digital input and digital output of a DAQ
Textbooks 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

20EI5352 – Process Control Lab

Course Category:	Program Core Lab 2	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:	Control 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	Demonstrate the characteristics of major components of process control loops.													
	CO2	Analyze the performance of different control schemes in various process stations.													
	CO3	Conduct experiments as individual or team on various industrial processes.													
	CO4	Write an effective report based on experiments.													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3														
	CO2		3													2
	CO3				3					1			1			1
	CO4										2					1
Course Content	**List of Experiments** 1. Characteristics of Chromel – Alumel thermocouple and temperature transmitter 2. Characteristics of PID controller in temperature process station. 3. Characteristics of level transmitter and I/P converter. 4. Characteristics of ON/OFF controller in level process station. 5. Characteristics of flow transmitter and control valve. 6. Characteristics of PI controller in flow process station. 7. Characteristics of pressure transmitter and I/P converter. 8. Comparison of P, PI & PID control modes in pressure process station. 9. Characteristics of cascade control. 10. Characteristics of feed forward control. 11. Study of pH control system. 12. Study of temperature control in heat exchanger.														

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

20HS5153 – Advanced Communication Skills Lab

Course Category:	Humanities and Social Sciences	**Credits:**	1
Course Type:	Theory& Lab	**Lecture- Tutorial - Practice:**	0 - 0- 2
Prerequisites:	Considerable semi-advanced proficiency in language skills viz Listening, Speaking, Reading, Writing and 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	Apply elements of listening comprehension relevant for professional environments													
	CO2	Apply rational spoken communication with authentic accentuation in connected speech complemented by the abilities of argumentation and skills of public speaking													
	CO3	Understand the nuances of requisite Advanced Reading Skills for transnational techno-professional communication													
	CO4	Produce higher order written communication required for administrative and corporate compilations													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1										3					
	CO2						1		1	2	3	2				
	CO3								1	2	3	2				
	CO4				1		1			2	3	2				
Course Content	**UNIT- I** **Advanced Listening Skills** TED TALKS- Listening involving 5R method ELEVATOR PITCH: Pitches for technical audience and administrators- exposure through soft components and illustrations **UNIT – II** **Advanced Spoken Communication Skills** ➢ **Interpersonal Communication** -Individual and Group - Pyramid discussion- Conceptual framework and practice ➢ **Dynamics Of Technical And Professional Presentations**- Illustrations and														

	Practice including paralinguistic elements **UNIT – III** **Advanced Reading and interpretation skills** ➢ **Effective Reading-** SQ3R Method, ERRQ Method and SPE Method with textual practice ➢ **Logical Reading-** Syllogisms -illustrations and practice **UNIT – IV** **Advanced Writing and other Professional Communication Skills** ➢ **Advanced Compilation and Drafting Skills** - Minuets, Resume & Video profile, Review and case writing ➢ **Life Skills for Work Place Communication** including sensitivity towards gender and diversity in communication- Multi-genre activity
Textbooks and Reference books	**Text Book:** [T1] Lokesh Mehra, Sanjiva Dubey, S. P. Singh, "Corporate Employability skills" , 1st Ed., CEGR, New Delhi, 2016 [T2] Brent C. Oberg.C., "Interpersonal Communication", 1st Impression, Jaico Publishing, Mumbai, 2005 [T3] Eclectic materials offered by the Department of English **Reference Books:** [R1] Chauhan, Gajendra Singh, Smitha Kashiramka, "Technical Communication", Cengage, Delhi, 1st Impression, 2018 [R2] Quintanilla KellyM, Shan T Wahl, "Business and Professional Communication: Keys for Workplace Excellence", SAGE , New Delhi, 2nd Impression 2012 [R3] Selinkar, Larry et al, English for Academic and Technical Purposes, ist Ed., Newbury House Publishers, 1981. [R4] John Langan, College Writing Skills, McGraw Hill, 9th Ed., 2014 [R5] Martin Cutts, Oxford Guide to Plain English, 7th Impression, OUP, 2011
E-resources and other digital material	1. ODll Language Learner's Software, Aug 2021 Orell Techno Systems, Visionet Spears Digital Language Lab software Advance Pro, Feb 2021 2. www.britishcouncil.org/learning-english-gateway. 3. the-oxford-guide-to-english-usage-pdf. www.cambridgeapps.org

20TP5106 – Personality Development

Course Category:	Soft Skills-3	**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	Understand the corporate etiquette													
	CO2	Make presentations effectively with appropriate body language													
	CO3	Be composed with positive attitude													
	CO4	Understand the core competencies to succeed in professional and personal life													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1								2		3					
	CO2									2	3					
	CO3										3					
	CO4									2	3					
Course Content	**UNIT- I** 1. Analytical thinking & listening skills, Self-Introduction, Shaping young minds - A talk by Azim Premji (listening activity), Self – Analysis, Developing positive attitude, perception. 2. Communication skills verbal communication; Nonverbal communication (body language) **UNIT – II** 3. Self-management skills anger management, Stress management, Time management, Six thinking hats, Team building, Leadership qualities 4. Etiquette social etiquette, Business etiquette, Telephone etiquette, Dining etiquette **UNIT – III** 5. Standard operation methods note making, Note taking, Minutes. preparation, Email& Letter writing 6. Verbal ability synonyms, Antonyms, One word substitutes-Correction of sentences analogies, Spotting errors, Sentence completion, Course of action sentences assumptions, Sentence arguments, Reading comprehension, Practice														

	work **UNIT – IV** 7.Job-Oriented Skills - I Group discussion, Mock group discussions 8.Job-Oriented Skills –II Resume preparation, Interview skills, Mock interviews
Textbooks and Reference books	**Text Book:** [T1] Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011. [T2] S.P. Dhanavel, English and Soft Skills, Orient Black swan, 2010. [T3] R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand& Company Ltd., 2018. [T4] Raman, Meenakshi& Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011
E-resources and other digital material	1. www. Indiabix.com 6. www.freshersworld.com

20EI5354 – EPICS/Internship

Course Category:	Internship/Project	**Credits:**	1.5
Course Type:	Internship/Project	**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 a through and systematic understanding of societal problems and contemporary issues													
	CO2	Develop interest towards research oriented field through literature exploration													
	CO3	Exhibit competency in suggesting optimum solution by detail analysis of the problem													
	CO4	Demonstrate effective interpersonal, communication& presentation skills in relating engineering issues to broader societal context													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1						3	3								3
	CO2												2			2
	CO3						2									2
	CO4									2	2	2				2

20EI5607 – Digital System Design with FPGA

Course Category:	Skill Oriented Course 1	**Credits:**	2
Course Type:	Theory& Lab	**Lecture- Tutorial - Practice:**	0 - 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	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.													
	CO5	Prepare an effective report based on experiments													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			3		2									3	3
	CO2			3		2									3	3
	CO3				3										3	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 combinatorial 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 load														

	signals. 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
Textbooks 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

20MC5108A – Biology for Engineers

Course Category:	Mandatory Course	**Credits:**	0
Course Type:	Theory& Lab	**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	Understand the biological concepts from an engineering perspective and classification of living organisms													
	CO2	Demonstrate the fundamentals of biomolecules like structure, function and regulation of biological processes													
	CO3	Understand the basic principles of Mendelian genetics, gene interactions and transfer/inheritance of genetic factors/genes													
	CO4	Explain the process of cellular respiration and photosynthesis, and illustrate important diversified microorganisms and their classification													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1							3								
	CO2							3								
	CO3							3								
	CO4							3								
Course Content	**UNIT- I** **Introduction and Classification of Living organisms:** Introduction, Fundamental differences between science and engineering draw a comparison between eye and camera, Bird flight and aircraft. Biological observations of 18th Century that lead to major discoveries-examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. **Classification:** Classification of living organisms based on (a) Cellularity- Unicellular or multicellular (b)Ultrastructure- Prokaryotes or eukaryotes. (c) Energy and carbon utilization -Autotrophs, Heterotrophs, Lithotrophs (d) Ammonia excretion – Ammonotelic, uricotelic, ureotelic (e)Habitat- aquatic, terrestrial (e) Molecular taxonomy- three major kingdoms of life. **UNIT- II**														

	Biomolecules and Enzymes **Biomolecules:** Structures of sugars (Glucose and Fructose), Starch and cellulose. Nucleotides and DNA/RNA. Amino acids and lipids. Proteins- Structure and functions- as enzymes, transporters, receptors and structural elements. **Enzymes:** Enzyme classification. Mechanism of enzyme action, Enzyme kinetics and kinetic parameters. **UNIT- III** **Genetics and Gene information Transfer** **Genetics:** Mendel's laws of inheritance, Concept of segregation and independent assortment. Concept of allele, Recessiveness and dominance. Gene Interaction-Epistasis. Cell cycle and cell division -Meiosis and Mitosis. Transfer of genetic material from parent to offspring during cell division. **Information Transfer:** DNA as a genetic material. Hierarchy of DNA structure - from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination **UNIT- IV** **Metabolism and Microbiology** **Metabolism:** Exothermic and endothermic reactions versus end ergonic and exergonic reactions. Respiration- Breakdown of glucose to$CO_2 + H_2O$ (Glycolysis and Krebs cycle) Photosynthesis- Synthesis of glucose from CO_2 and H_2O. Energy yielding and energy consuming reactions. **Microbiology:** Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Growth kinetics. Ecological aspects of single celled organisms. Microscopy
Text books and Reference books	**Text Books:** [T1]Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B, "Biology: A Global Approach", Pearson Education Ltd [T2] Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., "Outlines of Biochemistry", John Wileyand Sons [T3] Nelson, D. L and Cox, M. M.W.H. Freeman, "Principles of Biochemistry", 5th Ed. [T4] Stent, G. S.; and Calender, R.W.H. Freeman andcompany, "Molecular Genetics", 2nd Ed., CBS Publisher [T5] Prescott, L.M J.P. Harley and C.A. Klein, "Microbiology", 2nd Ed., Wm, C.Brown Publishers, 1995
E-resources and other digital material	

Third Year
(VI Semester)

20EI6301 – Microcontrollers and Embedded Systems

Course Category:	Program 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 architectural features and instructions of 32-bit microcontroller ARM Cortex M4.													
	CO2	Apply the knowledge gained for Programming ARM Cortex M4 for different applications													
	CO3	Apply the real time operating systems concepts in designing applications on ARM Cortex M4													
	CO4	Interface the various input and output peripherals with ARM Cortex M4													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		3												3	
	CO2		3												2	
	CO3						2								2	
	CO				3										3	
Course Content	**UNIT- I** **Introduction to ARMCortex - M Processors:** ARMCortex-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 – II** 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 – III** Overview of exceptions and interrupts, Overview of interrupt management, Exception														

	sequence overview, 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. **UNIT – IV** **Hardware Interfacing**: GPIO Programming, Interfacing with LEDs, Interfacing of LCD and keyboard, ADC& DAC interfacing, Timer programming, UART programming, Relay, Optoisolator and stepper motor interfacing, PWM and DC motor control
Textbooks and Reference books	**Text Book:** [T1] Joseph Yiu, "The Definitive Guide to Arm® Cortex®-M3 and Cortex®-M4 Processors", 3rd Ed., Newnes, Elsevier, 2014. [T2] 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.Embedded System Design with ARM, IIT kharagpur https://nptel.ac.in/courses/106105193

20EI6302 – Digital Signal Processing

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		3												3	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
Textbooks 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. [R3] P Ramesh Babu, "Digital Image Processing", 6th Ed., Scitech, 2010
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/

20EI6303 – Industrial Automation

Course Category:	Program 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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		3													2
	CO2	2														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, Fundamentals of logic, Field I/O devices

UNIT – II

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

UNIT – III

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

20EI6404/A – Biomedical Instrumentation

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Infer the physical foundations of biological systems and bioelectric potentials in medical field.													
	CO2	Elucidate the methods to monitor different bioelectric potentials in the human body.													
	CO3	Illustrate the concepts of medical assisting and therapeutic equipment for intensive and critical care and equipment for certain diagnosis.													
	CO4	Outline medical imaging techniques and Biotelemetry systems.													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3														
	CO2		3												2	
	CO3	3													2	
	CO4	3													2	

Course Content

UNIT- I

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

Physiological Systems of the Body: Basic features of the Cardiovascular system, Respiratory system, Nervous system- Electro physiology of nerve and nerve to muscle function, Transmission of impulse from nerve to muscle, Muscular system.

Bioelectric Potentials: Resting and action potentials, Propagation of action potentials, Bioelectric potentials, Evoked potentials.

UNIT- II

Bioelectric potentials Acquisition and Measurement: Biopotential Electrodes, ECG, EEG, EMG Lead systems and recording methods, Analysis of typical waveforms, Measurement of Blood pressure, Blood flow, Heart sounds, Cardiac output.

UNIT- III

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

	machine, Dialyzers, Diathermy, Audiometers, Endoscope. **Instruments in Clinical Laboratory:** Blood gas analysers: Blood pH, pCO_2 and pO_2 measurement, Complete Blood gas analyser, Blood cell counters. **UNIT- IV** **Imaging Modalities in Bio-Medical Field:** X-ray machine, Applications of X-Rays in medicine, CT scan, MRI scan, SPECT, PET, Ultrasonography. **Biotelemetry:** Introduction, Components of a Biotelemetry system, Applications of telemetry in patient care.
Textbooks and Reference books	**Text Books:** [T1] Leslie Cromwell, Fred. J, Weibell and Erich A. Pleiffer, "Biomedical Instrumentation and Measurements", 2nd Ed., Prentice Hall of India, 2004. [T2] R.S.Kandpur. "Handbook of Biomedical Instrumentation", 3rd Ed., McGraw Hill Education Pvt. Ltd., 2014. **Reference Books:** [R1] Dr M. Arumugam, "Biomedical Instrumentation", 2nd Ed., Anuradha publications, 2009. [R2] John. G. Webster, "Medical Instrumentation Application and Design", 3rd Ed., John Wiley & Sons, 2014.
E-resources and other digital material	[E1] https://www.visiblebody.com/learn/muscular/muscle-types [E2] https://nptel.ac.in/courses/108/105/108105101/ [E3] https://nptel.ac.in/courses/108/105/108105091/ [E4] http://www.sprawls.org/ppmi2/

20EI6404/B – Industrial Communication Networks

Course Category:	Program Elective 2	**Credits:**	3
Process 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 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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	2														2
	CO3		2													2
	CO4		3													3

Course Content

UNIT- I

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

Introduction to networks, Network topology, Network components, Classification of networks, OSI model, TCP/IP reference model

UNIT – II

Networks in Process Automation and Fieldbuses: Introduction, Communication hierarchy in factory automation, I/O bus networks, Networking at various levels, Comparison between a 4–20 mA System with a Fieldbus System, Expanded network view with fieldbus, Fieldbus benefits.

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

UNIT – III

	Foundation Field Bus: Introduction**,** Definition and features, Architecture, H1 benefits, HSE benefits, OSI reference model of foundation fieldbus, Physical Layer, Data link Layer, Application Layer, User application blocks, Device information, Redundancy **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
Textbooks and Reference books	**Text Book:** [T1] S. Sunit Kumar, "Fieldbus and Networking in Process Automation", 1st Ed., CRC Press, Taylor and Francis Group, 2014. [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, 2002. [R2] R. Bowden, "HART application Guide", HART Communication Foundation, 1999
E-resources and other digital material	1.https://www.youtube.com/watch?v=DgAwOJMN2N0 2.http://nptel.iitg.ernet.in/Elec_Engg/IIT 3.http://www.nptel.ac.in/courses/106105081

20EI6404/C – Process Modeling and Simulation

Course Category:	Program Elective 2	**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 concepts of process modeling and various control techniques.													
	CO2	Develop mathematical models and controllers for various chemical processes using suitable approaches.													
	CO3	Analyze the dynamic characteristics of various processes with different control approaches.													
	CO4	Use modern software tools for controller design and analysis.													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	3														3
	CO3		2													2
	CO4					2										2
Course Content	**UNIT- I** **Introduction to Process Modeling**: Definitions, Model representation, Types of modeling equations, Classification of mathematical models, Process models and dynamic behaviour, Reasons for modeling, Material balances, Material and energy balances, Form of dynamic models, Linearization of nonlinear models, Dynamic behaviour, Stability of linear state space models, Empirical models **UNIT – II** **PID Controller Tuning and Enhancements:** Introduction, PID controller forms, Closed-loop oscillation-based tuning, Tuning rules for first-order + dead time processes, Direct synthesis for minimum-phase and nonminimum phase processes, Reformulation of the desired response, Antireset windup, Autotuning techniques **UNIT – III** **Internal Model Control**: Introduction to model-based control, Practical open-loop controller design, Generalization of the open-loop control design procedure, Model														

	uncertainty and disturbances, The Internal Model Control (IMC) structure, The IMC design procedure, Effect of model uncertainty and disturbances, Improved disturbance rejection design. **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
Textbooks 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.
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

20EI6404/D – Power Plant Instrumentation

Course Category:	Program Elective 2	**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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3												1		
	CO2	3												2		
	CO3		2													1
	CO4		1											1		
Course Content	**UNIT- I** **Overview of Thermal Power Generation:** Introduction to thermal power plants, Comparison of various conventional power plants, Classification of instruments in a power plant, Objectives of instrumentation and control in thermal power plants, Layout of typical thermal power plants, Piping and instrumentation diagram **Instrumentation and Control in Water Circuit:** Water circuit, Boiler feed water circulation, Controls in water circuit, Impurities in water and steam, Effects of impurities, Measurement of impurities **UNIT – II** **Instrumentation and Control in Air-Fuel Circuit:** Air fuel circuit - Fuels, Combustion air, Flue gases, Waste gases, Controls in air fuel circuit - Combustion control, Furnace draft control, Analytical measurement - Oxygen measurement in flue gas, Measurement of carbon dioxide in flue gas, Combustibles analyzer, Infrared flue gas analyzers, Smoke detector, Dust monitor, Fuel analyzers, Chromatography, Pollution monitoring														

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

20EI6205/A – Artificial Intelligence and Machine Learning in Healthcare

Course Category:	Open /Job Oriented Elective 2	**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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	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 **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
Textbooks 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 [R2] Ian Goodfellow, Yoshua Bengio, and Aaron Courville , "Deep Learning",MIT Press, 2016
E-resources and other digital material	1. https://nptel.ac.in/courses/106105078 2.https://onlinecourses.nptel.ac.in/noc22_cs83/preview 3.https://www.foreseemed.com/artificial-intelligence-in-healthcare 4.https://www.classcentral.com/course/artificial-intelligence-for-healthcare-opportunit-13302

20EI6205/B – SAFETY INSTRUMENTATION SYSTEMS

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3													2	
	CO2		2												2	
	CO3		2												2	
	CO4		3												3	
Course Content	**UNIT- I Introduction:** Safety Instrumentation system; Confusion in the Industry; 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, AIChE CCPS, IEC 61508, ISA SP84, API RP 14C, API RP 554, NFPA 85, IEEE 803; Common Cause and Systematic/Functional Failures - Human Issues. **UNIT- III PROTECTION LAYERS:** Introduction; 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 Severity, 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.
Textbooks and Reference books	**Text Book:** [T1] Safety Instrumented Systems - Design, Analysis, and Justification (2nd Edition). **Reference Books:** [R1] Overview of Safety Instrumented Systems–Book boon-Ventus Publishing by IDC Technologies, (2012). [R2] Plant Hazard Analysis and Safety Instrumentation Systems by Swapan Basu.
E-resources and other digital material	1. Free Safety Instrumented System Training Course (instrumentationtools.com) 2. Safety Instrumented System Overview - Process Safety Control System - YouTube

20EI6205/C – CLAD Certification

Course Category:	Open /Job Oriented Elective 2	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Computer Networks	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

20EI6351 – Microcontrollers and Embedded Systems Lab

Course Category:	Program Core Lab 1	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Use the instruction sets of ARMCortex-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	Make an effective report based on experiments.													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3													3	
	CO2		3												3	
	CO3					3				2			1		3	
	CO4										2				2	
Course Content	**List of Experiments** **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 Note: Any 10 of the experiments in the above list need to be completed by the student														
Textbooks and Reference books	**Text Book:** [T1] Muhammad Ali Mazidi, Shujen Chen, Eshragh Ghaemi, "STM32 Arm Programming forEmbedded Systems", 1st Ed., MicroDigitalEd. [T2] Joseph Yiu, ―The Definitive Guide to Arm® Cortex®-M3 and Cortex®-M4														

	Processors, 3rdEd., Newnes, (Elsevier), 2014.
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

20EI6352 – Industrial Automation Lab

Course Category:	Program Core Lab 2	**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	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	Write an effective report based on experiments.													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3														3
	CO2	3														3
	CO3					3				2			1			
	CO4										2					
Course Content	**List of Experiments** 1. Implementation of Logic Gates 2. Implementation of Timers and Counters 3. ON-OFF Control of Level using PLC 4. ON-OFF Control of Pressure using PLC 5. PID control of Temperature using PLC 6. PIC 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. Automation of bottle filling System using PLC 11. Automatic drilling system using PLC 12. Automatic pneumatic stamping machine using PLC 13. Study of distributed control system -Honeywell DCS C200 14. Basic programming of DCS through Experion PKS server														

	15. Level control of single tank liquid system using DCS 16. Level control of multi tank liquid system using DCS 17. Implementation of cascade control in liquid system using DCS
Textbooks and Reference books	
E-resources and other digital material	

20EI6353 – Advanced Instrumentation Lab-II

Course Category:	Program Core Lab 3	**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	Apply the knowledge of LabVIEW programming to develop VI for embedded sensor interfacing with myRIO													
	CO2	Apply the knowledge of LabVIEW programming to develop VI for Vernier biomedical sensors interfacing with 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 the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			3											3	3
	CO2			3											3	3
	CO3				3										3	3
	CO4									3			2			
	CO5										3					
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 H-bridge geared motor with myRIO 6. Develop a VI to interface Webcam with myRIO 7. Develop a VI to interface Accelerometer with myRIO 8. Develop a VI to interface Gyroscope with myRIO 9. Develop a VI to interface compass with myRIO 10. Develop a VI to interface GPS receiver with myRIO 11. Develop a VI to extract features from an electrocardiogram (ECG)														

	signal. 12. Develop a VI to study the muscle activity and fatigue using hand dynamometer.
Textbooks 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

20TP6106 – Quantitative Aptitude

Course Category:	Soft Skills-4	**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	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 the achievement of Program Outcomes

(1– Low, 2– Medium, 3 – High)

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

Course Content

UNIT- I

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

Numerical Ability II: Ratio & Proportion, Partnership, Percentages, Profit & Loss

UNIT – II

Arithmetical Ability l: Problems on ages, Time & Work, Pipes & Cistern, Chain Rule.

Arithmetical Ability ll: Time & Distance, Problems on boats & Steams, Problems on Trains

UNIT – III

Arithmetical Ability lll: Allegation, Simple interest and compound interest, Races & Games of skills, Calendar and Clock

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

20EI6554 – Mini Project - I

Course Category:	Internship/Project	**Credits:**	1.5
Course Type:	Internship/Project	**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	Develop interest towards research oriented field through literature exploration													
	CO2	Illustrate the concepts of various methods, techniques, algorithms and tools used to address the feasible solution of a problem, identified in EPICS													
	CO3	Exhibit competency in suggesting optimum solution by detail analysis of the problem													
	CO4	Demonstrate effective interpersonal, communication& presentation skills													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1									3			3			
	CO2	2					2			2						2
	CO3		2				2		2	2						2
	CO4									3	3	3				3

20MC6107B – Innovation Incubation & Startup

Course Category:	Mandatory Course	**Credits:**	0
Course Type:	Theory& Lab	**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	To learn the innovation concepts related to business organizations.													
	CO2	To understand the importance of innovation in new start-ups													
	CO3	To know fundamental aspects of Intellectual property Rights.													
	CO4	To learn the basic concepts of entrepreneurship and its benefits.													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1		1						2	2		2				
	CO2		2						1	2		2				
	CO3		2						2	3		3				
	CO4		1						3	2		2				

Course Content

UNIT- I

Innovation Management: Introduction, Innovation: Definition, Importance – The need to view innovation in an organizational context – Different types of innovation - Innovation and invention – Popular views of innovation – Innovation as a management process.

UNIT – II

Innovation: New Product Development (NPD): Innovation management and new product development – Considerations when developing as NPD strategy - NPD as a strategy for growth – What is new product? – Classification of new products – NPD as an industry innovation cycle

UNIT – III

Intellectual Property Rights (IPR): Introduction and the need for intellectual property right (IPR) - Kinds of intellectual property rights: Patent, Copyright, Trade mark, Design, geographical indication, Plant varieties and layout design – Genetic resources and traditional knowledge – Trade secret - IPR in India : Genesis and development

UNIT – IV

	Entrepreneurship: Concept and need of entrepreneurship - Characteristics and types of entrepreneurship - Entrepreneurship as a career - Entrepreneurship as a style of management - The changing role of the entrepreneur - Entrepreneurial traits, Factors affecting entrepreneurs.
Textbooks and Reference books	**Text Book:** [T1] Paul Trott, "Innovation Management and New Product Development", Pearson Education Limited, UK, 2017. [T2] Nithyananda, K V., "Intellectual Property Rights: Protection and Management", Cengage Learning India Private Limited, 2019. [T3] Dr.S S Khanka, Entrepreneurial Development, S Chand, New Delhi, 2020 **Reference Books:** [R1] Joe Tidd, John Besant, "Weste Managing innovation: Integrating Technological, Market and Organizational Change",2018. [R2] Neeraj, P., & Khusdeep, D, "Intellectual Property Rights", PHI learning Private Limited, India, 2019. [R3] Vasant Desai, "The Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, India, 2022
E-resources and other digital material	1.https://edisciplinas.usp.br/pluginfile.php/5553082/mod_folder/content/0/Trott%20-%202017%20-%20%20roz%20Innovation-Management-and-New-Product-Development.pdf?forcedownload=1

Fourth Year
(VII Semester)

20EI7301– Computer Control of Processes

Course Category:	Program 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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2	1														1
	CO3		3			3										3
	CO4			3												3
	CO5	2				2										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] Pradeep B.Deshpande and Raymond H Ash, "Elements of Computer Process Control with Advanced Control Applications", 2nd Ed., Instrument Society of America.,1981 [T2] Krishna Kant, "Computer based Industrial Control", 2nd Ed., PHI, Delhi, 2010. **Reference Book:** [R1]M.Gopal, "Digital Control and State Variable Methods", 2rdEd.,TMH, New Delhi, 2009 [R2]C.D. Johnson, "Process Control Instrumentation Technology", 4th Ed., PrenticeHall Inc, 2000.
E-resources and other digital material	4. http://nptel.ac.in/courses/112103174/4 5. http://nptel.ac.in/courses/112103174/3

20EI7402A – Instrumentation and Control in Food Processing

Course Category:	Program Elective-3	**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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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. **Sensing Devices:** Role of transducers in food processing, Classification of transducers, Self-generating transducers, Photoelectric transducers, Photo conductive and Photovoltaic Cell, Magneto electric transducers, Radioactive transducers, Variable parameter type and Selection of transducers **UNIT- II** **Moisture Content Measurement in Food Processing:** Role of moisture content in quality of food, Microwave absorption method, Radio frequency impedance technique, Moisture release during drying of food.														

	Humidity in the Food Processing Environment: Role of humidity in quality of food, Conventional type and Electrical type of humidity meters. **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. **P^H Values of Food:** P^H scale, P^H electrodes and Potential, Ion sensitive field effect transistor P^H sensors. **Food Enzymes:** Importance of food enzyme detection, Enzyme sensors – Principle of operation, Calibration and Sensor materials, Semiconductor enzyme sensor. **Flavor Measurement:** Sources of flavor in food, Electronic Nose – Basic electronic nose, Sensor types and Signal processing **UNIT- IV** **Controllers and Indicators**: Introduction, Temperature control in food dehydration and drying, Electronic Controllers, Atmosphere control in food preservation, Timers and Indicators in food processing, Food sorting and Grading control. **Computer Based Monitoring and Control:** Introduction, Importance of monitoring and control with computers, Hardware features of a data acquisition and control computer, Examples of computer based measurement and Control in food processing
Text books and Reference books	**Text Book:** [T1] 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", IInd Ed., Woodhead Publishing Limited, 2001
E-resources and other digital material	1.https://nptel.ac.in/courses/126105011/

20EI7402B – Industrial Internet of Things

Course Category:	Program Elective-3	**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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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/

20EI7402C – Wireless Sensor Networks

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Understand the basic concepts of wireless sensor networks													
	CO2	Compare node and network architectures in wireless sensor networks													
	CO3	Apply suitable protocol in routing based on network and user requirement.													
	CO4	Analyze various clustering and localization techniques.													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2		2											2		
	CO3	2														2
	CO4		3													2

Course Content

UNIT- I

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

UNIT- II

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

UNIT- III

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

	Energy - efficient routing. **UNIT- IV** **Infrastructure Establishment:** Topology control, Clustering - Hierarchical networks by clustering. Time synchronization, Localization and positioning, Localization and services, Sensor tasking and control. **Sensor Network Platforms and Tools:** Sensor node hardware, Programming challenges, Node - level software platforms, Node level simulators
Text books and Reference books	**Text Book:** [T1]Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks" An Information Processing Approach, Elsevier, 2007. [T2] Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005 **Reference Books:** [R1] KazemSohraby, DanielMinoli, &TaiebZnati, "Wireless Sensor Networks- Technology, Protocols, And Applications", John Wiley, 2007 [R2] V.Gagrigungor, Gerhard P. Hancke "Industrial Wireless Sensor Networks", CRC Press, 2013.
E-resources and other digital material	1. https://nptel.ac.in/courses/106/105/106105160/ 2. http://computerscienceppt.blogspot.com/2010/08/introduction-to-wireless-sensor.html

20EI7402D – Drives and Control for Industrial Automation

Course Category:	Program Elective - 3	**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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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 KokKiong 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/

20EI7403A – Advanced Sensors

Course Category:	Program Elective - 3	**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 principle of operation of different sensors and their applications												
	CO2	Be updated on the recent trends in sensor technologies.												
	CO3	Apply knowledge in designing smart sensors.												
	CO4	Design environmental measurement systems using different chemical sensors.												
	CO5	Solve design and modelling issue using complex engineering mathematics.												
Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	2													
	CO2		3												
	CO3	2													
	CO4			2											
	CO5					3									
Course Content	**UNIT- I** **Sensor Fundamentals and Characteristics**: Sensor Classification, Performance and Types, Error Analysis characteristics **Classification of Instruments Transducers:** Input and output characteristics of various transducers, variable resistance transducer and its equivalent circuit, potentiometers, their construction and performance, variable inductance and variable capacitance transducers, their construction and performance, Piezoelectric transducer. **UNIT – II** **Sensor Technologies:** MEMS sensor, Comparison between MEMS and Macro sensor, Fabrication and packaging issue in sensor design, Thick film and thin film technique Physical sensors. Bio sensor, Silicon sensor, RF Sensor, sensors for robotics													

	Smart Sensors: Smart sensor basics, signal conditioning and A/D conversion for sensors, examples of available ICs and their applications. **UNIT – III** **Advanced Sensing Technology:** Sensors, instruments, and measurement techniques for emerging application areas such as environmental measurement like DO(dissolves oxygen),BOD (biological oxygen demand),COD(chemical oxygen demand)TOC(total organic carbon)Cox(carbon dioxides)NOx(nitrogen oxide),SOx (Sulpher Oxides) **UNIT – IV** **Design and Modelling Issue in Advanced Sensing Technique**: Introduction of different mathematical tools used in sensor design. Optimization techniques used in sensor design. The role of PCA, LDA, Neural network in designing sensor array.
Text books and Reference books	**Text Book:** [T1] Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland. (Unit-I) [T2] Tai Ran Hsu, MEMS & Micro systems Design and Manufacture Tata McGraw Hill, New Delhi, 2002(Unit-II and III) [T3]Jacob Fraden, "Handbook of Modern Sensors: physics, Designs and Applications", Springer, New York, 3rd edition, 2015(Units- IV) **Reference Books:** [R1] Jacoba Fraden "Handbook Of Modern Sensors "2nd Edition ,Springer-Verlag.New York 1996 [R2] G.K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Aatre, "Micro and Smart Systems: Technology and Modeling",Willey Publications, 2013.
E-resources and other digital material	1. https://www.youtube.com/watch?v=q8UuRkOQ9A0

20EI7403B – Database Management Systems

Course Category:	Program Elective-4	**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 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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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. [T2] Raghurama Krishnan, Johannes Gehrke, “Database Management Systems”, 3rd Ed., Tata McGraw Hill. [T3] H G Molina, J D Ullman, J Widom, “Database Systems - The Complete Book”, Pearson. [T4] Ramez Elmasri, Shamkant B. Navathe, “Database Management Systems”, 6th Ed., EA. **Reference Books:** [R1] Peter Rob & Carlos Coronel, “Database Systems Design, Implementation, and Management” 7th Ed., [R2] Silberschatz, Korth, “Database System Concepts”, 5th Ed., TMH. [R3] Narain Gehani, “The Database Book Principles & Practice Using Oracle/MySQL”, University Press..
E-resources and other digital material	

20EI7403C – Intelligent Systems and Control

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Apply fuzzy logic for simple control applications.													
	CO2	Use neural networks for system identification and control applications.													
	CO3	Compare various neuro fuzzy system configurations.													
	CO4	Present the steps involved in various evolutionary and swarm intelligence techniques.													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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, Supervised learning and unsupervised learning, Recurrent neural networks, Neural systems, System identification and control, Neural networks for control. **UNIT – III** **Neuro Fuzzy Systems:** Introduction, Combination of neural and fuzzy systems, Cooperative neuro-fuzzy systems – Cooperative FS-NN and cooperative NN-FS systems, Concurrent neuro-fuzzy systems, Hybrid neuro-fuzzy systems, Fuzzy Net (FUN), Adaptive neuro-fuzzy system, Fuzzy neurons.														

	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), Swarm intelligence algorithms - Basic Particle Swarm Optimization (PSO
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/112106064/38

20EI7403D – Digital Image Processing

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

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	Explain the fundamentals of digital image processing													
	CO2	Apply image enhancement techniques in spatial and frequency domains													
	CO3	Analyze various restoration techniques for image quality.													
	CO4	Analyze the performance of compression techniques and segmentation methods.													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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", 2nd Ed., Pearson Education, 2002. **Reference Books:** [R1] Anil K. Jain, "Fundamentals of Digital Image Processing", 3rd Ed., Pearson Education, 2003. [R2] William K Pratt, "Digital Image Processing", 4th Ed., A Wiley-Interscience Publication, 2007
E-resources and other digital material	1. http://www.imageprocessingplace.com/

20EI7404A – Instrumentation and Control in Paper Industries

Course Category:	Program Elective-5	**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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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

20EI7404B – Computer Networks

Course Category:	Program Elective-5	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Digital Electronics , Digital Signal Processing	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

<table>
<tr><td rowspan="5">Course outcomes</td><td colspan="15">Upon successful completion of the course, the student will be able to:</td></tr>
<tr><td>CO1</td><td colspan="14">Apply the basic concept of OSI reference model, services and role of each layer of OSI model and TCP/IP</td></tr>
<tr><td>CO2</td><td colspan="14">Analyse the functions of Network Layer i.e. Logical addressing, subletting& Routing Mechanism</td></tr>
<tr><td>CO3</td><td colspan="14">Analyse the different Transport Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism</td></tr>
<tr><td>CO4</td><td colspan="14">Analyse the different protocols used at application layer</td></tr>
<tr><td rowspan="5">Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High</td><td></td><td>PO 1</td><td>PO 2</td><td>PO 3</td><td>PO 4</td><td>PO 5</td><td>PO 6</td><td>PO 7</td><td>PO 8</td><td>PO 9</td><td>PO 10</td><td>PO 11</td><td>PO 12</td><td>PS O1</td><td>PS O2</td><td>PS O3</td></tr>
<tr><td>CO1</td><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Course Content</td><td colspan="15">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: 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</td></tr>
</table>

	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 protocol – TCP segment header – TCP connection establishment- TCP connection release. **Application Layer:** Domain Name Service (DNS), Electronic mail, WWW – architectural overview
Text books and Reference books	**Text Book:** [T1] A.S. Tanenbaum, Computer Networks Fourth edition, PHI Education, 2003 **Reference Books:** [R1] William Stallings, Data and computer communications, PHI, 2001. [R2] Forouzan, Data Communications and networking, PHI,2000
E-resources and other digital material	

20EI7404C – HMI &SCADA

Course Category:	Program Elective-5	**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 basic concepts associated with SCADA and HMI.													
	CO2	Explore and interpret functionality of SCADA and HMI.													
	CO3	Describe the basic design aspects of SCADA and HMI													
	CO4	Select appropriate features of SCADA and HMI for an industrial application													
	CO5	Develop simple SCADA and HMI screens													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	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 edition 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)

20EI7404D – Real World Instrumentation with Python

Course Category:	Program Elective-5	**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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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" I Ed., O'Reilly Media. 2010. [T2] Mark. Lutz, "Learning Python" V Ed., O'Reilly Media. 2013 **Reference Books:** [R1]E.Balaguruswamy, "Introduction to Computing and Problem Solving Using Python", Ist Ed., Mc Graw Hill, Jul 2017 [R2] SheetalTaneja, Naveen Kumar, "Python Programming: A modular approach", Ist Ed., Pearson Education, Sep 2017
E-resources and other digital material	1. https://nptel.ac.in/courses/106/106/106106145/

20EI7205/C – Automation in Manufacturing

Course Category:	Open Elective /Job Oriented Elective -3	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Basic Instrumentation , Transducers	**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 of automation in manufacturing industries													
	CO2	Identify various fabrication components and sensors required in typical automated systems for manufacturing													
	CO3	Apply the concepts of electric drives and select suitable drive in manufacturing applications													
	CO4	Analyze the basic elements and interpolators of CNC technology in manufacturing													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1															
	CO2		2												2	
	CO3			2											2	
	CO4	2													2	
Course Content	**UNIT- I** **Introduction to Automation in Manufacturing**: Definition of automation in manufacturing, Production system, Manufacturing system, Product lifecycle: Importance of automation. Mechatronics, Disciplines of Mechatronics, Mechatronics for replacement of mechanics: Wrist watch, Mechatronics-based system. Definition of a system, Example of a system, Mechanical spring, Mechatronics based automated system, Building blocks of Mechatronics-based system, Development of an equivalent Mechatronics based system **UNIT- II** **Relational Fabrication Process in Manufacturing**: Overview of fabrication, Casting, Forming, Joining, Machining, Additive Manufacturing. **Sensors Used in Manufacturing**: Measurement system, Sensors and transducers, Potentiometer sensors. Displacement. Position and Proximity														

	sensors, Strain gauge-based sensors, Capacitive elements, Linear variable differential transducer (LVDT), Eddy current based sensor, Inductive proximity switch. Optical encoder, Electric connection based switches, Pneumatic sensors, Hall effect based sensors **UNIT- III** **Electric Drives in Manufacturing Process**: Application of electric drives in automation. Direct current (DC) motor, alternating current (AC) motor, Working principle, Construction and application, Types of industrial automation, Mechanisms, Machines **UNIT- IV** **CNC Technology in Manufacturing**: Flexible manufacturing system, CNC technology in manufacturing, Vertical milling process: An example. CNC machine tools, Adaptive control technology based machine tools, Automated storage and retrieval system, Industrial conveyors, Industrial robots. CNC machines and interpolation
Text books and Reference books	**Text Book:** [T1] Sathish, Anup Goel, A. Jacob Moses, Dr. Subhash L. Gadhave, Vinayak V. Gaikwad, "Automation in Manufacturing", Technical Publications [T2] Anup Goel, Dr. Subhash, L. Gadhave, A. Jacob Moses, "Automation in Manufacturing", Technical Publications **Reference Books:** [R1] SIA Experts, "Automation in Manufacturing", 1st Ed., SIA Publishers & Distributors Pvt Ltd, 2018 [R2] Beno Benhabib, "Manufacturing Design, Production, Automation, and Integration", 2003
E-resources and other digital material	1.https://nptel.ac.in/courses/112/103/112103293/

20EI7206/E – Industrial Safety and Environmental Management

Course Category:	Open Elective /Job Oriented Elective -4	**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 various hazards and safety methods employed in industries.													
	CO2	Choose suitable risk assessment and management methods.													
	CO3	Outline the safety methods in oil and gas industry													
	CO4	Explain the impact of industries on environment													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			3				3								
	CO2			3			3	3								
	CO3			3			3									
	CO4			3			3	3								

Course Content

UNIT- I

Safety Assurance & Assessment: Introduction to HSE, Safety Assurance, Safety in design and operations, Organizing for safety, Hazard Classification and assessment, Hazard Evaluation and Control, Hazop, Hazop case study, FMEA.

UNIT- II

Accident Modeling, Risk Assessment and Management: Dose assessment, Safety regulations, Toxic releases-models and methods, Chemical risk analysis, Chemical exposure index(CEI), Case studies in oil industries, Quantitative risk assessment, Fire and explosion models, Flammability diagrams, Exposure models, Fire and explosion-prevention methods, Event tree and fault tree analyses

UNIT- III

Safety Measures in Design and Operation: Safety measure in oil & gas industry, Safety methods in design and operation, Process safety management, Software used in HSE

UNIT- IV

	Environmental Issues and Management: Environmental impact and management, Impact of oil and gas industry in marine environment, Oil hydrocarbons in marine environment, Chemical disposal of offshore industry and environmental management, Dispersion models and atmospheric pollution, Hazard assessment.
Text books and Reference books	**Text Book:** **Reference Books:**
E-resources and other digital material	

20EI7607 – Real Time Operating Systems

Course Category:	Skill Advanced Course	**Credits:**	3
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 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	Develop algorithms for data protection, synchronization and Intertask Communication using RTOS													
	CO2	Construct device drivers using FreeRTOS													
	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 (L – Low, M - Medium, H – High		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	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 FreeRTOS, 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 taks 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 interruts. 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 FreeRTOS heap implementations														

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, Libopencm3 andGCC", 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

20EI7551 – Mini Project-II

Course Category:	Internship/Project	**Credits:**	1.5
Course Type:	Internship/Project	**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	Develop interest towards research oriented field through literature exploration													
	CO2	Illustrate the concepts of various methods, techniques, algorithms and tools used to address the feasible solution of a problem													
	CO3	Exhibit competency in suggesting optimum solution by detail analysis of the problem													
	CO4	Demonstrate effective interpersonal, communication & presentation skills													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1									3			3			
	CO2	2					2			2						2
	CO3		2				2		2	2						2
	CO4									3	3	3				3

20EI7552 – Industrial/Research Internship

Course Category:	Internship/Project	**Credits:**	1.5
Course Type:	Internship/Project	**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 application of knowledge and skill sets acquired from the course and workplace in the assigned job function/s													
	CO2	Develop and enhance operational, customer service and other life-long knowledge and skills in a real world work environment													
	CO3	Exhibit critical thinking and problem solving skills by analysing underlying issue/s to challenges													
	CO4	Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means													
	CO5	Exhibit professional ethics by displaying positive disposition during internship													
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1	3														2
	CO2											3				3
	CO3		3				2	2								2
	CO4										3					3
	CO5								2							2

Fourth Year
(VIII Semester)

20EI8551 – Major Project & Internship

Course Category:	Internship/Project	**Credits:**	12
Course Type:	Internship/Project	**Lecture- Tutorial - Practice:**	0 - 0- 24
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 tightly integrated project plans using appropriate tools
	CO2	Illustrate proficiency in the use modern methodologies, multidisciplinary skill set and knowledge in while working on the project
	CO3	Demonstrate effective execution process that result in successful projects
	CO4	Demonstrate effective interpersonal, communication & presentation skills

Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
	CO1			3												2
	CO2					2	2	2		2						3
	CO3				2	2				2			2			2
	CO4									3	3		3			3

The student should undergo internship and parallelly he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report