Sri

SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

West Tambaram, Chennai - 44

www.sairam.edu.in

Approved by AICTE, New Delhi
Affiliated to Anna University

DEPARTMENT OF
ELECTRONICS & INSTRUMENTATION ENGINEERING

REGULATIONS
2020

Academic Year 2020-21 onwards

AUTONOMOUS
CURRICULUM AND
SYLLABUS
I - VIII
SEMESTERS

SRI SAIRAM ENGINEERING COLLEGE

VISION

To emerge as a "Centre of excellence " offering Technical Education and Research opportunities of very high standards to students, develop the total personality of the individual and instil high levels of discipline and strive to set global standards, making our students technologically superior and ethically stronger, who in turn shall contribute to the advancement of society and humankind.

MISSION

We dedicate and commit ourselves to achieve, sustain and foster unmatched excellence in Technical Education. To this end, we will pursue continuous development of infra-structure and enhance state-of-the-art equipment to provide our students a technologically up-to date and intellectually inspiring environment of learning, research, creativity, innovation and professional activity and inculcate in them ethical and moral values.

QUALITY POLICY

We at Sri Sai Ram Engineering College are committed to build a better Nation through Quality Education with team spirit. Our students are enabled to excel in all values of Life and become Good Citizens. We continually improve the System, Infrastructure and Service to satisfy the Students, Parents, Industry and Society.

DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING

VISION

To Impart technical Education and to develop competent Electronics and Instrumentation Engineers with exemplary personality who will be technically proficient and ethically strong leading to the growth of society and nation.

MISSION

To provide a platform in acquiring knowledge in the field of Electronics and Instrumentation Engineering with highest quality in technical education and services to the society. To fulfill the needs:

1. Provide quality education in both theoretical and applied foundations of Electronics and Instrumentation Engineering.
2. Create competent Electronics and Instrumentation engineers to develop solutions for the betterment of the nation.
3. Inculcate professional and ethical values among students.

AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20BSMA101	Engineering Mathematics-I	3	1	0	4	4
2	20HSEN101	Technical English-I	3	0	0	3	3
3	20BSPH101	Engineering Physics	3	0	0	3	3
4	20BSCY101	Engineering Chemistry	3	0	0	3	3
5	20ESCS101	Problem Solving and Programming in C	3	0	0	3	3
6	20ESGE101	Engineering Graphics	1	2	0	3	3
PRACTICAL							
7	20BSPL101	Physics and Chemistry Lab	0	0	3	3	1.5
8	20ESPL101	Programming in C lab	0	0	3	3	1.5
VALUE ADDITIONS - I							
9	20TPHS101	Skill Enhancement	0	0	2	2	1
10	20HSMG101	Personal Values	2	0	0	2	0
TOTAL						**29**	**23**

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20BSMA201	Engineering Mathematics -II	3	1	0	4	4
2	20HSEN201	Technical English - II	3	0	0	3	3
3	20ESIT201	Python Programming with Laboratory	3	0	2	5	4
4	20BSPH206	Physics for Instrumentation Engineering	3	0	0	3	3
5	20BSCY201	Environmental Science and Engineering	3	0	0	3	3
6	20EEPC201	Electrical Circuit Analysis	2	1	0	3	3
PRACTICAL							
7	20ESGE201	Engineering Practices Laboratory	0	0	3	3	1.5
8	20EEPL201	Electric Circuits and Simulation Laboratory	0	0	3	3	1.5
VALUE ADDITIONS - II							
9	20TPHS201	Skill Enhancement	0	0	2	2	1
10	20HSMG201	Interpersonal Values	2	0	0	2	0
TOTAL						**31**	**24**

SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
		THEORY					
1	20BSMA301	Linear Algebra, Partial Differential Equations and Transforms	3	1	0	4	4
2	20EIPC301	Electrical and Electronic Measurements	3	0	0	3	3
3	20EIPC302	Sensors and Transducers	3	0	0	3	3
4	20EIPC303	Analog Electronic circuits	3	0	0	3	3
5	20ESME301	Applied Thermodynamics & Fluid Mechanics	3	0	0	3	3
6	20ESIT301	Data Structures and algorithms	3	0	0	3	3
		PRACTICAL					
7	20EIPL301	Sensors and Transducers Laboratory	0	0	3	3	1.5
8	20EIPL302	Analog Electronic circuits Laboratory	0	0	3	3	1.5
9	20EITE301	Live-in-Lab – I	0	0	2	2	1
		VALUE ADDITIONS - III					
10	20EITP301	Skill Enhancement	0	0	2	2	1
		TOTAL				**29**	**24**

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
		THEORY					
1	20BSMA403	Statistics and Numerical Methods	3	1	0	4	4
2	20EIPC401	Electrical Machines	3	0	0	3	3
3	20EIPW401	Digital Electronics with Laboratory	2	1	2	5	4
4	20ICPC401	Control Systems	2	1	0	3	3
5	20ICPC402	Industrial Instrumentation	3	0	0	3	3
6	20EIPC402	Principles of Communication Engineering	3	0	0	3	3
		PRACTICAL					
7	20ICPL401	Electrical Machines and Control Systems Laboratory	0	0	3	3	1.5
8	20EITE401	Live-in-Lab – II	0	0	2	2	1
		VALUE ADDITIONS - IV					
9	20EITP401	Skill Enhancement	0	0	2	2	1
10	20MGMC301	Constitution of India	2	0	0	2	0
		TOTAL				**30**	**23.5**

SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20ICPC501	Process Control	2	1	0	3	3
2	20EIPC501	Analytical Instrumentation	3	0	0	3	3
3	20EIPC502	Microprocessor and Microcontrollers	3	0	0	3	3
4	20EIPC503	Digital Signal Processing	2	1	0	3	3
5	20XXELXXX	Professional Elective-I	3	0	0	3	3
6	20XXOEXXX	Open Elective-I	3	0	0	3	3
PRACTICAL							
7	20EIPL501	Microprocessor & Microcontroller Laboratory	0	0	3	3	1.5
8	20ICPL501	Industrial Instrumentation Lab	0	0	3	3	1.5
9	20EITE501	Live-in-Lab - III	0	0	4	4	2
VALUE ADDITIONS - V							
10	20EITP501	Skill Enhancement	0	0	2	2	1
TOTAL						**30**	**22**

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20EIPC601	Industrial Communication Networks	3	0	0	3	3
2	20EIPC602	Embedded Systems	3	0	0	3	3
3	20EIPC603	Power Electronics, Drives and Control	3	0	0	3	3
4	20XXELXXX	Professional Elective-II	3	0	0	3	3
5	20XXOEXXX	Open Elective-II	3	0	0	3	3
PRACTICAL							
6	20ICPL601	Process Control and Simulation Laboratory	0	0	3	3	1.5
7	20EIPL601	Embedded Systems Laboratory	0	0	3	3	1.5
8	20HSPL501	Communication and Soft Skills Laboratory	0	0	2	2	1
10	20EIPJ601	Innovative Design Project	0	0	2	2	1
VALUE ADDITIONS - VI							
11	20EITP601	Skill Enhancement	0	0	2	2	1
TOTAL						**27**	**21**

SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20ICPW701	Instrumentation System Design with Laboratory	3	0	2	5	4
2	20EIPC701	Robotics and Automation	3	0	0	3	3
3	20HSMG601	Principles of Engineering Management	3	0	0	3	3
4	20XXELXXX	Professional Elective-III	3	0	0	3	3
5	20XXELXXX	Professional Elective-IV	3	0	0	3	3
PRACTICAL							
6	20EI PL701	Industrial Automation Laboratory	0	0	3	3	1.5
7	20EI PJ701	Project Phase -1	0	0	4	4	2
VALUE ADDITIONS - VII							
8	20EITP701	Skill Enhancement	0	0	2	2	1
		TOTAL				**26**	**20.5**

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20EEELXXX	Professional Elective-V	3	0	0	3	3
PRACTICAL							
2	20EEPJ801	Project Phase - 2	3	0	0	8	4+
TOTAL						**11**	**7**

CREDIT DISTRIBUTION

Category	BS	ES	HS	EL	PC+PL	PW	OE	TE	PJ	TP	IS	MC	TOTAL
Credit	29.5	19	10	64.5	8	12	6	04	07	07	03	Y	170
Percentage	17	11	6	38	5	7	4	2	4	4	2	-	100

*IS-Internship

PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20EIEL501	Micro Electro Mechanical Systems						Instrumentation Engineering
2	20ICEL501	Virtual Instrumentation	3	3	0	0	3	Instrumentation Engineering
3	20ICEL502	Advanced Control Systems	3	3	0	0	3	Electrical Engineering
4	20EIEL502	Electromagnetic Interference and Compatibility	3	3	0	0	3	Instrumentation Engineering
5	20EIEL504	Smart and Wireless Instrumentation	3	3	0	0	3	Instrumentation Engineering
6	20ICEL504	Control System Components	3	3	0	0	3	Instrumentation Engineering
7	20EIEL503	Special Machines and Controllers	3	3	0	0	3	Electrical Engineering
8	20ICEL505	Metrology and Measurements	3	3	0	0	3	Instrumentation Engineering
9	20ESCS501	Computer Architecture	3	3	0	0	3	Comp. Science & Engineering
10	20EIEL505	Telemetry and Remote Control	3	3	0	0	3	Instrumentation Engineering
11	20MGEL501	Intellectual Property Rights	3	3	0	0	3	Management

PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20ICEL601	Power Plant Instrumentation	3	0	0	3	3	Instrumentation Engineering
2	20ICPC602	Biomedical Instrumentation	3	0	0	3	3	Biomedical Engineering
3	20EIEL601	Fibre Optics and Laser Instrumentation	3	0	0	3	3	Instrumentation Engineering
4	20EIEL602	Instrumentation Detail Engineering	3	0	0	3	3	Instrumentation Engineering
5	20ESCS601	Computer Networks	3	0	0	3	3	Comp. Science & Engineering
6	20EIEL603	Bio Signal Processing	3	0	0	3	3	Biomedical Engineering
7	20EIEL605	Microcontroller based system design	3	0	0	3	3	Electrical Engineering
8	20EIEL604	Biometric Systems	3	0	0	3	3	Biomedical Engineering
9	20ICEL602	Hydraulics and Pneumatics	3	0	0	3	3	Instrumentation Engineering
10	20EIEL606	Bio MEMS	3	0	0	3	3	Biomedical Engineering
11.	20MGEL601	Total Quality Management	3	0	0	3	3	Management

PROFESSIONAL ELECTIVES - III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20ICEL701	Introduction to Process Data Analytics	3	0	0	3	3	Instrumentation Engineering
2	20EIEL701	Applied Soft Computing Techniques	3	0	0	3	3	Instrumentation Engineering
3	20ICEL703	Industrial Internet of Things	3	0	0	3	3	Instrumentation Engineering
4	20EIEL702	Electrical and Hybrid Vehicles	3	0	0	3	3	Electrical Engineering
5	20CSPC402	Database Management System	3	0	0	3	3	Comp. Science & Engineering
6	20EIEL703	Introduction to Video and Image Processing	3	0	0	3	3	Information& Communication
7	20ICEL704	Instrumentation and Control in Petrochemical Industries	3	0	0	3	3	Instrumentation Engineering
8	20EIEL704	Cyber Physical Systems	3	0	0	3	3	Comp. Science & Engineering
9	20EIEL705	Fault detection and Diagnosis	3	0	0	3	3	Instrumentation Engineering
10	20CSPC702	Machine Learning Techniques	3	0	0	3	3	Artificial Intelligence
11.	20MGEL701	Foundation Skills in Integrated Product Development	3	0	0	3	3	Management

PROFESSIONAL ELECTIVES - IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20EIEL801	Cyber Security for Industrial Automation	3	0	0	3	3	Artificial Intelligence
2	20EIEL802	Project Management and Finance	3	0	0	3	3	Instrumentation Engineering
3	20ICEL802	System Identification & Adaptive Control	3	0	0	3	3	Instrumentation Engineering
4	20EIEL803	VLSI Design	3	0	0	3	3	Electronics Engineering
5	20ICEL803	Artificial Intelligence for Robotics	3	0	0	3	3	Robotics
6	20EIEL804	Tele Health	3	0	0	3	3	Biomedical Engineering
7	20ICEL804	Machine Vision systems	3	0	0	3	3	Artificial Intelligence
8	20EIEL805	Bio Mechanics	3	0	0	3	3	Biomedical Engineering
9	20EIEL806	Robotics in Medicine	3	0	0	3	3	Biomedical Engineering
10	20EIEL807	Vehicle Control Systems	3	0	0	3	3	Electrical Engineering
11.	20MGEL801	Professional Ethics and Values	3	0	0	3	3	Management

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 Graduates will have solid and sound basics in Mathematics, Electronic and Instrumentation fundamentals and advancements to solve technical problems.

PEO2 Graduates will have the capability to work productively as Electronics and Instrumentation Engineers, including supportive and leadership roles in multidisciplinary domain.

PEO3 Graduates will have the potential to participate in life-long learning through the successful completion of advanced degrees, continuing education, certifications and/or other professional developments.

PEO4 Graduates will have the ability to apply the gained knowledge to improve the society ensuring ethical and moral values.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1 To apply the fundamentals of mathematics and science in the field of Electronics Engineering.

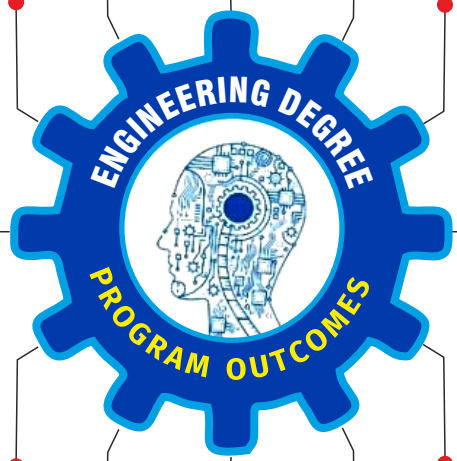
PSO2 To apply appropriate techniques to formulate and analyze engineering problems in instrumentation and process control.

COMPONENTS OF THE CURRICULUM (COC)

Course Component	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total Number of credits
Basic Sciences(BS)	17	31	29.5
Engineering Sciences(ES)	11	20	19
Humanities and Social Sciences (HS)	6	10	10
Professional Electives(EL)	7	12	12
Program Core+Program Lab (PC+PL)	38	82	64.5
Program theory with Lab (PW)	5	10	8
Open Electives (OE)	4	6	6
Talent Enhancement (TE)	2	8	4
Project (PJ)	4	12	7
Training & Placement (TP)	4	14	7
Internships/Seminars (IS)	2	-	3
Mandatory Courses (MC)	-	06	NA
Total number of Credits	100	211	170

PROGRAMME OUTCOMES(POs)

PROGRAM OUTCOME REPRESENTS THE KNOWLEDGE, SKILLS AND ATTITUDES THAT THE STUDENTS WOULD BE EXPECTED TO HAVE AT THE END OF THE 4 YEAR ENGINEERING DEGREE PROGRAM



01 Engineering knowledge
Apply the basic principle and knowledge of mathematics, science and engineering principles to solve technical problems.

02 Problem Analysis
Identify and analyze complex engineering problems reaching logical conclusions using the basic principles of mathematics, science and engineering.

03 Development of solutions
Design solutions for well-defined technical problems and assist with the design of systems, components or processes to meet specified needs.

04 Investigate complex problems
Perform investigations, use research based knowledge and conduct experiments, analyze and interpret the results to provide valid conclusions.

05 Modern tool usage
Create, select and apply the latest techniques, resources and modern engineering / IT tools to develop appropriate solutions with an understanding of the limitations.

06 The Engineer and Society
Apply reasoning based on contextual knowledge to assess societal, legal and cultural issues with competency in professional engineering practices.

07 Environment & Sustainability
Demonstrate professional skills, knowledge and contextual reasoning to assess / environmental / societal issues for sustainable development.

08 Apply ethical principles
Apply ethical principles and commit to professional ethics and responsibilities based on the norms of professional engineering pratices.

09 Individual & Teamwork
Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary professional settings.

10 Communicate effectively
Communicate effectively amongst the engineering community, being able to comprehend & write effective reports, make presentations & give/receive clear instructions.

11 Project management
Demonstrate knowledge and apply the principles of engineering & management in their own / team projects in multidisciplinary environments.

12 Life-long learning
Recognize the need for, and have the preparation, ability to engage in independent and life-long learning in the context of technological change.

SEMESTER - I

20BSMA101 SDG NO. 4 & 9	ENGINEERING MATHEMATICS-I	L	T	P	C
		3	1	0	4

OBJECTIVES:

The intent of the course is

- To understand and gain the knowledge of matrix algebra.
- To introduce the concepts of limits, continuity, derivatives and maxima and Minima
- To acquaint the concept of improper integrals and the properties of definite integrals.
- To provide understanding of double integration, triple integration and their application.
- To introduce the concept of sequence and series and impart the knowledge of Fourier series.

UNIT I MATRICES **12**

Symmetric, skew symmetric and orthogonal matrices; Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem (excluding proof) – Diagonalization of a Quadratic form using orthogonal transformation - Nature of Quadratic forms.

UNIT II DIFFERENTIAL CALCULUS **12**

Limits, continuity, Differentiation rules - Maxima and Minima of functions of one variable, partial derivatives (first and second order – basic problems), Taylor's series for functions of two variables, Jacobian, Maxima & Minima of functions of several variables, saddle points; Method of Lagrange multipliers.

UNIT III INTEGRAL CALCULUS **12**

Evaluation of definite integrals - Techniques of Integration-Substitution rule - Integration by parts, Integration of rational functions by partial fraction, Integration of irrational functions. Applications of definite integrals to evaluate surface area of revolution and volume of revolution. Evaluation of improper integrals.

UNIT IV MULTIPLE INTEGRALS **12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of

solids – Change of variables in double and triple integrals.

UNIT V SEQUENCES AND SERIES 12

Introduction to sequences and series – power series – Taylor's series – series for exponential, trigonometric, logarithmic, hyperbolic functions – Fourier series – Half range Sine and Cosine series – Parseval's theorem.

TOTAL: 60 PERIODS

TEXTBOOKS:

1. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
2. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 11th Reprint, 2010.

REFERENCES:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic Geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. T. Veerarajan, "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
4. N.P. Bali and Manish Goyal, "A text-book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
5. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2014.

WEB REFERENCES:

1. https://math.mit.edu/~gs/linearalgebra/ila0601.pdf
2. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter30/
3. https://ocw.mit.edu/courses/mathematics/18-02sc-multivariable-calculus-fall-2010/2.-partial-derivatives/
4. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter31/

ONLINE RESOURCES:

1. https://www.khanacademy.org/math/linear-algebra/alternate-bases/eigen-everything/v/linear-algebra-introduction-to-eigenvalues-and-eigenvectors
2. https://www.khanacademy.org/math/differential-calculus

OUTCOMES:

Upon completion of the course, the student should be able to

1. Diagonalize the matrix using orthogonal transformation and apply Cayley Hamilton Theorem to find the inverse and integral powers of a square matrix. (K3)
2. Evaluate the limit, examine the continuity and use derivatives to find extreme values of a function. (K3)
3. Evaluate definite and improper integrals using techniques of integration. (K3)
4. Apply double and triple integrals to find the area of a region and the volume of a surface. (K3)
5. Compute infinite series expansion of a function. (K3)

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	-	1
CO2	3	3	2	1	1	-	-	-	-	-	-	1
CO3	3	3	2	1	1	-	-	-	-	-	-	1
CO4	3	3	2	1	1	-	-	-	-	-	-	1
CO5	3	3	2	1	1	-	-	-	-	-	-	1

SEMESTER - I

20HSEN101 SDG NO. 4	TECHNICAL ENGLISH - I	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop the basic LSRW skills of the students
- To encourage the learners to adapt to listening techniques
- To help learners develop their communication skills and converse fluently in real contexts
- To help learners develop general and technical vocabulary through reading and writing tasks
- To improve the language proficiency for better understanding of core subjects

UNIT I INTRODUCTION 9

Listening – short texts – formal and informal conversations - **Speaking** – basics in speaking – speaking on given topics & situations – recording speeches and strategies to improve - **Reading –** critical reading – finding key information in a given text – shifting facts from opinions - **Writing –** free writing on any given topic – autobiographical writing - **Language Development** – tenses – voices- word formation: prefixes and suffixes – parts of speech – developing hints

UNIT II READING AND LANGUAGE DEVELOPMENT 9

Listening - long texts - TED talks - extensive speech on current affairs and discussions -Speaking – describing a simple process – asking and answering questions - **Reading** comprehension – skimming / scanning / predicting & analytical reading – question & answers – objective and descriptive answers –identifying synonyms and antonyms - process description - **Writing** instructions – **Language Development** – writing definitions – compound words.

UNIT III SPEAKING AND INTERPRETATION SKILLS 9

Listening - dialogues & conversations - **Speaking** – role plays – asking about routine actions and expressing opinions - **Reading** longer texts & making a critical analysis of the given text - **Writing** – types of paragraph and writing essays – rearrangement of jumbled sentences - writing recommendations - **Language Development** – use of sequence words - cause & effect expressions - sentences expressing purpose - picture based and newspaper based activities – single word substitutes

UNIT IV VOCABULARY BUILDING AND WRITING SKILLS 9

Listening - debates and discussions – practicing multiple tasks – self introduction – **Speaking** about friends/places/hobbies - **Reading** -Making inference from the reading passage – Predicting the content of the reading passage - **Writing** – informal letters/e-mails - **Language Development** - synonyms & antonyms - conditionals – if, unless, in case, when and others – framing questions.

UNIT V LANGUAGE DEVELOPMENT AND TECHNICAL WRITING 9

Listening - popular speeches and presentations - **Speaking** - impromptu speeches & debates - **Reading** - articles – magazines/newspapers **Writing** – essay writing on technical topics - channel conversion – bar diagram/ graph – picture interpretation - process description - **Language Development** – modal verbs - fixed / semi-fixed expressions – collocations

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Board of Editors. Using English: A Coursebook for Undergraduate Engineers and Technologists. Orient Blackswan Limited, Hyderabad: 2015.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai, 2011.

REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader – Centered Approach. Cengage, New Delhi, 2008.
2. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason, USA, 2007.
3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford, 2007.
4. Chauhan, Gajendra Singh and et.al.Technical Communication (Latest Revised Edition). Cengage Learning India Pvt. Limited, 2018.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_hs31/preview
2. http://engineeringvideolectures.com/course/696

ONLINE RESOURCES:

1. https://www.pearson.com/english/catalogue/business-english/technical-english.html
2. https://www.cambridgeenglish.org/learning-english/free-resources/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Express and explain short texts on different topics with key information applying suitable vocabulary (K2)
2 Interpret and dramatize fluently in informal and formal contexts(K2)
3 Choose and apply the right syntax in comprehending diversified general and technical articles (K3)
4 Analyze and write technical concepts in simple and lucid style (K3)
5 Construct informal letters and e-mails thoughtfully (K2)
6 Demonstrate technical concepts and summaries in correct grammar and vocabulary (K2)

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	1	-	2	3	1	1
CO2	-	-	-	-	-	-	-	1	2	3	2	1
CO3	-	-	-	-	-	-	-	-	1	3	3	2
CO4	-	2	-	-	-	-	-	1	2	3	1	1
CO5	-	-	-	-	-	-	-	2	-	3	2	1
CO6	-	-	-	-	-	-	3	-	-	3	2	1

SEMESTER - I

20BSPH101 SDG NO. 4	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate and enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology

UNIT I CRYSTAL PHYSICS **9**

Single crystalline, Polycrystalline and Amorphous materials - single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal - Miller indices - Interplanar distance - Powder diffraction method - Debye Scherer formula - Calculation of number of atoms per unit cell - Atomic radius - Coordination number - packing factor for SC, BCC, FCC and HCP structures - Polymorphism and allotropy - Diamond and Graphite structure (qualitative) - Growth of single crystals: Solution and Melt growth Techniques.

UNIT II PROPERTIES OF MATTER **9**

Elasticity - Stress - strain diagram and its uses - Poisson's ratio - Relationship between three moduli of elasticity (qualitative) - Factors affecting elastic modulus and tensile strength - Twisting couple - shaft - Torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT III QUANTUM PHYSICS **9**

Black body radiation - Planck's theory (derivation) - Compton effect: theory -

wave particle duality - electron diffraction - progressive waves - wave equation - concept of wave function and its physical significance - Schrödinger's wave equation - Time independent and Time dependent equations - particle in a box (one dimensional motion) - Tunneling (qualitative) - scanning tunneling microscope.

UNIT IV LASERS AND FIBER OPTICS 9

Lasers: population of energy levels, Einstein's A and B coefficients derivation - pumping methods - resonant cavity, optical amplification (qualitative) - three level and four level laser - CO_2 laser - Semiconductor lasers: Homojunction and Heterojunction.

Fiber optics: Principle, Numerical aperture and Acceptance angle - Types of optical fibers (material, refractive index, mode) - Losses associated with optical fibers - Fiber Optical Communication system (Block diagram) - Fiber optic sensors: pressure and displacement.

UNIT V THERMAL PHYSICS 9

Transfer of heat energy - thermal expansion of solids and liquids - bimetallic strips - thermal conduction, convection and radiation - heat conduction in solids (qualitative) - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) - thermal insulation - applications: heat exchangers, refrigerators and solar water heaters.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. D.K. Bhattachary & T.Poonam, "Engineering Physics". Oxford University Press, 2015.
2. R.K. Gaur& S.L. Gupta, "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. B.K. Pandey & S.Chaturvedi, "Engineering Physics", Cengage Learning India, 2017.
4. V. Rajendran, "Engineering Physics", Mc Graw Hill Publications Ltd. New Delhi, 2014.
5. M.N. Avadhanulu& P.G. Kshirshagar, "A textbook of Engineering Physics", S. Chand & Co Ltd. 2016.

REFERENCES:

1. D. Halliday, . Resnick & J. Walker, "Principles of Physics", Wiley, 2015.
2. R.A. Serway, & J.W. Jewett, "Physics for Scientists and Engineers", Cengage Learning, 2010.
3. N.K. Verma," Physics for Engineers", PHI Learning Private Limited, 2014.

4. P.A. Tipler & G. Mosca "Physics for Scientists and Engineers", W.H.Freeman, 2020.
5. Brijlal and Subramanyam, "Properties of Matter", S. Chand Publishing, 2018.
6. Shatendra Sharma & Jyotsna Sharma, "Engineering Physics", Pearson, 2018.

OUTCOMES :

Upon completion of the course, the student should be able to

1. To understand the crystal systems and elastic properties of Materials (K2)
2. To distinguish different crystal structures and heat conduction in conductor and insulators (K4)
3. To explain powder diffractionmethod-deformation of materials in response to action load,quantum mechanics to understand wave particle dualism (K2)
4. To apply quantum theory to set up one dimensional Schrodinger's wave equation and applications to a matter wave system and principle of laser action (K3)
5. To analyze bending of beams,types of optical fiber and modes of heat transfer (K4)
6. To discuss light propagation in optical fibers and transfer of heat energy in different measures and its applications (K2)

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	-	-	-	-	-	-	-	1
CO2	3	2	3	3	-	-	2	-	-	-	-	3
CO3	3	3	3	2	-	-	3	-	-	-	-	2
CO4	3	3	3	3	-	-	-	-	-	-	-	3
CO5	3	3	3	3	-	-	3	-	-	-	-	3
CO6	3	3	3	3	-	-	3	-	-	-	-	3

SEMESTER - I

20BSCY101 SDG NO. 4,6&7	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques
- To illustrate the principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials
- To categorize types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels
- To demonstrate the principles and generation of energy in batteries, nuclear reactors, solar cells, windmills and fuel cells
- To recognize the applications of polymers, composites and nano-materials in various fields

UNIT I WATER TECHNOLOGY AND SURFACE CHEMISTRY 9

Water Technology : Introduction – Hard water and Soft water. Hardness of water – types – expression of hardness (numerical problems). Boiler troubles – scale and sludge, priming and foaming, caustic embrittlement and boiler corrosion. Treatment of boiler feed water – Internal treatment (carbonate, phosphate, calgon, colloidal and sodium aluminate conditioning). External treatment – Ion exchange process, Zeolite process –Domestic water treatment (break point chlorination) –Desalination of brackish water – Reverse Osmosis.

Surface Chemistry: Adsorption – types – adsorption of gases on solids – adsorption of solutes from solution – applications of adsorption –role of adsorbents in catalysis and pollution abatement.

UNIT II ELECTROCHEMISTRY AND CORROSION 9

Electrochemistry: Cells – types (electrochemical and electrolytic cell) Redox reaction – single electrode potential (oxidation potential and reduction potential) – measurement and applications –Nernst equation (derivation and problems) – electrochemical series and its significance.

Corrosion: Causes, factors and types – chemical and electrochemical corrosion (galvanic, differential aeration). Corrosion control – material selection and design aspects, cathodic protection methods (sacrificial anodic and impressed current cathodic method) and corrosion inhibitors. Paints: Constituents and its functions. Electroplating of Copper and electroless plating of Nickel.

UNIT III FUELS AND COMBUSTION 9

Fuels: Introduction – classification of fuels – Coal – analysis of coal (proximate and ultimate). Carbonization – manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – manufacture of synthetic petrol (Bergius process). Knocking – octane number and cetane number – Gaseous fuels – Compressed natural gas (CNG), Liquefied petroleum gases (LPG). Biofuels – Gobar gas and Biodiesel.

Combustion of Fuels: Introduction – calorific value – higher and lower calorific values- theoretical calculation of calorific value – flue gas analysis (ORSAT Method).

UNIT IV ENERGY SOURCES AND STORAGE DEVICES 9

Energy sources: Nuclear fission – nuclear fusion – differences between nuclear fission and fusion – nuclear chain reactions – nuclear energy – light water nuclear power plant – breeder reactor – solar energy conversion – solar cells – wind energy.

Storage devices: Batteries – types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium–ion–battery), fuel cells – H_2 -O_2 fuel cell and super capacitors.

UNIT V POLYMERS AND NANOMATERIALS 9

Polymers: Classification – types of polymerization – mechanism (Free radical polymerization) –Engineering polymers: Nylon–6, Nylon–6,6, Teflon, Kevlar and PEEK – preparation, properties and uses – Plastic and its types - Conducting polymers – types and applications. Composites – definition, types, polymer matrix composites – FRP.

Nanomaterials: Introduction – Nanoparticles, Nanoclusters, Nanorods, Nanotubes (CNT: SWNT and MWNT) and Nanowires – Properties (surface to volume ratio, melting point, optical and electrical), Synthesis (precipitation, thermolysis, hydrothermal, electrodeposition, chemical vapour deposition, laser ablation, sol-gel process) and Applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015.
2. P. C. Jain and Monika Jain, "Engineering Chemistry" DhanpatRai Publishing Company (P) LTD, New Delhi, 2015.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.
4. Ravikrishnan A, 'Engineering Chemistry', Sri Krishna Hitech Publishing Company Pvt. Ltd, New Edition 2021.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

OUTCOMES

Upon completion of the course, the student should be able to

1. Identify the origin of water resources and develop innovative methods to produce soft water for industrial use and potable water at cheaper cost and recognize the basic design of adsorption systems and its industrial applications. (K2)
2. Recognize the basic concepts of electrochemistry and apply the principles of electrochemistry to corrosion process and the applications of protective coatings to overcome the corrosion. (K2)
3. Disseminating the importance of chemistry of fuels and combustion to enhance the fuel efficiency. (K2)
4. Acquire the basics of non-conventional sources of energy and illustrate the principles and the reaction mechanism of batteries and fuel cells. (K2)
5. Explain the synthesis and applications of polymers, composites and nano-materials. (K2)

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	1	2	-	-	-	-	1
CO2	3	2	3	2	2	1	2	-	-	-	-	3
CO3	3	2	3	2	-	1	2	-	-	-	-	1
CO4	3	2	3	2	-	1	2	-	-	-	1	3
CO5	3	2	3	1	2	1	1	-	-	-	1	3

SEMESTER - I

20ESCS101 SDG NO. 4&9	PROBLEM SOLVING AND PROGRAMMING IN C	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand about the programming language
- To develop C Programs using basic Programming Constructs, Loops Arrays and Strings
- To develop applications in C using Functions , Pointers and Structures
- To perform I/O operations and File Handling in C

UNIT I INTRODUCTION TO PROGRAMMING AND ALGORITHMS FOR PROBLEM SOLVING 10

The Basic Model of Computation, Programming Paradigms- Program Development Life Cycle - Algorithm –Pseudo Code – Flow Chart - Programming Languages - Compilation - Linking and Loading - Testing and Debugging - Documentation - Control Structures – Algorithmic Problem Solving- Problems Based on Sequential, Decision Making - Branching and Iteration.

UNIT II BASICS OF C PROGRAMMING 8

Structure of C program - C programming: Data Types – Storage Classes - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions – Input / Output Statements - Assignment Statements – Decision making Statements - Switch Statement - Looping Statements – Pre-Processor Directives - Compilation Process

UNIT III ARRAYS AND STRINGS 9

Introduction to Arrays: Declaration, Initialization – One Dimensional Array – Example Program: Computing Mean, Median and Mode - Two Dimensional Arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) - String Operations: Length, Compare, Concatenate - Copy – Selection Sort - Linear and Binary Search.

UNIT IV FUNCTIONS AND POINTERS 9

Introduction to Functions: Function Prototype, Function Definition, Function Call, Built-in Functions (String Functions, Math Functions) – Recursion – Example Program: Computation of Sine Series - Scientific Calculator using Built-in Functions - Binary Search using Recursive Functions – Pointers – Pointer Operators – Pointer Arithmetic – Arrays and Pointers –

Array of Pointers – Example Program: Sorting of Names – Parameter Passing: Pass by Value - Pass by Reference – Example Program: Swapping of Two Numbers using Pass by Reference.

UNIT V STRUCTURES and FILE PROCESSING 9

Structure - Nested Structures – Pointer and Structures – Array of Structures – Example Program using Structures and Pointers – Self Referential Structures – Dynamic Memory Allocation - Singly Linked List – Typedef.

Files – Types of File Processing: Sequential Access, Random Access – Sequential Access File - Example Program: Finding Average of Numbers stored in Sequential Access File - Random Access File - Example Program: Transaction Processing Using Random Access Files – Command Line Arguments.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2012.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication.
2. Jeri R. Hanly & Elliot B. Koffman, "Problem Solving and Program Design in C", Pearson Education, 2013.
3. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
6. Kanetkar Y, "Let us C", BPB Publications, 2007.
7. Hanly J R & Koffman E.B, "Problem Solving and Programme design in C", Pearson Education, 2009.

WEB REFERENCES:

1. https://www.learn-c.org/
2. https://codeforwin.org/
3. https://www.cprogramming.com/

ONLINE RESOURCES:

1. https://www.linuxtopia.org/online_books/programming_books/gnu_c_programming_tutorial
2. https://nptel.ac.in/courses/106105171
3. https://swayam.gov.in/nd1_noc19_cs42/preview

OUTCOMES:

Upon completion of the course, the student should be able to

1. Develop efficient algorithms for solving a problem. (K2)
2. Use the various constructs in C to develop simple applications. (K3)
3. Design and Implement applications using Array & Strings. (K3)
4. Develop applications using Functions and Pointers. (K6)
5. Design and Develop applications using Structures. (K3)
6. Design and Develop applications using Files. (K4)

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	1	-	2	2	-	3	2	3
CO2	3	3	3	3	2	-	1	1	2	2	3	3	2	3
CO3	3	3	3	3	2	1	1	1	2	-	3	-	3	2
CO4	3	3	3	3	2	1	-	1	2	2	3	3	1	2
CO5	3	3	3	3	2	1	1	1	2	2	3	3	2	1
CO6	3	3	3	3	2	1	1	1	2	2	3	3	3	2

SEMESTER - I

20ESGE101 SDG NO. 4,6,7, 9, 12,14 &15	ENGINEERING GRAPHICS	L	T	P	C
		1	2	0	3

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products
- To visualize the job in three dimensions
- To have a clear conception and appreciation of the shape, size, proportion and design
- To expose the student community to existing national standards related to technical drawings

CONCEPTS AND CONVENTIONS (Not for Examination) 3

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning- Projection of Points

UNIT I PLANE CURVES AND FREEHAND SKETCHING 6+9

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid on Horizontal Surfaces – construction of involutes of circle for one complete revolution – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF LINES AND PLANE SURFACE 6+9

Orthographic projection- principles-Principal planes- Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method- Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 6+9

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+9

Sectioning of prisms, pyramids, cylinder and cone in simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and truncated solids in vertical position – Prisms, pyramids cylinder and cone.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+9

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinder, cone- Perspective projection of simple solids-Prisms, pyramids and cylinder by visual ray method.

TOTAL: 78 PERIODS

TEXT BOOKS:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
2. T. Jeyapoovan, "Engineering Graphics using AUTOCAD", Vikas Publishing House Pvt Ltd, 7th Edition.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
3. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
4. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
5. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
6. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
7. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/103/112103019/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/104/105104148/

PUBLICATION OF BUREAU OF INDIAN STANDARDS:

1. IS10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods

OUTCOMES:

Upon completion of the course, the student should be able to

1. Relate thoughts and ideas graphically in a neat fashion and ability to perform sketching of engineering curves used in engineering practices, multiple views of objects. (K1)
2. Understand the concepts of orthographic projections for basic geometrical constructions. (K2)
3. Acquire the knowledge of orthographic projection in three dimensional object. (K2)
4. Develop knowledge about Sectioning and apply interior shapes of solids. (K3)
5. Analyze the concepts of design in developing various 3 dimensional projections. (K4)
6. Build a strong foundation to analyze the design in various dimensions. (K4)

CO - PO , PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO2	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO3	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO4	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO5	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO6	3	2	2	-	-	-	-	-	2	2	-	2	2	2

SEMESTER - I

20BSPL101 SDG NO. 4	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

PHYSICS LABORATORY

OBJECTIVES:

- To acquaint the students with practical knowledge of physics principles in various fields such as optics, thermal physics and properties of matter for developing basic experimental skills
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis

LIST OF EXPERIMENTS (Any 5 Experiments)

1. Determination of Young's modulus by non-uniform bending method.
2. Determination of rigidity modulus –Torsion pendulum.
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
4. (a) Determination of wavelength and particle size using Laser.
   (b) Determination of acceptance angle in an optical fiber.
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of specific resistance of a given coil of wire – Carey Foster's bridge.
7. Determination of wavelength of mercury spectrum – spectrometer grating.
8. Determination of band gap of a semiconductor.
9. Determination of Hall coefficient by Hall Effect experiment.
10. Determination of solar cell characteristics.

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS / 6 (max.) STUDENTS PER EXPERIMENT

1. Young's modulus by non-uniform bending method-experimental set-up – 12 sets
2. Rigidity modulus - Torsion pendulum experimental set-up – 12 sets
3. Ultrasonic Interferometer to determine velocity of sound and compressibility of liquid – 6 sets
4. (a) Experimental set-up to find the wavelength of light, and to find particle size using Laser – 6 sets
   (b) Experimental set-up to find acceptance angle in an optical fiber – 6 sets
5. Lee's disc method- experimental set up to find thermal conductivity of a bad conductor – 6 sets
6. Experimental set-up to find specific resistance of a coil of wire-Carey Foster's Bridge – 6 sets
7. Experimental set-up to find the wavelength of mercury spectrum-spectrometer grating – 6 sets
8. Experimental set-up to find the band gap of a semiconductor – 12 sets
9. Experimental set-up to find the Hall coefficient by Hall Effect Experiment – 6 sets

10. Experimental set-up to study characteristics of solar cells – 6 sets

TEXTBOOKS:

1. J.D. Wilson& C.A. Hernandez Hall "Physics Laboratory Experiments" Houghton Mifflin Company, New York, 2010.
2. M.N. Srinivasan, S. Balasubramanian &R. Ranganathan, "Practical Physics", S. Chand & Sons educational publications, New Delhi, 2011.
3. R. Sasikumar, "Practical Physics", PHI Learning Pvt. Ltd., New Delhi, 2011.

CHEMISTRY LABORATORY

(Any five experiments to be conducted)

OBJECTIVES:

- To acquaint the students with practical knowledge of the basic concepts of chemistry, the student faces during the course of their study in the industry and engineering field
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis
- To understand and develop experimental skills for building technical competence

LIST OF EXPERIMENTS (Any five experiments to be conducted)

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water samples.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Conductometric titration of strong acid vs strong base.
7. Estimation of iron content of the given solution using potentiometer.
8. Estimation of iron content of the water sample using spectrophotometer (1, 10- Phenanthroline / thiocyanate method).
9. Estimation of sodium and potassium present in water using flame photometers.
10. Determination of molecular weights of polymers using Ostwald's Viscometer.

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS / 6 (MAX.) STUDENTS PER EXPERIMENT.

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample - 6 sets
2. Determination of total, temporary & permanent hardness of water by EDTA method - 6 sets
3. Determination of DO content of water sample by Winkler's method - 6sets
4. Determination of chloride content of water sample by argentometric method – 6 sets
5. Determination of strength of given hydrochloric acid using pH meter - 6 sets
6. Conductometric titration of strong acid vs strong base - 6 sets
7. Estimation of iron content of the given solution using potentiometer - 6 sets
8. Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method) - 2 sets
9. Estimation of sodium and potassium present in water using flame photometer - 2 sets
10. Determination of molecular weights of polymer using Ostwald's Viscometer. - 6 sets

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th edition, 2014).

OUTCOMES:

Upon completion of the course, the student should be able to

1. Apply the principles of thermal physics and properties of matter to evaluate the properties of materials and to determine the physical properties of liquid using ultrasonic interferometer. (K1)
2. Understand measurement technique and usage of new instruments in optics for real time application in engineering. (K2)
3. Apply the knowledge of semiconductor materials to evaluate the band gap and Hall coefficient of materials and to study the characteristics of solar cell for engineering solutions. (K3)
4. Interpret quantitative chemical analysis to generate experimental skills in building technical competence. (K3)
5. Analyze the quality of water for domestic and industrial purpose. (K3)

6. Standardize the solutions using volumetric titrations, conductivity, pH, redox potential and optical density measurements. (K3)

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	3	3	2	2	1	1	3
CO2	3	3	3	3	3	3	3	2	2	2	2	3
CO3	3	3	3	3	3	3	3	2	1	1	2	3
CO4	3	2	3	3	1	1	2	2	2	2	3	2
CO5	3	2	3	3	1	1	2	2	2	2	3	2
CO6	3	2	3	3	1	1	2	2	2	2	3	2

SEMESTER - I

20ESPL101 SDG NO. 4&9	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To develop programs in C using basic Programming Constructs
- To develop applications in C using Arrays and Strings
- To design and implement applications in C using Functions, Structures
- To develop applications in C using Files

LIST OF EXPERIMENTS

1. Write a program using I/O statements and expressions.
2. Write programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Write a program to check whether a given number is Armstrong number or not?

6. Write a program tocheck whether a given number is odd or even?
7. Write a program to find the factorial of a given number.
8. Write a program to find out the average of 4 integers.
9. Write a program to display array elements using two dimensional arrays.
10. Write a program to perform swapping using function.
11. Write a program to display all prime numbers between two intervals using functions.
12. Write a program to reverse a sentence using recursion.
13. Write a program to get the largest element of an array using the function.
14. Write a program to concatenate two string.
15. Write a program to find the length of String.
16. Write a program to find the frequency of a character in a string.
17. Write a program to store Student Information in Structure and Display it.
18. The annual examination is conducted for 10 students for five subjects. Write a program to read the data and determine the following:
    (a) Total marks obtained by each student.
    (b) The highest marks in each subject and the marks of the student who secured it.
    (c) The student who obtained the highest total marks.
19. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
20. Count the number of account holders whose balance is less than the minimum balance using sequential access file.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Solve some simple problems leading to specific applications. (K6)
2. Demonstrate C programming development environment, compiling, debugging, linking and executing a program. (K6)
3. Develop C programs for simple applications making use of basic constructs, arrays and strings. (K6)
4. Develop C programs involving functions and recursion. (K6)

5. Develop C programs involving pointers, and structures. (K6)
6. Design applications using sequential and random access file. (K6)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	1	1	2	2	3	3	2	3
CO2	3	3	3	3	2	1	-	1	2	2	3	3	1	3
CO3	3	3	-	3	2	-	1	1	-	2	-	3	3	2
CO4	3	3	3	3	2	1	1	1	2	2	3	3	1	3
CO5	3	3	3	-	2	-	1	-	2	2	3	-	2	1
CO6	3	3	3	3	2	1	1	1	2	-	3	3	3	2

SEMESTER - I

20TPHS101 SDG NO. 4&5	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To enrich social network ethics
- To develop and enhance browsing culture
- To understand the concepts of networking
- To promote self professionalism
- To acquire knowledge about various digital identification procedures

UNIT I SOCIAL NETWORK ETIQUETTES **6**

Introduction to social network – Social Networking Etiquettes - Pros and Cons - Usage of Facebook, Instagram, WhatsApp , Telegram, Youtube, Evolution of Android and IOS, Introduction to Linkedin & Benefits. (Practicals – Official Mail id- Linkedin Id Creation, Linkedin Profile Bulilding , Facebook Id and Creation and Modifying the existing FB ID)

UNIT II BROWSING CULTURE **6**

Introduction to browsing – Search Engines-Google - Bing -Yahoo!-AOL -MSN –DuckDuckGo ,browsers, phishing – Cookies - URL – https:// extensions , browsing history, Incognito mode- VPN – Pros and Cons – Book mark.

UNIT III NETWORKING **6**

Basics of networking - LAN, MAN, WAN, Introduction to network topologies, Protocols , IP Commands (Command line prompt), Define online complier and editor (Practicals – Find Your System IP,Ping Command, Firewall Fortinet, Basic DOS Commands)

UNIT IV PROFESSIONALISM **6**

Dress Code, Body Language, Appropriate Attire ,Communication Skills, Interview preparation – Introducing yourself - How to greet Superiors, Importance of Eye Contact During conversation.

UNIT V DIGITAL IDENTIFICATION **6**

Introduction to NAD - Importance of Aadhar, PAN Card, Passport, Bank Account, Bar Code, QR scan, Payment Gateway (Gpay, Phone Pe, UPI, BHIM, Paytm), Mobile Banking (Practicals - NAD registration Step by Step, Linking bank account with netbanking , Register for payment gateway).

TOTAL : 30 PERIODS

WEB REFERENCES :

Unit I: Social Network Etiquettes:

1. https://sproutsocial.com/glossary/social-media-etiquette/
2. https://www.shrm.org/resourcesandtools/tools-and-samples/hr-qa/pages/socialnetworkingsitespolicy.aspx
3. https://www.frontiersin.org/articles/10.3389/fpsyg.2019.02711/full
4. https://medium.com/@sirajea/11-reasons-why-you-should-use-telegram-instead-of-whatsapp-ab0f80fbfa79
5. https://buffer.com/library/how-to-use-instagram/
6. https://www.webwise.ie/parents/what-is-youtube/
7. https://www.androidauthority.com/history-android-os-name-789433/
8. https://www.mindtools.com/pages/article/linkedin.htm

Unit II: Browsing Culture:

1. https://sites.google.com/site/bethanycollegeofteacheredn/unit--ict-connecting-with-world/national-policy-on-information-and-communication-technology-ict/accessing-the-web-introduction-to-the-browser-browsing-web
2. https://www.wordstream.com/articles/internet-search-engines-history
3. https://www.malwarebytes.com/phishing/
4. https://www.adpushup.com/blog/types-of-cookies/
5. https://www.eff.org/https-everywhere
6. https://www.sciencedirect.com/topics/computer-science/browsing-history\

7. https://www.vpnmentor.com/blog/pros-cons-vpn/
8. https://www.tech-wonders.com/2016/10/use-hush-private-bookmarking-extension-chrome.html

Unit III:Networking

1. https://www.guru99.com/types-of-computer-network.html
2. https://www.studytonight.com/computer-networks/network-topology-types
3. https://www.cloudflare.com/learning/network-layer/what-is-a-protocol/
4. https://www.howtogeek.com/168896/10-useful-windows-commands-you-should-know/
5. https://paiza.io/en

Unit IV : Professionalism

1. https://career.vt.edu/develop/professionalism.html
2. https://englishlabs.in/importance-dress-code/
3. https://www.proschoolonline.com/blog/importance-of-body-language-in-day-to-day-life
4. https://www.thespruce.com/etiquette-of-proper-attire-1216800
5. https://shirleytaylor.com/why-are-communication-skills-important/
6. https://www.triad-eng.com/interview-tips-for-engineers/
7. https://www.indeed.co.in/career-advice/interviewing/interview-question-tell-me-about-yourself
8. https://toggl.com/track/business-etiquette-rules/

Unit V: Digital Identification

1. https://nad.ndml.in/nad-presentation.html
2. https://www.turtlemint.com/aadhaar-card-benefits/
3. https://www.bankbazaar.com/pan-card/uses-of-pan-card.html
4. https://www.passportindex.org/passport.php
5. https://consumer.westchestergov.com/financial-education/money-management/benefits-of-a-bank-account
6. https://en.wikipedia.org/wiki/QR_code
7. https://www.investopedia.com/terms/p/payment-gateway.asp
8. https://www.paisabazaar.com/banking/mobile-banking/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Learn and apply social network ethics. (K3)
2. Understand the browsing culture. (K2)
3. Analyze the networking concepts . (K4)

4. Develop self professionalism. (K3)
5. Gain hands-on experience in various digital identification procedures. (K2)
6. Analyse and apply the different digital payment gateway methods. (K4)

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Co1	-	-	-	-	3	2	-	3	2	3	-	2
CO2	-	-	-	-	3	2	-	3	2	3	-	2
CO3	-	-	-	-	3	2	-	-	1	3	-	2
CO4	-	-	-	-	3	2	-	3	3	3	-	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2
CO6	-	-	-	-	3	2	-	-	2	3	-	2

SEMESTER - I

20HSMG101 SDG NO. 4&5	PERSONAL VALUES	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Values through Practical activities

UNIT I SELF CONCEPT **6**

Understanding self Concept – Identify Yourself – Who am I – an individual, engineer, citizen – Attitude – Measuring Behaviour – Change of Behaviour – Personality – Characteristics in personal, professional life.

UNIT II INDIVIDUAL VALUES **6**

Personal Values – Attributes –Courage – Creativity, Honesty, Perfection, Simplicity, Responsibility – Measuring personal values

UNIT III MORAL VALUES **6**

Moral – Understanding right and wrong – Positive thoughts – Respect to others – Doing good to society.

UNIT IV PHYSICAL AND MENTAL WELL-BEING **6**

Health – Physical fitness –Mental vigour – Diet management – Yoga – Meditation – Peaceful life – Happiness in life

UNIT V DECISION MAKING **6**

Goal Setting – Decision making skill – Overcome of Barriers – Success – Mental strength and weakness

TOTAL: 30 PERIODS

Note:

Each topic in all the above units will be supplemented by practice exercises and classroom activities and projects.

REFERENCE BOOKS:

1. Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press, 2016.
2. B.N.Ghosh, "Managing Soft Skills for Personality Development" McGraw Hill India, 2012.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Become an individual in knowing the self. (K4)
2. Acquire and express Personal Values, Spiritual values and fitness. (K4)
3. Practice simple physical exercise and breathing techniques. (K2)
4. Practice Yoga asana which will enhance the quality of life. (K1)
5. Practice Meditation and get benefitted. (K1)
6. Understanding moral values and need of physical fitness. (K2)

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	3	3	1	1	1
CO2	-	-	-	-	-	2	2	3	3	1	1	1
CO3	-	-	-	-	-	2	2	3	3	1	1	1
CO4	-	-	-	-	-	2	2	3	3	1	1	1
CO5	-	-	-	-	-	2	2	3	3	1	1	1
CO6	-	-	-	-	-	2	2	3	3	1	1	1

SEMESTER - II

20BSMA201 SDG NO. 4	ENGINEERING MATHEMATICS - II	L	T	P	C
		3	1	0	4

OBJECTIVES:

- The objective of this course is to familiarize the prospective engineers with techniques in Vector Calculus, Ordinary differential equations, Complex variables and Laplace transforms. It aims to equip the students to deal with advanced levels of Mathematics and applications that would be essential for their disciplines.

UNIT I VECTOR CALCULUS 12

Gradient and Directional derivatives - Divergence and Curl- Vector identities - Irrotational and Solenoidal vector fields - Line integral over a plane curve - Surface integral - Volume integral – Gauss divergence, Green's and Stoke's theorems - Verification and application in evaluating line, Surface and volume integrals.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 12

Second and higher order linear differential equations with constant coefficients - Method of variation of parameters - Homogeneous equation of Euler's and Legendre's types - System of simultaneous linear differential equations with constant coefficients.

UNIT III COMPLEX DIFFERENTIATION 12

Analytic functions- Necessary and sufficient conditions for analyticity in cartesian and polar coordinates (without proof) - Properties - Harmonic conjugate - construction of analytic functions- Conformal mapping - Mapping by functions $w = z+a, w=az, w=1/z, w=z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Contour integrals, Cauchy- Goursat theorem (without proof) - Cauchy Integral formula (without proof) - Taylor's series - Zeroes of Analytic functions - Singularities - Laurent's Series - Residues – Cauchy Residue theorem (without proof) – Application of Residue theorem for evaluation of real integrals – use of circular contour and semicircular contour(without poles on real axis).

UNIT V LAPLACE TRANSFORM 12

Existence conditions – Transforms of elementary functions – Transform of Unit step function and Unit impulse function – Basic properties – Shifting

theorems – Transforms of derivatives and integrals – Initial and Final value theorems – Convolution theorem – Transform of Periodic functions – Application of solution of linear second order ordinary differential equations with constant coefficients.

TEXT BOOKS:

1. Erwin Kreyszig, Advance Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill Publishing Company, New Delhi, 2008.

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma, "Higher Engineering Mathematics", S.Chand Private Ltd., 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2010.
3. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4. E.A.Coddinton, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
5. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2014.
6. N.P.Bali and Manish Goyal, "A text Book of Engineering Mathematics", Laxmi Publications, Reprint 2008.

WEB COURSES:

1. https://nptel.ac.in/courses/122107036/
2. https://nptel.ac.in/courses/111105134/
3. https://ocw.mit.edu/courses/mathematics/18-04-complex-variables-with-applications-spring-2018/
4. https://ocw.mit.edu/courses/mathematics/18-02-multivariable-calculus-fall-2007/
5. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/

ONLINE RESOURCES:

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/lecture-1-introduction/
2. http://www.nptelvideos.com/course.php?id=90

COURSE OUTCOMES:

Upon completion of the course, the student should be able to

1. Compute the derivatives of scalar and vector point functions. Use vector point function to establish a relation between line, surface and volume integrals. (K3)
2. Solve ordinary differential equations of second and higher order with constant coefficients, variable coefficients and simultaneous linear differential equations. (K3)
3. Construct an analytic function and apply the properties of analytic functions to check for harmonic and orthogonal functions and find the images of circle and straight lines under the standard transformations. (K3)
4. Use Cauchy's integral theorem, formula and Cauchy's Residue theorem to evaluate complex and real integrals, find the Taylor's and Laurent's series expansion. (K3)
5. Apply Laplace and inverse Laplace Transforms to solve the Linear ordinary differential equations with constant coefficients. (K3)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	-	-	-	-	-	-	1
CO2	3	3	2	1	-	-	-	-	-	-	-	1
CO3	3	3	2	1	-	-	-	-	-	-	-	1
CO4	3	3	2	1	-	-	-	-	-	-	-	1
CO5	3	3	2	1	-	-	-	-	-	-	-	1

SEMESTER - II

20HSEN201 SDG NO. 4	TECHNICAL ENGLISH - II	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To strengthen the listening skills for comprehending and critically analyzing passages
- To enhance students' ability with multiple strategies and skills for making technical presentations
- To participate in group discussions for developing group attitude
- To develop skills for preparing effective job application
- To write effective technical reports

UNIT I LANGUAGE DEVELOPMENT **9**

Listening – Listening conversations involving two participants – multiple participants – **Speaking** – conversation methods in real life occurrences using expressions of different emotions and imperative usages – **Reading** passages and short stories - **Writing** – preparation of checklist – extended definition – **Language Development** – tenses - subject - verb agreement

UNIT II VOCABULARY BUILDING **9**

Listening – listening formal and informal conversation and participative exercises – **Speaking** - creating greetings/wishes/excuses and thanks – **Reading** – articles/novels-**Writing** summary of articles and concise writing identifying new words – homonyms, homophones, homographs – one-word substitutions – easily confused words - creating SMS and using emoticons - sharing information in social media. **Language Development** - reported speeches – regular and irregular verbs - idioms & phrases

UNIT III WRITING TECHNICAL REPORTS **9**

Listening – listening conversation – effective use of words and their sound aspects, stress, intonation & pronunciation – **Speaking** - practicing telephonic conversations – observing and responding. **Reading** – regular columns of newspapers/magazines - **Writing** – reports – feasibility, accident, survey and progress - preparation of agenda and minutes – **Language Development** - using connectives – discourse markers

UNIT IV TECHNICAL WRITING **9**

Listening – Model debates & documentaries - **Speaking** – expressing agreement/disagreement, assertiveness in expressing opinions – **Reading**

biographies/autobiographies – **Writing** – note-making – formal letters – inviting guests – acceptance/declining letters - **Language Development** – degrees of comparison - numerical adjectives – embedded sentences

UNIT V GROUP DISCUSSION AND JOB APPLICATION 9

Listening – Listening - classroom lectures – recommending suggestions & solutions – **Speaking** – participating in group discussion – learning GD strategies – **Reading** – journal articles - Writing – Job application – cover letter - résumé preparation – **Language Development** – purpose statement – editing – verbal analogies.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Board of editors. Fluency in English: A Course book for Engineering and Technology. Orient Blackswan, Hyderabad 2016.
2. Ashraf Rizvi. M, Effective Technical Communication. 2nd ed. McGraw Hill, New Delhi, 2018.

REFERENCES

1. Bailey, Stephen. Academic Writing: A Practical Guide for Students. Routledge, New York,2011.
2. Raman, Meenakshi and Sharma, Sangeetha. Technical Communication Principles and Practice. Oxford University Press, New Delhi, 2014.
3. Muralikrishnan& Mishra Sunitha, Communication skills for Engineers 2nd ed. Pearson, Tamilnadu, India 2011. P. Kiranmai and Rajeevan, Geetha. Basic Communication Skills, Foundation Books, New Delhi, 2013.
4. Suresh Kumar, E. Engineering English. Orient Blackswan, Hyderabad, 2015
5. Richards, Jack C. Interchange Students' Book – 2. Cambridge University Press, New Delhi, 2015.

WEB REFERENCES :

1. https://swayam.gov.in/nd1_noc20_hs21/preview
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/109106122/lec1.pdf
3. https://freevideolectures.com/course/3250/introduction-to-film-studies/10

ONLINE RESOURCES

1. https://www.ef.com/wwen/english-resources/

2. https://www.smilesforlearning.org/gclid=EAIaIQobChMI49DF9bnd6AIVSY6PCh1d_gV9EAAYASAAEgIBPvD_BwE.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Define technical terms with the correct use of grammar (K1)
2 Identify new words, phrases, idioms and summarize articles/ write ups effectively (K2)
3 Pronounce words correctly, speak fluently and share opinions and suggestions effectively in conversations, debates and discussions (K3)
4 Construct reports convincingly and write official letters emphatically (K3)
5 Communicate confidently while speaking and writing by employing language strategies (K2)
6 Adapt group behavior, execute their role as a contributing team member and prepare winning job applications (K3)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	3	1	2
CO2	-	2	-	-	-	-	-	-	2	3	1	1
CO3	-	-	-	1	-	-	-	2	2	3	1	1
CO4	-	-	-	-	-	2	-	3	2	3	2	2
CO5	-	-	-	-	-	-	-	-	2	3	2	2
CO6	-	-	-	-	-	-	-	2	2	3	1	2

SEMESTER - II

20ESIT201 SDG NO. 4	PYTHON PROGRAMMING WITH LABORATORY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To Develop Python Programs with Conditionals and Loops
- To Use Python Data Structures – Lists, Tuples, Dictionaries, Sets
- To Define Python Functions and Work with Modules and Packages
- To Work with Python Classes, Objects and Handling Exceptions

UNIT I BASICS OF PYTHON PROGRAMMING 9

Python Interpreter and Interactive Mode - Features – History of Python – Literals – Variables and Identifiers – Data Types – Input Operation – Comments – Reserved Words – Indentation – Operators and Expressions – Operator Precedence– Operations on Strings – Other Data types – Type Conversion - Illustrative Programs: Use of various Operators, Evaluation of expressions, String Operations.

UNIT II DECISION CONTROL STATEMENTS 9

Conditionals: Boolean Values and Operators, Conditional (if) - Alternative (if-else) - Chained Conditional (if-elif-else) - Iteration: state - while - for - break - continue - pass - Illustrative Programs: Exchange the Values of Two Variables - Circulate the values of N Variables - Distance Between Two Points - Square Root - GCD - Exponentiation - Sum and Array of Numbers.

UNIT III STRING, LISTS, TUPLES, DICTIONARIES, SETS 9

Strings: String Slices - Immutability - String functions and methods - String Module - Lists: List Operations - List Slices - List methods - List Loop - Mutability - Aliasing - Cloning lists - List Parameters - Tuples: Tuple Assignment - Tuple as return value - Dictionaries: Operations and Methods - Advanced List Processing - List Comprehension - Sets: Creating Sets – Operations and Methods – Set Comprehension - Illustrative programs: Linear Search - Binary Search - Selection Sort - Insertion Sort - Merge Sort - Histogram.

UNIT IV FUNCTIONS, MODULES AND PACKAGES 9

Functions - Function Definition and Use - Flow of Execution - Parameters and Arguments - Fruitful Functions: Return values - Parameters - Local and Global Scope - Function Composition - Recursion - Modules – from-import Statement – Name of Module – Making your own modules - Packages - Standard Library Modules – globals(), locals() and reload() - Illustrative programs: Fibonacci Series using functions - Arithmetic Operations using Module - Area of different shapes using Packages.

UNIT V CLASSES, OBJECTS AND EXCEPTION HANDLING 9

Classes and Objects – Defining Classes – Creating Objects – Data Abstraction and Hiding through Classes - init() method – Class Variables and Object Variables – Introduction to Errors and Exception Handling – Handling Exceptions – Multiple Except Blocks – else Clause – Raising Exceptions – Built-in and User-defined Exceptions – Finally Block.

LIST OF EXPERIMENTS 15

1. Write a Python program to perform
   a. Linear Search
   b. Binary Search
2. Write a Python program to perform Selection Sort.
3. Write a Python program to sort the given numbers using Insertion Sort.
4. Write a Python program to do sorting using Merge sort.
5. Write a Python program to find first n prime numbers.
6. Write a Python program to Multiply two matrices.
7. Write a Python program to create Student class and instantiate its Object.
8. Write a Python License verification process using Exception handling.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. ReemaThareja. "Python Programming Using Problem Solving Approach", Oxford University Press 2018.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, O'Reilly Publishers, 2016.

REFERENCES:

1. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python" Revised and updated for Python 3.2, Network Theory Ltd., 2011.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-Disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
6. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013.
7. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

WEB REFERENCES:

1. http://greenteapress.com/wp/think-python/
2. www.docs.python.org
3. https://nptel.ac.in/courses/106/106/106106182/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Describe the syntax, semantics and control flow statements of Python programming. (K2)
2. Implement simple programs using control structures in Python. (K3)
3. Explain the methods to create and manipulate strings, lists, dictionaries, tuples and sets. (K2)
4. Articulate the concepts of functions, modules and packages in Python. (K2)
5. Implement simple programs using Python Data types and functions. (K3)
6. Apply the concepts of Exception handling, classes and objects. (K3)

CO - PO, MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	2	-	-	-	1	-	3	3
CO2	1	2	3	3	3	2	1	1	1	1	1	3
CO3	-	1	3	3	2	1	-	-	-	-	1	3
CO4	1	2	3	3	2	-	-	-	-	-	1	3
CO5	2	3	3	3	3	1	1	2	2	1	2	3
CO6	2	3	3	3	3	1	1	2	2	1	2	3

SEMESTER - II

20BSPH206 SDG NO. 4	PHYSICS FOR INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquaint the electrical properties of materials
- To present the principles of semiconductor physics and its applications
- To educate the properties of magnetic and dielectric materials and their uses
- To introduce the superconductor and optical properties of materials
- To explicit the fundamental principles of nanodevices.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS **9**

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity expression - Wiedemann-Franz law - Success and failures -

electrons in metals - Particle in a three dimensional box - degenerate states - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential- Energy bands in solids - Tight binding approximation - Electron effective mass- concept of hole.

UNIT II DIELECTRIC MATERIALS **9**

Dielectric Polarization and Mechanism – Internal or local Field ClausiusMossotti relation – Dielectric loss Temperature and frequency dependence of dielectric constant – Measurement of Dielectric constant and loss using Scherring bridge – Elementary ideas of Piezoelectric, Ferroelectrics and Pyroelectric materials and its Applications.

UNIT III MAGNETIC PROPERTIES **9**

Elementary Ideas of classification of magnetic materials (Dia, Para, Ferro &Ferri) – Quantum theory of Para & Ferro Magnetism – Domain Theory of Hysteresis – Heisenberg Theory of Exchange Interaction (without derivation) – Qualitative ideas of Anti ferromagnetic Ordering – Structure and Properties of Ferrites – Properties of Soft & Hard Magnetic Materials – Applications: floppy disks, CD ROM, Magneto optical recording

UNIT IV SEMICONDUCTORS AND SUPERCONDUCTORS **9**

Derivation of Carrier concentration in intrinsic Semiconductor – Hall effect in Semiconductors Application of Hall Effect Basic Ideas of Compound Semiconductors (II-VI & III-V) Basic concepts of superconductivity – transition temperature – Meissner effect – Type I and II superconductors – high temperature superconductors – 123 superconductor.

UNIT V ADVANCED MATERIALS **9**

Liquid Crystals – Types – Application as Display Devices – Metallic Glasses – Nanomaterials (one, Two & three Dimensional) – Physical Properties and Applications of Carbon Nano Tubes.

TOTAL = 45 PERIODS

TEXT BOOKS:

1. S.O.Pillai "Solid State Physics", New Age International Publishers, 5th Edition, New Delhi.2018.
2. S.O.Kasap, "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2017.
3. P.K.Palanisamy, "Physics for Electronics Engineering", Scitech Publication, 2018.
4. S. Salivahanan, A. Rajalakshmi, S. Karthie, N.P.Rajesh, " Physics for Electronics Engineering and Information ", McGraw Hill Education, 2018.

5. G.W.Hanson, "Fundamentals of Nanoelectronics". Pearson Education, 2011.

REFERENCES

1. C.Kittel, "Introduction to Solid State Physics", Wiley, 2018.
2. B. Rogers, J. Adams &S.Pennathur, "Nanotechnology: Understanding Small Systems", CRC Press, third edition, 2017.
3. N.K.Verma, "Physics for Engineers", PHI Learning Private Limited, 2017.
4. H.C.Marcel Van de Voorde, Robert Puers, LivioBaldi, Abstiaan Evan Nooten, "Nanoelectronics: Materials, devices and application", Wiley VCH, 2017.
5. MoriakiWakaki, "Optical materials and Applications" CRC Press, 2018.
6. Umesh K Mishra &Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2014.
7. W.D.Callister., "Materials Science and Engineering: An introduction", John Wiley & Sons Inc., New York, 6th Edition, 2002.
8. V.Raghavan ."Materials Science and Engineering – A first course", Prentice Hall, New Delhi,

OUTCOMES:

At the end of the course, the students should be able to

1. Understand the basic concepts of free electron theory of solids and apply it to determine the conducting properties, carrier concentration and effective mass of an electron in conductors (K3)
2. Remembering the basic laws of Physics to understand the dielectric properties of materials, understanding the importance of various theories to explain the material behaviour and its applications (K2)
3. Gain knowldge on the basic concepts of magnetic properties, its classification and their applications in optical data storage devices like CD ROM, floppy disks and optical recording(K2)
4. Acquire the basic knowledge about semiconducting and superconducting materials, understanding its types, carrier concentration and properties (K2)
5. Gain knowledge on the fundamental principles of advanced materials amd its applications in power and display devices (K2)
6. understand the basics of nanomaterials, quantum structures, its properties, carbon nanotubes and its applications (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	2	-	-	-	-	-	-	1
CO2	3	3	-	3	2	-	-	-	-	-	-	1
CO3	3	3	2	3	2	-	1	-	-	-	-	2
CO4	2	3	3	3	2	-		-	-	-	-	2
CO5	3	3	3	3	1	-	2	-	-	-	-	1
CO6	3	2	3	3	2	-	2	-	-	-	-	1

SEMESTER - II

20BSCY201 SDG NO. 4,17	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the nature and facts about environment
- To find and implement scientific, technological, economic and political solutions to environmental problems
- To study the interrelationship between living organism and environment
- To provide the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment – need for public awareness – Ecosystem: concept of an ecosystem – structure and functions of an ecosystem – Biotic and abiotic components – Biogeochemical cycle (C, N & P) – energy flow in the ecosystem – food chains, food webs and ecological pyramids – ecological succession - keystone species. Introduction to biodiversity definition: genetic, species and ecosystem diversity – values of biodiversity – IUCN Red list species classification - endemic, endangered, rare, vulnerable, extinct and exotic species – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – man-wildlife conflicts. Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of Terrestrial (Forest,

Grassland, Desert) and Aquatic ecosystem (Pond, Lake, River, Estuary and Marine)

UNIT II ENVIRONMENTAL POLLUTION 9

Definition – causes, effects and control measures of: Air pollution, Water pollution, Soil pollution Marine pollution, Noise pollution, Thermal pollution and Nuclear pollution – solid waste management: causes, effects and control measures of municipal solid wastes (MSW) – role of an individual in prevention of pollution – Case studies related to environmental pollution.

Disaster management: floods, earthquake, cyclone and landslides – nuclear holocaust – Case studies.

UNIT III NATURAL RESOURCES 9

Forest resources: Use and over – exploitation, deforestation – Land resources: land degradation, man induced landslides, soil erosion and desertification – Water resources: Use and over- utilization of surface and groundwater – dams-benefits and problems, conflicts over water – Mineral resources: Environmental effects of extracting and using mineral resources – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – fertilizer – pesticide problems, water logging and salinity. Energy resources: Renewable energy (Solar energy, Wind energy, Tidal energy, Geothermal energy, OTE, Biomass energy) and non renewable energy (Coal, Petroleum, Nuclear energy) sources. – role of an individual in conservation of natural resources. Case studies – timber extraction, mining, dams and their effects on forests and tribal people.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 10

Atmospheric Chemistry - Composition and structure of atmosphere. Climate change - greenhouse effect- role of greenhouse gases on global warming. Chemical and photochemical reactions in the atmosphere - Formation of smog, PAN, acid rain (causes, effect and control measures). Oxygen and ozone chemistry - Ozone layer depletion (causes, effect and control measures). environmental ethics: Issues and possible solutions – Green chemistry - 12 principles of green chemistry.

Urbanisation - Urban problems related to energy - Water conservation: rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns - case studies. Environment Legislations and Laws : Environment (protection) act – 1986. Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act. Biomedical Waste(Management and Handling rules):1998 and amendments- scheme of labelling of environmentally friendly products (Ecomark) - Issues involved in

enforcement of environmental legislation - central and state pollution control boards, role of non-governmental organization – Public awareness - Environmental Impact Assessment (EIA).

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 8

Population growth, variation among nations – population explosion – family welfare programme – women and child welfare environment and human health – HIV / AIDS – Role of Information Technology in environment and Human health – Case studies – human rights – value education – Sustainable Development – Need for sustainable development – concept – 17 SDG goals – 8 Millennium Development Goals(MDG).

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
3. Ravikrishnan A, 'Environmental Science and Engineering', Sri Krishna Hitech Publishing Company Pvt. Ltd, Revised Edition 2020.

REFERENCES :

1. Dharmendra S. Sengar, "Environmental law", Prentice hall of India Pvt Ltd, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt Ltd., Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd., Delhi, 2014.
4. Rajagopalan. R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.

OUTCOMES:

Upon successful completion of this course, student should be able to

1. Explain the different components of environment, structure and function of an ecosystem, importance of biodiversity and its conservation. (K1)
2. Aware about problems of environmental pollution, its impact on human and ecosystem, control measures and basic concepts in Disaster Management. (K2)
3. Disseminate the need for the natural resources and its application to meet the modern requirements and the necessity of its conservation. (K2)
4. Illustrate the various aspects of atmospheric chemistry with a focus on climate change and recognize the principles of green chemistry. Describe

suitable scientific, technological solutions and Protection Acts to eradicate social and environmental issues. (K2)

5. Recognize the need for population control measures and the environmental based value education concepts to achieve the Sustainable Development Goals. (K2)

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	-	1	2	-	1	1	-	2
CO2	2	2	2	-	2	2	3	1	2	2	-	2
CO3	1	1	1	1	-	1	1	-	1	2	-	1
CO4	2	2	2	2	1	1	1	-	1	1	1	1
CO5	2	2	1	-	-	1	1	-	-	-	1	-
CO6	1	1	1	1	1	1	1	1	1	1	1	1

SEMESTER - II

20EEPC201 SDG NO. 4 & 9	ELECTRIC CIRCUITS ANALYSIS	L	T	P	C
		2	1	0	3

OBJECTIVES:

- To impart knowledge on electric circuits and solving circuit equations using network theorems
- To educate on obtaining the transient response of circuits and phenomenon of resonance and coupled circuits
- To introduce Phasor diagrams and analysis of three phase circuits

UNIT I BASIC CIRCUITS ANALYSIS **6 +3**

Resistive elements - Ohm's Law Resistors in series and parallel circuits – Kirchoff's law, Network reduction: voltage and current division, Source transformation – Star Delta conversion. AC Fundamentals- Average and RMS value - Phasor Diagram – Power, Power Factor and Energy – Mesh current and node voltage - methods of analysis

UNIT II NETWORK THEOREMS FOR DC AND AC CIRCUITS **6+3**

Superposition Theorem - Thevenin's and Norton's Theorems – Maximum power transfer theorem– Reciprocity Theorem – Millman's theorem.

UNIT III TRANSIENT RESPONSE ANALYSIS **6+3**

R, L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

UNIT IV RESONANCE AND COUPLED CIRCUITS **6+3**

Series and parallel resonance– their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT V POLY PHASE CIRCUITS **6+3**

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurement in three phase circuits.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. SudhakarA and Shyam Mohan SP, "Circuits and Network Analysis andSynthesis", McGraw Hill, Fifth Edition, June 2015.
2. Charles K.Alexander,Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", Sixth Edition, McGraw Hill, February 14, 2019.
3. Joseph A.Edminister, Mahmood Nahri, "Electric circuits",(Schaum's outline series), Mc Graw- Hill, New Delhi, Fifth edition, February 5 2010.

REFERENCES

1. Chakrabarti A, "Circuits Theory Analysis and Synthesis", Dhanpath Rai & Sons,New Delhi, Seventh edition, 2015
2. A Nagoor kani, "Circuit Analysis," McGraw Hill,3rd January 11, 2016
3. William H. Hayt, Jack Kemmerly, Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill, eighth edition, July10 2013.
4. Mahadevan K ,Chitra C., "Electric Circuits Analysis," Prentice-Hall of India Pvt Ltd., New Delhi, Second edition, 2015.
5. Richard C. Dorf and James A.Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, Inc., 9th edition, August 2014.

WEB RESOURCES:

1. https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic
2. http://homepages.wmich.edu/~miller/ECE2100.html
3. https://engineering.purdue.edu/~ee202https://engineering.purdue.edu/~ee202

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc17_ee13/preview
2. https://www.coursera.org/learn/linear-circuits-dcanalysis
3. https://onlinecourses.nptel.ac.in/noc17_ee15/preview
4. https://swayam.gov.in/course/218-networks-and-systems

OUTCOMES:

At the end of the course, the student should be able to

1. Apply the laws, transformation concepts with respect to DC, AC Circuits (K3)
2. Analyze DC and AC circuits using mesh and nodal method (K4)
3. Apply the concept of theorems for analyzing DC and AC circuits (K3)
4. Apply the steady state and transients Response concepts related to DC and AC circuits (K3)
5. Understand the Frequency Response of series and parallel circuits (K2)
6. Analyze the concepts of coupled circuits, single phase and three phase circuits (K4)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	1	-	-	-	-	-	2	3	2
CO2	3	3	2	2	-	1	-	-	-	-	-	2	3	2
CO3	3	3	2	2	-	1	-	-	-	-	-	2	3	2
CO4	3	3	2	2	-	1	-	-	-	-	-	2	2	2
CO5	3	3	2	2	-	1	-	-	-	-	-	2	2	2
CO6	3	3	2	2	-	1	-	-	-	-	-	2	2	2

SEMESTER - II

20ESGE201 SDG NO. 4,9,12	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Electrical and Electronics Engineering, Civil and Mechanical Engineering

ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

CIVIL ENGINEERING PRACTICE

Buildings:

Study of plumbing and carpentry components of residential and industrial buildings, safety aspects.

Plumbing Works:

1. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
2. Study of pipe connections requirements for pumps and turbines.
3. Preparation of plumbing line sketches for water supply and sewage works.
4. Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
5. Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

1. Study of the joints in roofs, doors, windows and furniture.
2. Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

MECHANICAL ENGINEERING PRACTICE

Welding:

1. Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
2. Gas welding practice.

Basic Machining:

1. Simple Turning and Taper turning.
2. Drilling Practice.

Sheet Metal Work:

1. Forming & Bending.
2. Model making – Trays and funnels.
3. Different type of joints.

Machine assembly practice:

1. Study of centrifugal pump.
2. Study of air conditioner.

Demonstration on:

1. Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
2. Foundry operations like mould preparation for gear and step cone pulley.
3. Fitting – Exercises – Preparation of square fitting and V – fitting models.

Total : 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Electrical

1	Assorted electrical components for house wiring	15 Sets
2	Electrical measuring instruments	10 Sets
3	Study purpose items:	
	Iron box, fan and regulator, emergency lamp	1 Each
4	Megger (250V/500V)	1 No
5	Power Tools:	
	Range Finder	2 Nos
	Digital Live-wire detector	2 Nos

2. Electronics

1	Soldering guns	10 Nos
2	Assorted electronic components for making circuits	50 Nos

3	Small PCBs	10 Nos
4	Multimeters	10 Nos

3. Civil

1	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets
2	Carpentry vice (fitted to work bench)	15 Nos
3	Standard woodworking tools	15 Sets
4	Models of industrial trusses, door joints, furniture joints	5 each
5	Power Tools:	
	Rotary Hammer	2 Nos
	Demolition Hammer	2 Nos
	Circular Saw	2 Nos
	Planer	2 Nos
	Hand Drilling Machine	2 Nos
	Jigsaw	2 Nos

4. Mechanical

1	Arc welding transformer with cables and holders	5 Nos
2	Welding booth with exhaust facility	5 Nos
3	Welding accessories like welding shield, chipping hammer, wire brush, etc	5 Sets
4	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5	Centre lathe	2 Nos
6	Hearth furnace, anvil and smithy tools	2 Sets
7	Moulding table, foundry tools	2 Sets
8	Power Tool: Angle Grinder	2 Nos
9	Study-purpose items: centrifugal pump, air-conditioner	1 each

OUTCOMES:

Upon completion of the course, the students should be able to

1. Elaborate on the components, gates, soldering practices. Calculate electrical parameters such as voltage, current, resistance and power. (K1)
2. Design and implement Rectifier and Timer circuits (K2)
3. Measure the electrical energy by single phase and three phase energy meters. (K2)
4. Prepare the carpentry and plumbing joints. (K2)

5. Perform different types of welding joints and sheet metal works (K2)
6. Perform different machining operations in lathe and drilling. (K2)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	1	-	-	1	1	1	1
CO2	3	2	1	1	2	1	-	-	1	1	1	1
CO3	2	2	1	1	1	1	-	-	1	1	1	1
CO4	1	1	1	-	-	2	-	-	1	1	1	2
CO5	2	1	1	-	-	1	1	1	1	1	1	2
CO6	2	1	1	-	-	1	-	1	1	1	1	2

SEMESTER - II

20EEPL20 SDG NO. 4&9	ELECTRIC CIRCUITS AND SIMULATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To simulate various electric circuits using Pspice/ Matlab/e-Sim /Scilab
- To gain practical experience on electric circuits and verification of theorems
- To gain practical Knowledge on electric circuits transients and resonance

LIST OF EXPERIMENTS

1. Simulation and experimental solving of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Simulation and experimental solving of electrical circuit problems using Thevenin's theorem.
3. Simulation and experimental solving of electrical circuit problems using Norton's theorem.
4. Simulation and experimental solving of electrical circuit problems using Superposition theorem.
5. Simulation and experimental verification of Maximum Power transfer Theorem.
6. Study of Analog and digital oscilloscopes and measurement of sinusoidal voltage, frequency and power factor.

7. Simulation and Experimental validation of R-L & R-C electric circuit transients.
8. Simulation and Experimental validation of frequency response of RLC electric circuit.
9. Design and Simulation of series resonance circuit.
10. Design and Simulation of parallel resonance circuits.
11. Simulation of three phase balanced and unbalanced star, delta networks circuits.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1	Regulated Power Supply: 0 – 15 V D.C / Distributed PowerSource.	- 10 Nos
2	Function Generator (1 MHz)	- 10Nos.
3	Single Phase Energy Meter	- 1 No.
4.	Oscilloscope (20MHz)	- 10 Nos.
5.	Digital Storage Oscilloscope (20 MHz)	– 1 No.
6.	10 Nos of PC with Circuit Simulation Software (min 10 Users) (e-Sim / Scilab/ Pspice / Matlab /other Equivalent software Package) and Printer (1No.)	
7.	AC/DC - Voltmeters (10 Nos.), Ammeters (10 Nos.) and Multi-meters (10 Nos.) 8 Single Phase Wattmeter	– 3Nos.
9	Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box Each	- 6 Nos.
10	Circuit Connection Boards	- 10Nos.

Necessary Quantities of Resistors, Inductors, Capacitors of various capacities.

OUTCOMES:

On completion of the course on Electric circuit laboratory, the students should be able to

1. Measure electrical quantities using multimeters, power supplies and oscilloscopes and apply basic circuit laws. (K4)
2. Understand DC and AC Network theorems and apply to them in laboratory measurements. (K4)
3. Analyze the transient response of series RL and RC electric circuits. (K5)
4. Simulate the frequency behavior of RLC electric circuits. (K4)
5. Design and simulate the resonance circuit. (K5)
6. Analyze the balanced and unbalanced star delta network circuits. (K5)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	-	-	-	2	-	1	2	3	2
CO2	3	3	2	1	1	-	-	-	2	-	1	1	2	2
CO3	3	3	2	2	1	-	-	-	2	-	1	2	2	2
CO4	3	3	2	2	1	-	1	-	2	-	1	2	2	2
CO5	3	3	2	1	1	-	-	-	2	-	1	-	2	2
CO6	3	3	2	2	1	-	1	-	2	-	1	2	2	2

SEMESTER - II

20TPHS201 SDG NO. 4&5	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the nuances in resume building
- To explore various virtual meeting tools
- To gain knowledge about online certification courses
- To develop knowledge in Google Suite products
- To enhance presentation skills

UNIT I RESUME BUILDING **6**

Your Strength, Projects, Internship, Paper Presentation, uploading your coding in github, Introduction to HackerRank, HackerEarth virtual online assessment (Auto Proctored) (Practicals - Construct a resume, Register for a online Mock Assessment / Contest)

UNIT II VIRTUAL MEETINGS **6**

Basic Etiquette of virtual meeting – Introduction to Skype - Zoom - Webex - Google Meet - Gotowebinar - Jio meet – Screen Share - Jamboard - Feedback polling - Chatbox

(Practicals - Accept and Register for a mock class to attend - How to host a meeting).

UNIT III ONLINE LEARNING **6**

Online Certification - Coursera – Udemy – Edx – Cisco – Online Practice Platforms - SkillRack – Myslate - FACEprep - BYTS - aptimithra - Contest

Registrations - TCS Campus Commune - HackwithInfy, InfyTQ - Virtusa NurualHack - Mindtree Osmosis – Online assessment - AMCAT-PGPA.

(Practicals - Campus Commune Registration , Coursera registration - Mock Registration (KAAR Technologies as sample).

UNIT IV GOOGLE SUITE **8**

Define google suite - Benefits of google suite - Google Search - Sheet - Docs - Forms - Calender - Drive - Slide - Translate - Duo - Earch - Maps - Hangouts- Sites - Books - Blogger (Practicals – Create google sheets and share - Create google Forms and share, Create Google Slide and share , Google drive creation and share (Knowledge of Rights), Create poll and share.

UNIT V PRESENTATION SKILLS **4**

Email Writing – Group Discussion - Power Point Presentation

(Practicals- Create a self SWOT Analysis report. A PowerPoint Slide Preparation)

TOTAL : 30 PERIODS

WEB REFERENCES :

Unit I: Resume Building:

1. https://zety.com/blog/resume-tips
2. https://resumegenius.com/blog/resume-help/how-to-write-a-resume
3. https://www.hackerearth.com/recruit/
4. https://www.hackerrank.com/about-us

Unit – II:Virtual Meetings

1. https://www.claphamschool.org/our-community/blog/online-learning-etiquette-guide-14-principles-to-guide-students
2. https://online.hbs.edu/blog/post/virtual-interview-tips?c1=GAW_SE_NW&source=IN_GEN_DSA&cr2=search__-__nw__-__in__-__dsa__-__general&kw=dsa__-__general& cr5=459341920955&cr7=c&gclid=Cj0KCQjw8fr7BRDSARIsAK0Qqr4dRRbboL3kltrwDsr7hm8oIHtN5dfjD3NIFZULuzNwEXxhjpNFQ2caApn5EALw_wcB
3. https://hygger.io/blog/top-10-best-group-meeting-apps-business/
4. https://www.zdnet.com/article/best-video-conferencing-software-and-services-for-business/

Unit – III:Online Learning

1. https://www.coursera.org/browse
2. https://support.udemy.com/hc/en-us/articles/229603868-Certificate-of-Completion

3. https://www.edx.org/course/how-to-learn-online
4. https://www.cisco.com/c/en/us/training-events/training-certifications/certifications.html
5. https://campuscommune.tcs.com/en-in/intro
6. https://www.freshersnow.com/tcs-campus-commune-registration/
7. https://www.infosys.com/careers/hackwithinfy.html
8. https://www.mindtree.com/blog/osmosis-2013-my-experiences
9. https://www.myamcat.com/knowing-amcat
10. https://www.admitkard.com/blog/2020/02/06/amcat/

Unit IV: Google Suite

1. https://www.inmotionhosting.com/blog/what-is-g-suite-and-why-should-i-consider-using-it/
2. https://en.wikipedia.org/wiki/G_Suite
3. https://blog.hubspot.com/marketing/google-suite
4. https://kinsta.com/blog/g-suite/

Unit V: Presentation Skills

1. https://www.mindtools.com/CommSkll/EmailCommunication.htm
2. https://www.grammarly.com/blog/email-writing-tips/
3. https://business.tutsplus.com/articles/how-to-write-a-formal-email--cms-29793
4. https://www.softwaretestinghelp.com/how-to-crack-the-gd/
5. https://www.mbauniverse.com/group-discussion/tips
6. https://slidemodel.com/23-powerpoint-presentation-tips-creating-engaging-interactive-presentations/
7. https://business.tutsplus.com/articles/37-effective-powerpoint-presentation-tips--cms-25421
8 https://blog.prezi.com/9-tips-on-how-to-make-a-presentation-a-success/
9. http://www.garrreynolds.com/preso-tips/design/

OUTCOMES:

On completion of this course, the student should be able to

1. Construct a suitable resume and registration procedure for online mock assessments. (K1)
2. Handle various virtual meeting tools. (K3)
3. Acquire exposure about online certification courses. (K4)
4. Get involved and work in a collaborative manner. (K2)

5. Gain knowledge in various presentation methodologies. (K1)
6. Apply knowledge to practice Google suite features and SWOT analysis. (K3)

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	3	2	-	3	2	3	-	2
CO2	-	-	-	-	3	2	-	3	2	3	-	2
CO3	-	-	-	-	3	2	-	-	1	3	-	2
CO4	-	-	-	-	3	2	-	3	3	3	-	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2
CO6	-	-	-	-	3	2	-	-	2	3	-	2

SEMESTER - II

20HSMG201 SDG NO. 4 & 5	INTERPERSONAL VALUES	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Values through Practical activities

UNIT I INTERPERSONAL VALUES **6**

Interpersonal Relationships and Values – Importance and Barriers – Building and maintain relationships – Mutual understanding – Respect to others.

UNIT II EFFECTIVE COMMUNICATION **6**

Communication skills –Importance and Barriers - Impressive formation and management – Public speaking

UNIT III GROUP DYNAMICS **6**

Group formation –Teamwork – Identify others attitude and behaviour – Formation of relationship – Personal and professional.

UNIT IV MUTUAL RELATIONSHIP **6**

Building mutual understanding and cooperation – Enhancing decision making skills – Problem solving skills – Comparative Appraisal – Interpersonal needs.

UNIT V POSITIVE ATTITUDE **6**

Fostering trust and cooperation – Developing and maintain positive attitude – Improving socialization – Development of security and comfort.

TOTAL: 30 PERIODS

Note: Each topic in all the above units will be supplemented by practice exercises and classroom activities and projects.

REFERENCE BOOKS:

1. Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press, 2016.
2. B.N.Ghosh, "Managing Soft Skills for Personality Development", McGraw Hill India, 2012.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Develop a healthy relationship & harmony with others. (K1)
2. Practice respecting every human being. (K3)
3. Practice to eradicate negative temperaments. (K3)
4. Acquire Respect, Honesty, Empathy, Forgiveness and Equality. (K4)
5. Manage the cognitive abilities of an Individual. (K5)
6. Understanding the importance of public speaking and teamwork. (K2)

CO – PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	3	3	1	1	1
CO2	-	-	-	-	-	2	2	3	3	1	1	1
CO3	-	-	-	-	-	2	2	3	3	1	1	1
CO4	-	-	-	-	-	2	2	3	3	1	1	1
CO5	-	-	-	-	-	2	2	3	3	1	1	1
CO6	-	-	-	-	-	2	2	3	3	1	1	1

SEMESTER - III

20BSMA301 SDG NO. 4	LINEAR ALGEBRA, PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- The aim of this course is to impart knowledge in the concepts of linear algebra as a prerequisite for the recent thrust areas of technological advancement
- To know the importance of partial differential equations in modeling various engineering problems
- To introduce the techniques of Fourier transform and Z- Transforms to analyze continuous and discrete signals

UNIT I VECTOR SPACES 15

Vector spaces – Subspaces – Linear combinations– Linear independence and linear dependence – Bases and dimensions.

UNIT II LINEAR TRANSFORMATION AND INNER PRODUCT SPACES 15

Linear transformation - Null and range spaces - Dimension theorem (Statement only) - Matrix of a linear transformation - Inner product - Norm - Gram Schmidt orthogonalization process.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT IV FOURIER TRANSFORMS 9

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9

Z-transforms - Elementary properties – Inverse Z-transform (using partial fractions and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL: 60 PERIODS

TEXTBOOKS:

1. Friedberg A.H., Insel A.J. and Spence L., "Linear Algebra", Prentice Hall of India, New Delhi, 2004. Unit I (Sec. 1.2, 1.3, 1.4 (linear combinations only), 1.5 & 1.6), Unit II (Sec. 2.1, 2.2, 6.1 & 6.2) (In Units I & II to include theorem statements only).
2. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., 3rd Edition, New Delhi. Unit III (Sec. 1.2, 1.5, 1.7, 1.11, 1.13, 1.14), Unit IV (Sec. 4.1, 4.2, 4.3, 4.6), Unit V(Sec. 5.1, 5.2, 5.3, 5.4, 5.5).

REFERENCES:

1. Strang G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.
2. Lay D. C., "Linear Algebra and its Applications", 5th Edition, Pearson Education, 2015.
3. Kumaresan S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
4. James G., "Advanced Modern Engineering Mathematics", Pearson Education, 2007.
5. O'Neil,P.V., "Advanced Engineering Mathematics", Cengage Learning, 2011.

WEB RESOURCES

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
2. https://nptel.ac.in/courses/111/106/111106135/
3. https://nptel.ac.in/courses/111/103/111103021/

ONLINE RESOURCES:

1. https://www.khanacademy.org/math/linear-algebra
2. https://ocw.mit.edu/courses/mathematics/18-06-linear-algebr a-spring-2010/video-lectures/
3. https://freevideolectures.com/course/3244/advanced-engineering-mathematics

OUTCOMES:

Upon completion of the course, the students should be able to

1. Identify a vector space, subspace and construct the basis and dimension of a vector space. (K3)
2. Compute the rank and nullity of a linear transformation and construct an orthonormal basis using the Gram Schmidt orthogonalization process. (K3)

3. Solve first order linear partial differential equations and higher order homogeneous and non - homogeneous partial differential equations. (K3)
4. Find Fourier transforms and Fourier sine and cosine transforms of simple functions. (K3)
5. Solve difference equations using Z-transforms. (K3)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	-	1
CO2	3	3	2	1	1	-	-	-	-	-	-	1
CO3	3	3	2	1	1	-	-	-	-	-	-	1
CO4	3	3	2	1	1	-	-	-	-	-	-	1
CO5	3	3	2	1	1	-	-	-	-	-	-	1

SEMESTER - III

20EIPC301 SDG NO. 4	ELECTRICAL AND ELECTRONIC MEASUREMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge in the specific area of electrical measuring instruments. Emphasis is laid on the meters used to measure current, voltage, resistance measuring methods, inductance and capacitance
- To have an adequate knowledge in the measurement techniques for power and energy
- Elaborate discussion about potentiometer and to impart knowledge on various instrument transformers and to understand the calibration of various meters
- In-depth understanding and idea of analog and digital instruments
- Detailed study of display and recording devices

UNIT I MEASUREMENT OF ELECTRICAL PARAMETERS 9

Types of ammeters and voltmeters: PMMC Instruments, Moving Iron Instruments, Dynamometer type Instruments –Extension of meters-Resistance measurement: Wheatstone bridge, Kelvin double bridge and Direct deflection methods, Megger. Measurement of Inductance: Maxwell-Wein Bridge, Hay's bridge and Anderson Bridge - Measurement of Capacitance: Schering Bridge.

UNIT II POWER AND ENERGY MEASUREMENTS 9

Electro-dynamic type wattmeter: Theory and its errors – LPF wattmeter – Phantom loading –Single phase Induction type energy meter: Theory and Adjustments –Calibration of wattmeter and Energy meters - smart energy meters

UNIT III POTENTIOMETERS AND INSTRUMENT TRANSFORMERS 9

D.C. Potentiometers: Student type potentiometer, Precision potentiometer – A.C. Potentiometers: Polar and coordinate types – Applications – Instrument Transformer: Construction and theory of Current Transformers and Potential Transformers.

UNIT IV ANALOG AND DIGITAL INSTRUMENTS 9

Wave analyzers – Signal and function generators – Q meter – Digital voltmeter and multi-meter – Microprocessor based DMM with auto ranging and self diagnostic features – Frequency & time period measurement, digital LCR meter.

UNIT V DISPLAY AND RECORDING DEVICES 9

Cathode ray oscilloscope: Classification, Sampling and storage scopes-Seven segment display, Light Emitting Diode display - LCD – X-Y recorders –Digital Data Recording –Digital memory waveform recorder – Data loggers, IOT enabled recorder.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. E.W. Golding & F.C. Widdis, "Electrical Measurements and Measuring Instruments", Reem Publications Pvt, Ltd, Third Edition, 2011.
2. Albert D Helfrick, William D Cooper, "Modern Electronic Instrumentation & Measurement Techniques", Pearson India Education, 2015.
3. David.A.Bell, Electronic Instrumentation and Measurements, Oxford University Press, Third Edition, 2013.

REFERENCES:

1. Northrop, R.B., "Introduction to Instrumentation and Measurements", Taylor & Francis, New Delhi, 3rd Edition, 2017.
2. Carr, J.J., "Elements of Electronic Instrumentation and Measurement", Pearson India Education, New Delhi, 2011.
3. Sawhney, A.K., "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co, New Delhi, 2015.
4. Kalsi, H.S.," Electronic Instrumentation", Tata McGraw-Hill, New Delhi, 3rd Edition, 2017.

WEB REFERENCES:

1. https://www.youtube.com/watch?v=xLjk5DrScEU

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108105153/
2. https://www.dsslearning.com/ac-dc-theory-electrical-measurement/E50060/
3. https://pdhonline.com/courses/e244/e244_new.htm
4. https://swayam.gov.in/nd1_noc19_ee44/
5. https://www.udemy.com/course/complete-course-in-electrical-measurement-instrumentation/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand and measure electrical quantities such as current, voltage, power and energy.(K1)
2. Interpret and design bridge circuits for the measurement of resistance, inductance and capacitance.(K2)
3. Elaborate the concept of calibration and the process of current, voltage, power and energy measuring devices.(K3)
4. Measure the current and voltage levels using different potentiometric method and Instrument transformers.(K3)
5. Introduce about the functioning concept of different analog and digital instruments and the concept of frequency and time period measurements.(K1)
6. Illustrate and analyze the various display and recording devices.(K4)

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	2	-	-	-	-	-	2	1	3
CO2	2	2	2	1	2	2	-	-	-	-	-	1	2	2
CO3	2	2	1	2	1	2	-	-	-	-	-	1	2	2
CO4	2	2	2	1	2	1	-	-	-	-	-	1	2	3
CO5	2	2	1	1	2	3	-	-	-	-	-	1	2	3
CO6	2	2	1	1	2	3	-	-	-	-	-	1	2	3

SEMESTER - III

20EIPC302 SDG NO. 4 & 9	SENSORS AND TRANSDUCERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the methods of measurement, classification of transducers and to analyze error.
- To understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
- Get exposed to different types of resistive transducers and their application areas.
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

Units and standards – Static calibration – Classification of errors, Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics: - Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics: Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.

UNIT III VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Inductive transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details, characteristics of capacitive transducers – Different types & Signal Conditioning – Applications:- Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

UNIT V OTHER SENSORS AND TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fiber optic sensors -Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors - Environmental Monitoring sensors (Water Quality & Air pollution).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.
2. Sawney A K and PuneetSawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
3. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003.

REFERENCES:

1. Patranabis D, "Sensors & Transducers", 2nd Edition, PHI, New Delhi, 2010.
2. Bela G.Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
3. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
4. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_ee41/preview
2. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html
3. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf

ONLINE RESOURCES:

1. https://instrumentationtools.com/tag/sensors-and-transducers-nptel-pdf/
2. https://electronics-tutorials.ws/io/io-

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand how to apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications (K2).

2. Analyze the problems related to sensors & transducers(K4).
3. Select the right sensor/transducer for a given application(K3).
4. Determine the static and dynamic characteristics of transducers using software packages(K4).
5. Understand fiber optic sensor and applications(K2).
6. Understand about smart transducer and its standard (K2).

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3	3	1	-	-	-	-	-	3	1	3
CO2	3	3	2	3	3	1	-	-	-	-	-	3	1	3
CO3	2	2	2	2	2	1	-	-	-	-	-	2	2	3
CO4	2	1	2	2	2	1	-	-	-	-	-	2	3	3
CO5	2	1	3	1	1	3	-	-	-	-	-	3	3	3
CO6	2	1	1	1	1	2	-	-	-	-	-	2	2	2

SEMESTER - III

20EIPC303 SDG NO. 4,9&11	ANALOG ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the structure of basic electronic devices and BJT amplifiers
- To familiarize the operation and applications of transistor like FET and Power amplifiers
- To learn the required functionality of positive and negative feedback systems
- To study and analyze linear and non-linear applications using Op-amp
- To study Functional blocks and the applications of special ICs like Timer, regulator Circuits

UNIT I PN JUNCTION DEVICES AND BJT AMPLIFIERS 9

PN junction diode: structure, operation and V-I characteristics, diffusion and transition capacitance-Zener diode characteristics- Zener Reverse characteristics – Zener as regulator.

BJT: NPN and PNP transistors, Characteristics of CE, CB and CC amplifier configurations, Biasing circuits, Small Signal analysis of BJT amplifier, Frequency response of BJT amplifier- Thyristors: SCR and UJT.

UNIT II FET AMPLIFIERS AND POWER AMPLIFIERS 9

FET: JFET and MOSFET, Characteristics of CS, CG and CD amplifier configurations – Small signal analysis of FET amplifier - Classification of Power amplifiers:- Class A, B, AB and C Power amplifiers-Push-Pull amplifiers - Design of power output, efficiency and cross-over distortion.

UNIT III FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

UNIT IV APPLICATIONS OF OPAMP 9

Ideal op-amp – Block diagram - Inverting and Non-inverting Amplifiers, differential amplifier - differentiator and integrator - Instrumentation amplifier – comparator - Astable and Monostable multivibrator - clippers, clampers, peak detector, S/H circuit.

UNIT V APPLICATION AND SPECIAL Ics 9

555 Timer - Functional block diagram – Astable and Monostable mode – applications. LM317, 723 Variable voltage regulators, switching regulator - IC8038 function generator IC.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th edition2008.
2. Sedra and Smith, "Microelectronic circuits", 7th Ed., Oxford University Press.
3. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', II edition, New Age, 2003.

REFERENCES:

1. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
2. Robert L.Boylestad, "Electronic devices and circuit theory", 2002
3. Prof. K.R.K. Rao, IITM. NPTEL video lectures on "Electronics for Analog Signal Processing I".
4. Jacob Millman, Christos C.Halkias, "Integrated Electronics - Analog and Digital circuits system", McGraw Hill, 2003.
5. Floyd ,Buchla, "Fundamentals of Analog Circuits", Pearson,2013.

WEB RESOURCES:

1. http://www.freebookcentre.net/electronics-ebooks-download/Electronic-Devices-and-Circuits-(PDF-313p).html
2. https://www.researchgate.net/publication/275408225_Electronic_Devices_and_Circuits
3. https://www.tutorialspoint.com/linear_integrated_circuits_applications/linear_integrated_circuits_applications_comparators.htm

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/117103063/
2. https://www.coursera.org/specializations/semiconductor-devices
3. https://nptel.ac.in/courses/108/108/108108111/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Understand the behavior of semiconductor devices (K2)
2. Analyze a given transistor amplifier and evaluate its performance (K3)
3. Design of FET amplifiers by knowing its characteristics and power amplifiers using BJT (K3)
4. Develop design proficiency in the area of feedback amplifiers and oscillators (K3)
5. Understand the importance of Signal analysis and acquire knowledge on the applications of an op-amp (K3)
6. Understand the operation and the applications of special ICs like Timers and Regulator circuits (K2)

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3	1	1	-	-	-	-	2	-	2	2
CO2	3	-	3	3	-	1	-	-	-	-	2	1	3	2
CO3	2	2	2	2	2	-	-	-	-	-	-	2	3	3
CO4	3	-	3	3	3	2	1	-	2	3	3	1	3	3
CO5	2	2	2	1	2	-	-	-	-	3	1	1	3	3
CO6	2	2	3	3	1	1	-	-	-	-	2	-	2	2

SEMESTER - III

20ESME301 SDG NO. 4,6,7, 9,12,14,15	APPLIED THERMODYNAMICS AND FLUID MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand Fundamental laws of thermodynamics its applications and basics of heat devices and its performance calculations
- Know about basic cycle analysis, comparison of cycles ,steam formation and Performance calculations
- Learn fluid properties, pressure measurement , application of energy equations and types of fluid flow
- Understand about methods of Dimensional analysis, Nondimesional numbers and importance of Model analysis
- Learn about various types of Pumps and Turbines, Performance calculations

UNIT 1 BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 9

Systems- Types of systems- Zeroth law, First law of thermodynamics – concept of internal energy and enthalpy applications to closed and open systems – Second law of thermodynamics – concept of entropy – Application of second law of thermodynamics –Carnot Cycle- heat pump, refrigerator –Efficiency and COP- Combined cycles - Equivalence of second law- clausius inequality and principles of increase of entropy.

UNIT 2 IC ENGINES CYCLE ANALYSIS, STEAM POWER CYCLES AND BOILERS 9

Otto, Diesel and Dual and Brayton cycle analysis -Comparison of Cycles- Properties of steam – Rankine cycle– Boiler mountings and its accessories - Trail run of Engines & Boilers.

UNIT 3 FLUID PROPERTIES AND FLOW OF FLUIDS 9

Units and Dimensions – Fluid properties – Density, Specific gravity, Viscosity, Surface tension, capillarity, compressibility and bulk modulus – Pascal's Law – pressure measurements – manometers - Simple- Differential and Inverted U tube Manometers.

Fluid Kinematics - Lagrangian and Eulerian Descriptions - Types of fluid flow – control volume – continuity equation– Velocity and Acceleration - Energy equation – Euler and Bernoulli's equations and its Applications.

UNIT 4 DIMENSIONAL ANALYSIS AND MOMENTUM PRINCIPLE 9

Dimensional analysis- Need and Methods - dimensional homogeneity- Rayleigh method and Buckinghamtheorems - Applications- Similitude - types - prototype and model – model testing and analysis.

UNIT 5 HYDRAULIC TURBINES AND PUMPS 9

Principle-construction of velocity diagrams. Classification of Turbines - construction, working and design of Pelton wheel, Kaplan and Francis Turbines- operating characteristics.

Classification of pumps - centrifugal pump-working principle - discharge, work done and efficiencies- operating characteristics. Reciprocating pump – working principle- performance calculation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics ", Fifth Edition, 2017.
2. Yunus A. Cengel & Michael A. Boles, "Thermodynamics", 8th edition 2015.
3. Dr.R.K.Bansal, (2000), Fluid Mechanics and Hydraulic Machines, Laxmi Publication (P) Ltd., New Delhi.
4. P.N.Modi and S.M.Seth (1999), Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House, Naisarak, Delhi.

REFERENCES:

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
2. Borgnakke&Sonnatag, "Fundamental of Thermodynamics", 8th Edition, 2016.
3. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
4. Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", 8th Edition.
5. Nag.P.K., "Engineering Thermodynamics", 5th Edition, Tata McGraw-Hill, New Delhi, 2013.
6. Vijay Gupta and S.K.Gupta, (1999), Fluid Mechanics and Applications, New-Age International Ltd.
7. D.S. Kumar,(2004), Fluid Mechanics and Fluid Power Engineering, Katson Publishing House, Delhi.
8. V.L. Streeter, (2001), Fluid Mechanics, McGraw Hill Book Co.
9. R.K. Rajput, "Fluid Mechanics and Hydraulic machines", S.Chand& Company Ltd, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/104/112104113/
2. https://nptel.ac.in/courses/112/108/112108148/
3. https://nptel.ac.in/courses/112/106/112106133/
4. https://nptel.ac.in/courses/112/104/112104118/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/102/112102255/
2. https://nptel.ac.in/courses/112/105/112105123/
3. https://nptel.ac.in/courses/112/105/112105220/
4. https://nptel.ac.in/courses/112/105/112105266/
5. https://nptel.ac.in/courses/112/105/112105171/
6. https://nptel.ac.in/courses/112/105/112105183/
7. https://nptel.ac.in/courses/112/105/112105269/

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the fundamantal basic laws of thermodynamics, air standard and steam power cycles. (K2)
2. Analyse Power developing and Power absorbing devices.(K4)
3. Evaluate the combined cycles and Performance parameters of Boilers. (K5)
4. Apply fluid properties for dimensional investigation and model testing. (K3)
5. Study the Continuity, Energy Equations for fluid motion and its effect. (K1)
6. Investigate different types of similitudes and hydraulic machines. (K5)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	2	1	-	-	1	1	2	3	2
CO2	3	3	2	1	-	1	-	-	1	-	1	2	3	3
CO3	3	3	2	-	-	1	2	-	-	-	-	3	3	2
CO4	3	3	2	1	-	-	1	-	1	1	1	2	2	2
CO5	3	3	3	2	-	-	2	-	1	1	1	2	3	2
CO6	3	3	3	2	-	-	2	-	1	1	1	2	3	2

SEMESTER - III

20ESIT301 SDG NO. 4	DATA STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of ADT's
- To learn Linear Data Structures – Lists, Stacks, and Queues
- To understand Sorting, Searching and Hashing Algorithms
- To learn Dynamic Data Structures - Tree and Graph

UNIT I LINEAR DATA STRUCTURES – I **9**

Stacks and Queues : Abstract Data Types (ADTs) – Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to Postfix expression - Queue ADT – Operations - Circular Queue – Priority Queue –Dequeue – Applications of Queues.

UNIT II LINEAR DATA STRUCTURES – II **9**

Linked List: List ADT – Array-Based Implementation – Linked List Implementation –– Singly Linked Lists- Circularly Linked Lists- Doubly-Linked Lists – Applications of Lists –Polynomial Manipulation – All Operations (Insertion, Deletion, Merge, Traversal).

UNIT III NON LINEAR DATA STRUCTURES – I **9**

Trees : Tree ADT – Tree Traversals - Binary Tree ADT – Expression Trees – Applications of Trees – Binary Search Tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree -Heap – Applications of Heap.

UNIT IV NON LINEAR DATA STRUCTURES – II **9**

Graphs : Definition – Representation of Graph – Types of Graph – Breadth First Traversal –Depth First Traversal – Topological Sort – Bi-Connectivity – Cut Vertex – Euler Circuits – Applications of Graphs - Dijkstra‟s algorithm – Bellman-Ford algorithm – Floyd's Algorithm - minimum spanning tree – Prim's and Kruskal's algorithms – Applications of Graphs

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES **9**

Searching- Linear Search - Binary Search - Sorting - Bubble Sort - Selection Sort - Insertion Sort - Shell Sort – Radix Sort – Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education Asia, 2002.
2. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2011.

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
2. Stephen G. Kochan, "Programming in C", 3rd edition, Pearson Education.
3. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education, 1983.
4. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008.

WEB REFERENCES :

1. https://www.programiz.com/dsa
2. http://masterraghu.com/subjects/Datastructures/ebooks/remathareja.pdf

OUTCOMES:

Upon completion of the course, the student should be able to

1. Implement abstract data types for linear data structures.(K3)
2. Implement abstract data types for non-linear data structure.(K3)
3. Apply the different linear and non-linear data structures to problem solutions.(K3)
4. Implement the various sorting and searching algorithms. (K3)
5. Solve Problem involving Graph, Trees and Heap. (K3)
6. Choose appropriate data structures to solve real world problems efficiently.(K3)

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	1	1	0	2	2	3	3	1	1
CO2	2	2	1	2	1	1	1	0	2	2	3	3	1	1
CO3	3	3	2	3	3	1	1	1	2	2	3	3	1	1
CO4	2	2	1	2	3	2	1	0	1	1	2	1	1	2
CO5	2	2	1	2	3	0	0	1	2	1	2	2	1	2
CO6	3	3	3	3	1	0	0	0	1	1	2	1	2	2

SEMESTER - III

20EIPL301 SDG NO. 4	SENSORS AND TRANSDUCERS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To make the students aware of basic concepts of measurement and operation of different types of transducers.
- To make the students conscious about static and dynamic characteristics of different types of transducer.
- To make the students to analyze step response of RTD.
- To make the student to measure resistance using bridge circuits.
- To make the students to calibrate the electrical instruments.

LIST OF EXPERIMENTS :

1. Displacement versus output voltage characteristics of a potentiometric transducer.
2. Characteristics of Strain gauge and Load cell.
3. Characteristics of LVDT and Photoelectric transducer.
4. Characteristics of LDR.
5. Characteristic and Step response of RTD.
6. Characteristic and Step response of Thermocople.
7. Characteristic and Thermistor.
8. Wheatstone and Kelvin's bridge for measurement of resistance.
9. Schering Bridge for capacitance measurement and Anderson Bridge for inductance measurement.
10. Measurement of Angular displacement using resistive and capacitive transducer.
11. Calibration of Ammeter and Voltmeter .
12. Design of Opto-coupler using photoelectric transducers.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Experimental setup for

- Measurement of Linear displacement using Potentiometer .
- Strain gauge and Load cell characterisation and application.
- Hall Effect characterisation and application.
- LVDT, Photoelectric characterisation and application.
- Measurement of Angular displacement.
- Thermocouples, Thermistor and RTD characterisation and application.
- Sufficient number of Power supply, Galvanometer, Bread board, Multimeter, Resistors, Decade Capacitance box, Decade Resistance box, Decade Inductance box, CRO.

OUTCOMES:

Upon completion of the course, the students should be able to

1. Recognize the fundamental principles of various types of sensors including thermal, mechanical, electrical, electromechanical and optical sensors. (K5)
2. Analyze the measured data (resolution, error analysis etc) obtained from sensors and transducers. (K4)
3. Verify the characteristics of Thermocouple, Thermister and RTD. (K4)
4. Interpret about the fundamental measurement method of resistance, capacitance, inductance, by using various Bridges. (K4)
5. Acquire knowledge about the principles of Micro pressure and Micro accelerometer sensing device. (K4)
6. Acquire knowledge of analyzing different stages of signal conditioning units. (K4)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	2	1	-	-	-	-	-	2	1	3
CO2	2	3	2	3	2	3	-	-	-	-	-	3	2	2
CO3	3	3	3	3	3	2	-	-	-	-	-	3	2	2
CO4	1	2	1	2	1	1	-	-	-	-	-	1	2	3
CO5	3	2	3	2	3	1	-	-	-	-	-	3	2	3
CO6	3	2	3	2	3	1	-	-	-	-	-	3	2	3

SEMESTER - III

20EI PL 302 SDG NO. 4,9&11	ANALOG ELECTRONIC CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To facilitate the students to study the characteristics of diodes.
- To provide practical knowledge on the analysis of Transistors like BJT,UJT.
- To provide practical knowledge on the analysis of Field effect transistors
- To provide practical knowledge on the op-amps and their applications.
- To facilitate the students about Voltage regulator

LIST OF EXPERIMENTS1.

1. Simulation and experimental Characterization of Semiconductor diode and Zener diode.
2. Simulation and experimental Characterization of a NPN Transistor under common emitter configurations.
3. Simulation and experimental Characterization of JFET
4. Simulation and experimental Characterization of MOSFET
5. Simulation of Single-Phase half-wave and full wave rectifiers.
6. Simulation and experimental Characterization of UJT and generation of saw tooth waveforms.
7. Characteristics of SCR and application as a controlled rectifier
8. Application of Op-Amp: inverting and non-inverting amplifier, comparator, Integrator and Differentiator
9. Variability Voltage Regulator using IC Lm317.
10. Timer IC application: Study of NE/SE 555 timer in Astable, Monostable mode operations

LABORATORY REQUIREMENTS:

1. Semiconductor devices like Diode, Zener Diode, NPN Transistors, JFET, MOSFET,UJT,SCR -25 Nos
2. Resistors, Capacitors and inductors - Necessary Quantities of various capacities.
3. Function Generators – 10 Nos
4. Regulated 3 output Power Supply 5, ± 15V – 10 Nos
5. CRO – 10 Nos
6. Storage Oscilloscope - 1 Nos
7. Bread boards – 25 Nos
8. IC741/ICNE555/LM317
9. 10 Nos of PC with Circuit Simulation Software (min 10 Users) (e-Sim / Scilab/ Pspice / Matlab /other Equivalent software Package) and Printer (1No.)
10. Component data sheets to be provided

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1. Gain knowledge on the proper usage of various electronic equipment and simulation tools for design and analysis of electronic circuits. (K4)
2. Get hands-on experience in simulating the characteristics of semiconductor devices. (K4)
3. Simulate and analyze various electronic circuits such as voltage regulators. (K4)

4. Analyze and simulate various electronic circuits such as transistor amplifiers. (K4)
5. Design simulate and analyze the operational amplifier applications. (K4)
6. Carry out the Experiments in batches to motivate the Teamwork. (K5)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3	1	1	-	-	-	-	2	-	2	2
CO2	3	-	3	3	-	1	-	-	-	-	2	1	3	2
CO3	2	2	2	2	2	-	-	-	-	-	-	2	3	3
CO4	3	-	3	3	3	2	1	-	2	3	3	1	3	3
CO5	2	2	2	1	2	-	-	-	-	3	1	1	3	3
CO6	3	-	3	3	3	2	1	-	2	3	3	1	3	3

SEMESTER - III

20ICTE301 SDG NO. 4,11,15	LIVE-IN-LAB - I	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To provide opportunities for the students, expose to Industrial environment and real time work
- To enable hands-on experience in the electronics hardware/Software domain
- To enable development of skill set for designing and realizing prototype electronic systems/simulation model

COURSE METHODOLOGY

- This initiative is designed to inculcate ethical principles of research and to get involve in life-long learning process for the students.
- The project work must involve engineering design with realistic constraints. It must also include appropriate elements of the following: Engineering standards, design analysis, modeling, simulation, experimentation, prototyping, fabrication, correlation of data, and software development.
- Project can be individual work or a group project, with maximum of 3 students. In case of group project, the individual project report of each student should specify the individual's contribution to the group project.

- On completion of the project, the student shall submit a detailed project report. The project should be reviewed and the report shall be evaluated and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION

- First evaluation (Immediately after first internal examination) : 20 marks
- Second evaluation (Immediately after second internal examination): 30 marks
- Final evaluation Last week of the semester) : 50 marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL PERIODS: 45

OUTCOMES:

Upon completion of the course, the students should be able to

1. List the problems and conduct literature survey to identify the gap and come up with an application oriented research problem in the specific domain.(K1)
2. Understand the project characteristics and explore necessary tools and components needed at various stages of the project(K2)
3. Design and validate the proposed system using simulation.(K3)
4. Develop the Prototype of the proposed system by adapting Industrial safety standards and best financial management practices(K5)
5. Analyze the obtained results and prepare a technical report.(K4)
6. Evaluate the project and go for journals and patents publication.(K5)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO4	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO6	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - III

20ECTP301 SDG NO. 4	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

APTITUDE & COGNITIVE SKILLS – PHASE 1

COURSE OBJECTIVE:

- To educate and enrich the students on quantitative ability, reasoning ability, and verbal ability.

UNIT I QUANTITATIVE ABILITY – I **6**

Problems on Trains, Time and Distance, Height and Distance, Time and Work

UNIT II QUANTITATIVE ABILITY – II **6**

Problems on Ages, Alligation or Mixture, Chain Rule, Simple Interest, Simple Equation, Theory Of Equation

UNIT III REASONING ABILITY – I **6**

Analytical Reasoning, Pipes and Cistern, Logical Problems, Logical Games, Logical Deduction, Data Sufficiency, Arithmetic Reasoning

UNIT IV VERBAL ABILITY – I **6**

Idioms & Phrases, Synonyms, Antonyms, Classification

UNIT V CREATIVITY ABILITY – I **6**

Venn Diagrams, Cube and Cuboids, Dice, Cubes and Dice, Figure Matrix

TOTAL : 30 PERIODS

REFERENCES:

1) Quantitative Aptitude for Competitive Exams by R. S. Agarwal
2) Quantum CAT by Sarvesh Verma
3) A Modern Approach to Logical Reasoning by R. S. Agarwal
4) Verbal Ability and Reading Comprehension by Arun sharma

PROBLEM SOLVING USING C PROGRAMMING AND DATA SCIENCE USING R PROGRAMMING - PHASE 2

COURSE OBJECTIVE:

- The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language.
- This course involves a lab component which is designed to give the student hands-on experience with the concepts.
- This course aims at learning new tools for data science using open source software- R .
- This course is oriented towards familiarizing the concepts of data analysis and statistical modelling

UNIT I INTRODUCTION TO PRINCIPLES OF PROGRAMMING 6

Introduction to Programming , Programing Domain : Artificial Intelligence, Systems Programming, Assembly Level Languages, Problem solving using Algorithms and Flowcharts.

UNIT II INTRODUCTION TO C PROGRAMMING 6

Features of C and its Basic Structure, Simple C programs, Constants, Integer Constants, Real Constants, Character Constants, String Constants Floating-point Numbers, The type cast Operator, Interactive Programming.

Operators Expressions and Control statement, The goto statement, The if statement, The if-else statement, Nesting of if statements, The conditional expression, The break statement and continue statement.

UNIT III ARRAYS, STRINGS AND POINTERS 6

Arrays, Multidimensional Arrays, Strings, Basics of Pointers, Pointer Arithmetic, Similarities between Pointers and One-dimensional Arrays Structures, Unions And Functions, Basics of Structures, Arrays of Structures, Pointers to Structures, Function Basics, Function Prototypes, and Passing Parameters, Structures and Functions Recursion.

UNIT IV R PROGRAMMING FUNDAMENTALS 6

Overview of Data Science- Downloading and installing R and RStudio- R Basics- Data Types- Vector- Matrix-Arrays- Data frame- packages- R charts and graphs

UNIT V DATA SCIENCE USING R

Importing and exporting data using R- Working with open source datasets from Kaggle- Data cleaning- Exploration Analysis and Visualization for real time data sets- Case studies

TOTAL : 30 PERIODS

REFERENCES:

1. Programming in ANSI C - Balagurusamy - Tata McGraw-Hill Education, 2008
2. Programming in C (3rd Edition), by Stephen G. Kochan, Sams, 2004
3. Programming in C - Stephen G. Kochan, III Edition, Pearson Education.
4. Nathan Metzler, R Programming for Beginners, First Edition
5. Hadley Wickham,Garrett Grolemund, "R for Data Science: Import, Tidy, Transform, Visualize, and Model Data",O'Reilly Publications,2017.
6. Kaelen Medeiros, R Programming Fundamentals, First Edition

COURSE OUTCOMES :

Upon completion of this course, the students should be able to:

1. Analyze their quantitative ability. (K4)
2. Understand the ability of arithmetic reasoning along with creative thinking and problem solving skills. (K2)
3. Create their verbal ability through vocabulary building and grammar. (K6)
4. Evaluate the situations to analyse the computational methods in order to identify and abstract the programming task involved. (K5)
5. Understand the basics of data science and R programming fundamentals. (K2)
6. Apply R programming language concepts such as data types, vectors, matrix arrays, structures, functions, and boolean operators by writing R programs and through examples. (K3)

CO- PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO2	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO3	-	-	-	-	3	2	-	-	1	3	-	2	-	-
CO4	-	-	-	-	3	2	-	3	3	3	-	2	2	2
CO5	3	2	2	2	3	2	-	-	-	3	-	2	-	-
CO6	2	2	3	2	3	2	-	-	-	3	-	2	-	-

SEMESTER - IV

20BSMA403 SDG NO. 4	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To identify small, large samples and apply testing of hypothesis
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems
- To introduce the basic concepts of solving algebraic and transcendental equations
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines
- To introduce the knowledge of various techniques and methods of solving ordinary differential equations

UNIT I TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F-distributions for mean, variance and proportion - Contingency table (test for independence) - Goodness of fit.

UNIT II DESIGN OF EXPERIMENTS 12

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices .

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 12

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Single step methods : Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Multi step methods : Milne's and Adams - Bashforth predictor corrector methods for solving first order equations. Solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by Crank Nicholson method – One dimensional wave equation by explicit method.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.

WEB RESOURCES:

1. https://www.classcentral.com/course/swayam-numerical-analysis-17709
2. https://online-learning.harvard.edu/course/statistics-and-r?delta=1

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3057/numerical-methods-and-computation
2. https://nptel.ac.in/courses/111107105/
3. https://www.maths.unsw.edu.au/courses/math2089-numerical-methods-and-statistics

OUTCOMES:

Upon completion of the course, the student should be able to

1. Apply statistical techniques for testing of hypothesis of small and large samples. (K3)
2. Perform Analysis of Variance (ANOVA) in the Design of Experiments. (K3)
3. Provide numerical solution for Algebraic equations, Transcendental equations and Eigen value problems. (K3)
4. Apply Numerical techniques to interpolate data and find Numerical Differentiation and Integration. (K3)
5. Solve Ordinary and Partial Differential equations using numerical techniques. (K3)

CO- PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	-	1
CO2	3	3	2	1	1	-	-	-	-	-	-	1
CO3	3	3	2	1	1	-	-	-	-	-	-	1
CO4	3	3	2	1	1	-	-	-	-	-	-	1
CO5	3	3	2	1	1	-	-	-	-	-	-	1

SEMESTER - IV

20EIPC401 SDG NO. 4, 9	ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the principle of operation of DC machines as motor and as generator
- To introduce the principle of operation of Transformers
- To introduce the principle of operation of Synchronous machines
- To introduce the principle of operation of Induction machines
- To introduce other special machines

UNIT I D.C.MACHINES **9**

D.C. Machines: – Principle of operation and construction of motor and generator – torque equation – Various excitation schemes – EMF Equation of Generator-Characteristics of Motor and Generator – Starting, Speed control of D.C. Motor.

UNIT II TRANSFORMERS **9**

Transformer - Principle - Theory of ideal transformer - EMF equation - Construction details of shell and core type transformers - Tests on transformers - Equivalent circuit – Phasor diagram on load- Regulation and efficiency of a transformer-Introduction to three phase transformer.

UNIT III SYNCHRONOUS MACHINES **9**

Principle of Operation, type - EMF Equation and Phasor diagrams - Synchronous motor- Rotating Magnetic field -Starting Methods , Torque V-Curves, inverted – V curves.

UNIT IV THREE PHASE INDUCTION MOTORS **9**

Induction motor-principle of operation, Types - Torque-slip characteristics - Starting methods and Speed control of induction motors.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Types of single phase induction motors –Double field revolving theory-Capacitor start capacitor run motors – Shaded pole motor – Repulsion type motor – Universal motor – Hysteresis motor - Switched reluctance motor – Brushless D.C motor.-Stepper motor.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Fitzgerald A.E, Kingsley C., Umans S. and Umans S.D., "Electric Machinery", McGraw- Hill, 2002.
2. Theraja B.L., "A Text book of Electrical Technology", Vol.II, S.C Chand & Co., New Delhi, 2007.

REFERENCES:

1. AbhijitChakrabarti and SudiptaDebnath, "Electrical Machines", McGraw-Hill Education, 2015.
2. Deshpande M. V., "Electrical Machines" PHI Learning Pvt. Ltd., New Delhi, 2011.
3. B.S.Guru and H.R.Hiziroglu, "Electric Machinery and Transformer', Oxford university Press, 2007/

4. Del Toro V., "Electrical Engineering Fundamentals", Prentice Hall of India, New Delhi, 1995.
5. Nagrath I. J and Kothari D. P. 'Electric Machines', Fourth Edition, McGrawHill Education, 2010.
6. C.A.Gross, "Electric Machines", CRC Press2010.

WEB REFERENCES:

1.https://videos.gitam.edu/nptel/electrical.html

ONLINE RESOURCES:

1. https://www.slideshare.net/gokulvlsi/electrical-machines-2-ac-machines-49205468
2. https://www.javatpoint.com/electrical-machines-tutorial

OUTCOMES:

Upon completion of the course, the students should be able to

1. Understand the construction and working of DC and AC- Motors (K2)
2. Understand the construction and working of DC and AC Generators. Also to understand the construction of transformers-single phase-three phase (K2)
3. Derive the torque equation of DC motors, Induction Motors- three phase, single phase and apply the concepts to solve real world problems, the emf equation of Generator, Transformer, Alternator and apply the concepts to solve real world problems. (K3)
4. Analyse the Characteristics of DC and AC- Motors and Generator. Also to analyse the various applications of motors and Generators (K4)
5. Analyse the Phasor diagrams of Transformers, Alternators and Synchronous Motors and apply the concepts to learn about Regulation and calculation of efficiency. (K4)
6. Compare the speed control and starting methods of DC and AC motors. Also to up bridge with the latest developments related to machines (K3)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	1	-	-	1	-	-	1	1	2
CO2	2	2	2	2	2	2	-	-	2	-	-	-	1	2
CO3	1	2	2	1	2	1	-	-	2	-	-	-	-	3
CO4	2	2	1	1	1	2	-	-	2	-	-	-	-	2
CO5	2	2	1	1	1	2	-	-	1	-	-	-	-	2
CO6	1	2	2	1	1	1	-	-	1	-	-	1	1	2

SEMESTER - IV

20EIPW401 SDG NO. 4, 8	DIGITAL ELECTRONICS WITH LABORATORY	L	T	P	C
		2	1	2	4

OBJECTIVES:

- To study various number systems and simplify the logical expressions using Boolean functions
- To study combinational circuits
- To design various synchronous and asynchronous circuits.
- To introduce asynchronous sequential circuits and PLDs
- To implement combinational and sequential circuits experimentally and introduce VHDL simulation for development of application oriented logic circuits.

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 10

Review of number systems, binary codes, Error detection and correction codes (Parity and Hamming code) - Representation of logic functions- SOP and POS forms - K-map representations - minimization using K maps -Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family.

UNIT II COMBINATIONAL CIRCUITS 10

Combinational logic - Simplification and implementation of combinational logic – Adders, Subtractors, - Code converters - Multiplexers and De-multiplexers - Encoders and Decoders.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 10

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Mealy models- Counters, state diagram; state reduction; state assignment

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES 10

Asynchronous sequential logic circuits-Transition table flow table-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.

UNIT V VHDL PROGRAMMING 10

Introduction to VHDL - VHDL implementation of combinational circuits- Adders- Multiplexers & De multiplexers, VHDL implementation of Sequential circuits- counters, flip flops

LAB EXPERIMENTS 12

1. Implementation of SOP and POS using logic gates
2. Implementation of Half adder and Full adder using logic gates
3. Implementation of Multiplexer and De multiplexer using logic gates
4. Implementation of Code converter using logic gates
5. Implementation of flip flops
6. Implementation of Counters
6. VHDL simulation of Adder and Multiplexer
7. VHDL simulation of Flip flop & Counters

TOTAL: 60 PERIODS

TEXT BOOKS:

1. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
2. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.
3. Comer "Digital Logic & State Machine Design, Oxford, 2012.

REFERENCES:

1. Mandal, "Digital Electronics Principles & Application", McGraw Hill Edu, 2013.
2. William Keitz, "Digital Electronics - A Practical Approach with VHDL", Pearson, 2013.

3. Thomas L.Floyd, "Digital Fundamentals", 11th edition, Pearson Education, 2015.
4. Charles H.Roth, Jr, LizyLizy Kurian John, "Digital System Design using VHDL", Cengage, 2013.
5. D.P.Kothari,J.S.Dhillon, "Digital circuits and Design", Pearson Education, 2016.

WEB REFERENCES:

1. https://www.electronics-tutorials.ws/
2. https://nptel.ac.in/courses/117107094/

ONLINE RESOURCES:

1. http://www.nptelvideos.in/2012/11/digital-integrated-circuits.html
2. https://nptel.ac.in/courses/108/105/108105132/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand various number systems and simplify the logical expressions using Boolean functions (K3)
2. Understand and apply various Combinational and Synchronous Circuits for digital applications.(K3)
3. Understand the operation of digital logic families and implement them combinational and sequential circuits (K3)
4. Analyze Synchronous and Asynchronous sequential circuits and design of Programmable Logic devices (K4)
5. Understand and Simulate the various digital electronic circuits using VHDL software.(K3)
6. Design and realize of Combinational and synchronous circuits.(K4)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	1	1	-	1	2	2	2	2	3
CO2	2	2	2	2	3	-	-	-	1	2	2	2	2	3
CO3	3	2	3	3	3	2	-	-	1	2	2	2	2	3
CO4	3	-	3	3	3	2	1	-	2	3	3	2	3	3
CO5	2	2	3	3	3	-	-	-	-	3	3	3	3	3
CO6	2	2	3	3	3	-	-	-	-	3	3	3	3	3

SEMESTER - IV

20ICPC401 SDG NO. 4, 9	CONTROL SYSTEMS	L	T	P	C
		2	1	0	3

OBJECTIVES:

- To understand the use of transfer function models for analysis physical systems and introduce the control system components
- To provide adequate knowledge in the time response of systems and steady state error analysis
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems To introduce stability analysis for Electrical, Mechanical systems
- To introduce design of Compensator

UNIT I MATHEMATICAL MODELING OF SYSTEMS 9

Open loop and closed loop systems – Physical system - Linear and Non-Linear systems - Transfer function - Mathematical modeling of electrical and mechanical systems - Analogous systems - Effect of feedback on system sensitivity - Block diagram representation - Signal flow graphs and their properties - Mason's gain formula. Control system components : Potentiometer and DC servo motor

UNIT II TIME DOMAIN ANALYSIS 9

Standard test signals – Time response of first order and second order feedback control system to step input – Time domain specifications - Steady state error – Static error constants - Dynamic error coefficients - System response with additional poles and zeros - Introduction to P, PI, PID modes of feedback control.

UNIT III FREQUENCY DOMAIN ANALYSIS 9

Frequency domain specifications – Correlation between frequency domain and time domain specifications - Bode plot – Polar plot – Determination of closed loop response from open loop response.

UNIT IV STABILITY ANALYSIS 9

Concepts of Stability: - Necessary conditions for stability - Routh Hurwitz stability criterion - Relative stability analysis. Root locus: Concepts of root - locus - construction of root locus - Determination of open loop gain for a specified damping of the dominant roots – Nyquist stability criterion

UNIT V DESIGN OF FEED BACK CONTROL SYSTEM **9**

Design specifications: Lead, Lag and Lag-Lead compensators using Bode plot techniques.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Benjamin C. Ku and Farid Golnaraghi, "Automatic Control Systems", 10th edition McGraw-Hill Education, 2017.
2. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", 6th edition New Age International Publishers, 2017.

REFERENCES:

1. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education, 13th impression 2017.
2. John J.D., Azzo Constantine, H. and Houpis Stuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor & Francis Reprint, 2014
3. Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Private ltd, PEARSON 5th edition 2015.
4. NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee13/preview
2. https://nptel.ac.in/courses/107106081/
3. https://www.tutorialspoint.com/control_systems/index.htm

ONLINE RESOURCES:

1. https://freevideolectures.com/course/5301/dynamics-and-control
2. https://freevideolectures.com/course/2337/control-engineering

OUTCOMES:

Upon completion of the course, the student should be able to

1. Derive the mathematical model of electrical, mechanical systems and determine/reduce the transfer function for the system using block diagram reduction and signal flow graph methods.(K3)
2. Determine the time response and specifications of I and II order systems for standard test inputs.(K3)
3. Determine the frequency response specifications and construct bode plot, polar plot for determining stability and establish the correlation between time and frequency domains.(K3)

4. Determine the stability of a system using root locus, Routh Hurwitz and Nyquist stability criterion (K3)
5. Apply bode plot and root locus for the design of compensators (K3)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	2	2
CO2	3	2	1	2	1	-	-	-	-	-	-	1	2	2
CO3	3	2	1	1	-	-	-	-	-	-	-	1	2	2
CO4	3	2	3	1	-	-	-	-	-	-	-	-	2	2
CO5	3	2	1	1	1	-	-	-	-	-	-	1	2	2
CO6	3	1	1	1	1	-	-	-	-	-	-	-	2	2

SEMESTER - IV

20ICPC402 SDG NO. 4	INDUSTRIAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the measurement techniques of viscosity, humidity and moisture
- To introduce the measurement of temperature and pressure
- To introduce the flow measurement techniques
- To introduce the electrical flow measurement techniques
- To introduce the level measurement techniques and transmitters

UNIT I MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE **9**

Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers –Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter. Moisture: Different methods of moisture measurements –Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in solids.

UNIT II TEMPERATURE AND PRESSURE MEASUREMENT 9

Definitions and standards –Different types of filled in system thermometers –Bimetallic thermometers – IC sensors – Thermocouples, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation,, Special techniques for measuring high temperature using thermocouple –- Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers –Fiber optic sensor for temperature measurement – Thermograph – Temperature sensor selection, Installation and Calibration, Manometers: Different types, Bourdon tube, Bellows, Diaphragms and Capsules, Pressure gauge selection, installation and calibration using dead weight tester.

UNIT III FLOW MEASUREMENT 9

Orifice plate: different types of orifice plates – Cd variation – pressure tappings – Venturi tube – Flow nozzle – Dall tube – Pitot tube, Installation and applications of head flowmeters, Positive displacement flow meters, Rotameter –theory, characteristics, installation and applications, Mass flow meter, Calibration of flow meters: – Dynamic weighingmethod.

UNIT IV ELECTRICAL TYPE FLOW METERS 9

Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.

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UNIT V LEVEL MEASUREMENT AND TRANSMITTERS 9

Level measurement: Float gauges - Displacer type, Ultrasonic gauge – Boiler drum level measurement :– Differential pressure method and Hydrastep method - Solid level measurement, Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Doebelin, E.O. and Manik, D.N., "Measurement systems Application and Design",6thMcGraw-Hill Education Pvt. Ltd,2011.
2. Jones, B.E., "Instrument Technology", Vol.2, Butterworth-Heinemann, International Edition, 2003.

REFERENCES:

1. Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press,2005.

2. Patranabis, D., "Principles of Industrial Instrumentation", 3rd Edition, McGraw-Hill Education,2017.
3. Eckman D.P., "Industrial Instrumentation", Wiley Eastern Limited,1990.
4. Singh,S.K., "Industrial Instrumentation and Control", Tata Mc-Graw-Hill Education Pvt. Ltd., New Delhi,2009.
5. AlokBarua, "Lecture Notes on Industrial Instrumentation", NPTEL, E-Learning Course, IITKharagpur.
6. Jayashankar, V., "Lecture Notes on Industrial Instrumentation", NPTEL, E-Learning Course, IIT Madras.
7. A.K. Sawhney and PuneetSawhney, "Mechanical Measurements and Instrumentation and Control ", DhanpatRai& Co. (P) Limited, 2015.
8. Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishers, Delhi,1999.McGraw-Hill, 2002.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee13/preview
2. https://nptel.ac.in/courses/108108111/

ONLINE RESOURCES:

1. http://instrumentationtoolbox.com
2. Our instrumentation.com
3. Home Instrumentation Tools

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand Principles and working of Viscosity, Humidity, Moisture, temperature , pressure, flow and level measuring Instruments.(K2)
2. Calibrate temperature,flow , level and Pressure measuring devices .(K3)
3. Apply measurement of Viscosity, Humidity, Moisture, temperature , pressure, flow and level in Industrial Applications.(K3)
4. Select and install Industrial instruments for various applications .(K2)
5. Understand various Electrical type Industrial Instruments .(K2)
6. Understand the design and working of Various Industrial Transmitters. (K3)

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	2	3	-	-	-	-	2	3	3
CO2	3	-	2	-	-	2	2	-	-	-	-	2	3	3
CO3	3	-	2	-	-	2	2	-	-	-	-	2	3	3
CO4	3	-	2	-	-	2	2	-	-	-	-	2	3	3
CO5	3	-	2	-	-	2	2	-	-	-	-	2	3	3
CO6	3	-	2	-	-	2	2	-	-	-	-	2	3	3

SEMESTER - IV

20EIPC402 SDG NO. 4	PRINCIPLES OF COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the various analog and digital modulation techniques
- To learn data and pulse communication
- To study the principles behind information theory and coding
- To study the various digital communication techniques

UNIT I ANALOG MODULATION **9**

Amplitude Modulation – AM, DSBSC, SSBSC, VSB, modulators and demodulators – Angle modulation – PM and FM, modulators and demodulators – Super heterodyne receivers.

UNIT II PULSE MODULATION **9**

Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing.

UNIT III DIGITAL MODULATION AND TRANSMISSION **9**

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers.

UNIT IV INFORMATION THEORY AND CODING **9**

Measure of information – Entropy – Source coding theorem – Shannon–Fano

coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes- Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi coding.

UNIT V SPREAD SPECTRUM AND MULTIPLE ACCESS 9

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronization and tracking – Multiple Access – FDMA, TDMA, CDMA.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH2007
2. S. Haykin "Digital Communications" John Wiley2005

REFERENCES:

1. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd edition, OxfordUniversity Press,2007
2. H P Hsu, Schaum Outline Series – "Analog and Digital Communications" TMH2006
3. B.Sklar, Digital Communications Fundamentals and Applications" 2/e Pearson Education2007.

WEB REFERENCES:

1 https://swayam.gov.in/nd1_noc20_ee16/preview
2. https://www.scientechworld.com/education-software-training-and-skill-development/sku-online-learning/analog-and-digital-communication

ONLINE RESOURCES:

1 https://freevideolectures.com/search/communication-engineering/
2 https://www.tutorialspoint.com/principles_of_communication/index.htm

OUTCOMES:

Upon completion of the course, the student should be able to

1. Interpret various modulation techniques to model a communication system (K3)
2. Discuss angle modulation techniques and compare various analog modulation techniques. (K3)
3. Evaluate the performance of digital modulation schemes such as BPSK, BFSK, QPSK, DPSK & QAM (K4)

4. Illustrate and compare the Encoding schemes such as PCM, DPCM, DM & ADM (K3)
5. Infer the channel coding theorem and error control coding and decoding schemes like block codes, hamming codes, cyclic codes, convolutional codes and viterbi decoder (K4)
6. Analyse different spread spectrum and multiple access techniques (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	-	2	-	-	-	-	1	2	3	3
CO2	3	2	3	2	-	2	-	-	-	-	1	2	3	3
CO3	3	2	3	2	-	2	-	-	-	-	1	2	3	3
CO4	3	1	3	2	3	2	-	-	-	-	1	2	3	3
CO5	3	1	3	2	3	2	-	-	2	-	1	2	3	3
CO6	3	1	3	2	3	2	-	-	2	-	1	2	3	3

SEMESTER - IV

20ICPL401 SDG NO. 4, 11	ELECTRICAL MACHINES AND CONTROL SYSTEMS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To impart hands on experience to estimate the performance characteristics of DC Generator, DC motor, Transformer, Induction Motor
- To find out the transfer function model of AC and DC servomotor
- To introduce MATLAB software for finding out time domain specifications and stability analysis for a given transfer function

LIST OF EXPERIMENTS

1. Determination of Open circuit and Load characteristics of a self excited D.C. shunt generator.
2. Load test on DC shunt motor.
3. Load test on DC series motor.
4. Load test on single phase induction motor.
5. Load test on single phase transformer.

6. Speed control of DC shunt motor.
7. Determination of Transfer function of DC motor.
8. Study of characteristics of Synchros.
9. Transfer function model and State space model for a classical transfer function using MATLAB – Verification.
10. Determination of time and frequency responses of a Second order system.
11. Design, Analysis and implementation of lag and lead compensators using Bode plot and Root locus for a physical system using MATLAB.
12. Effect of P, PD, PI, PID controller on a second order system (open loop stable and open loop unstable system).

TOTAL: 45 PERIODS

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

Sl.No	Equipment	Nos
1.	DC Shunt Motor Coupled with DC Shunt Generator	1 No
2.	DC Shunt Motor with Loading Arrangement	3 Nos
3.	DC Series Motor with Loading Arrangement	1 No
4.	Single Phase Transformer	2 Nos
5.	Single Phase Auto Transformer	2 Nos
6.	Single Phase Induction Motor with Loading Arrangement	1 No
7.	Single Phase Resistive Loading Bank	2 Nos
8.	SPST switch	2 Nos
9.	Tachometer -Digital/Analog, Ammeters and Voltmeters	Few
10.	Synchro Transmitter-receiver module	1 No
11.	Servo motor Module	1 No
12.	MATLAB Software	Few Licenses

OUTCOMES:

Upon completion of the course, the student should be able to

1. Determine the various characteristics of the given DC Generators (K4).
2. Determine the performance characteristics of the given DC motors (K4).
3. Predetermine the efficiency and regulation of the given single phase transformer (K4).
4. Simulate the performance of synchronous machines using MATLAB software(K3)
5. Determine the performance characteristics of the given induction motors(K4)

6. Understand and determine the load test for different types of transformers (K2)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	-	-	-	1	2	2	2
CO2	2	1	1	1	2	-	-	-	-	-	1	2	2	2
CO3	1	1	1	2	2	-	-	-	-	-	1	2	2	2
CO4	2	1	1	1	2	-	-	-	-	-	1	2	1	2
CO5	1	1	1	1	1	-	-	-	-	-	1	2	1	2
CO6	2	1	1	1	2	-	-	-	-	-	1	2	1	2

SEMESTER - IV

20ICTE401 SDG NO. 4,11,15	LIVE-IN-LAB - II	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To provide opportunities for the students, expose to Industrial environment and real time work
- To enable hands-on experience in the electronics hardware/Software domain
- To enable development of skill set for designing and realizing prototype electronic systems/simulation model

COURSE METHODOLOGY:

- This initiative is designed to inculcate ethical principles of research and to get involve in life-long learning process for the students.
- The project work must involve engineering design with realistic constraints. It must also include appropriate elements of the following: Engineering standards, design analysis, modeling, simulation, experimentation, prototyping, fabrication, correlation of data, and software development.
- Project can be individual work or a group project, with maximum of 3 students. In case of group project, the individual project report of each student should specify the individual's contribution to the group project
- On completion of the project, the student shall submit a detailed project report. The project should be reviewed and the report shall be evaluated

and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION:

- First evaluation (Immediately after first internal examination) : 20 marks
- Second evaluation (Immediately after second internal examination): 30 marks
- Final evaluation Last week of the semester) : 50 marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the student should be able to

1. Conduct literature survey to identify the gap and an application oriented research problem in the specific domain(K4)
2. Design and validate the proposed system using simulation(K6)
3. Prototype the proposed system(K5)
4. Analyze the obtained results and prepare a technical report(K4)
5. Publish the work in journals and apply for the patents.(K3)
6. Prepare for industrial environment and real time work(K3)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO4	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO6	2	2	2	2	3	2	2	2	2	2	3	3	3	3

SEMESTER - IV

20ECTP401 SDG NO. 4	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

PROBLEM SOLVING SKILLS – PHASE 1

COURSE OBJECTIVE:

- Improve their quantitative ability.
- Improve their reasoning ability.
- Enhance their verbal ability through vocabulary building and grammar
- Equip with creative thinking and problem solving skills

UNIT I QUANTITATIVE ABILITY – III **6**

Compound Interest, Profit and Loss, Partnership, Percentage, Set Theory

UNIT II QUANTITATIVE ABILITY – IV **6**

True Discount, Ratio and Proportion, Simplification, Problems On H.C.F and L.C.M

UNIT III REASONING ABILITY – II **6**

Course of Action, Cause and Effect, Statement and Conclusion, Statement and Argument, Data Sufficiency (DS), Statement and Assumption, Making Assumptions.

UNIT IV VERBAL ABILITY – II **6**

Change of Voice, Change of Speech, Letter and Symbol Series, Essential Part, Verbal Reasoning, Analyzing Arguments.

UNIT V CREATIVITY ABILITY – II **6**

Seating Arrangement, Direction Sense Test, Character Puzzles, Missing Letters Puzzles, Mirror &Water Images.

TOTAL : 30 PERIODS

REFERENCES:

1) Quantitative Aptitude for Competitive Exams by R. S. Agarwal
2) Quantum CAT by Sarvesh Verma
3) A Modern Approach to Logical Reasoning by R. S. Agarwal
4) Verbal Ability and Reading Comprehension by Arun sharma

ADVANCED C PROGRAMMING AND MATLAB AND SIMULINK PROGRAMMING - PHASE 2

COURSE OBJECTIVE:

- The course is oriented to those who want to advance structured and procedural programming understating and to improve C programming skills.
- The major objective is to provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.
- The main objective of this course is oriented towards exposing the students to a programming language that expresses matrix and array mathematics directly.
- This course also aims to train the students in model based learning using Simulink. Also create a simulation environment to validate a design concept.

UNIT I INTRODUCTION TO RECURSION AND GROWTH FUNCTIONS 6

Introduction to Recursion, Recurrence Relation, Deriving time complexity and space complexity using recurrence relation Polynomial Equations, Compare growth functions, Nth Fibonacci Number, Exponent Function, Taylor Series, Tower of Hanoi.

UNIT II STORAGE CLASSES, THE PREPROCESSOR AND DYNAMIC MEMORY ALLOCATION 6

Storage Classes and Visibility, Automatic or local variables, Global variables, Macro Definition and Substitution, Conditional Compilation, Dynamic Memory Allocation, Allocating Memory with malloc and callo Allocating Memory with calloc, Freeing Memory, The Concept of linked list, Inserting a node by using Recursive Programs, Deleting the Specified Node in a Singly Linked List.

UNIT III FILE MANAGEMENT AND BIT MANIPULATION 6

Defining and Opening a file, Closing Files, Input/output Operations on Files, Predefined Streams, Error Handling during I/O Operations, Random Access to Files, Command Line Arguments, The hexadecimal number system, C bitwise operators, , How to generate all the possible subsets of a set, Tricks with Bits, Applications of bit operations.

UNIT IV BASICS OF PROGRAMMING IN MATLAB 6

Variables, array, matrices, programming structure, Script files, Functions,

Debugging programs, Loops, branches and control flow, Relational and logical operations-Simple Programming Exercises

UNIT V SIMULINK PROGRAMMING FOR CONTROL SYSTEM APPLICATIONS **6**

Introduction SIMULINK models, blocks, Systems and subsystems, Simulating Dynamic System, Solving a model, solvers,

MATLAB SIMULINK for Control Systems- Time Domain and frequency Domain Analysis of SISO and MIMO systems

TOTAL : 30 PERIODS

REFERENCES:

1. R. G. Dromey, "How to Solve It By Computer", Pearson, 1982
2. A.R. Bradley, "Programming for Engineers", Springer, 2011
3. Kernighan and Ritchie, "The C Programming Language", (2nd ed.) Prentice Hall, 1988
4. Stephen J. Chapman, "MATLAB Programming for Engineers", Sixth Edition, Cengage Publications,2019
5. Katsuhiko Ogata,"MATLAB for Control Engineers", Pearson Prentice Hall, 2019
6. Rao V Dukkipati,"Matlab For Control System Engineers, New Age International (P) Ltd., Publishers, 2018

COURSE OUTCOMES :

Upon completion of this course, the students should be able to:

1. Analyze their quantitative ability. (K4)
2. Understand the ability of arithmetic reasoning along with creative thinking and problem solving skills. (K2)
3. Create their verbal ability through vocabulary building and grammar. (K6)
4. Evaluate code organization and functional hierarchical decomposition with complex data types. (K5)
5. Understand the basics of MATLAB programming fundamentals and apply them to write simple programs. (K3)
6. Understand the basics of SIMULINK programming and apply them to control system applications. (K3)

CO- PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO2	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO3	-	-	-	-	3	2	-	-	1	3	-	2	-	-
CO4	-	-	-	-	3	2	-	3	3	3	-	2	2	2
CO5	2	1	1	-	3	1	-	-	1	-	-	2	1	1
CO6	2	1	1	-	3	1	-	-	1	-	-	2	1	1

SEMESTER - IV

20MGMC301 SDG NO. 4	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

At the end of the course, the student is expected to

- To know about Indian constitution
- To know about central government functionalities in India
- To know about state government functionalities in India
- To know about Constitution function
- To Know about Constitutional remedies

UNIT I INTRODUCTION 6

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties

UNIT II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT 6

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India.

UNIT III STRUCTURE AND FUNCTION OF STATE GOVERNMENT 6

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV CONSTITUTION FUNCTIONS **6**

Indian Federal System – Centre – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries.

UNIT V CONSTITUTIONAL REMEDIES **6**

Enforcement of fundamental rights - Power of parliament to modify the rights the conferred by this part in their application to forces.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
2. R.C. Agarwal, (1997) "Indian Political System", S. Chand and Company, New Delhi.
3. M.V. Pyle (2019) , "An Introduction to The Constitution of India, 5/e", Vikas Publishing, New Delhi.
4 P.M. Bakshi, (2018) , "Constitution of India", Universal Law Publishing, New Delhi.

REFERENCES:

1. Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi.
2. U.R.Gahai, "Indian Political System", New Academic Publishing House, Jalandhar.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Explain the Constitution and Fundamental rights of citizens (K2)
2. Discuss the structure, hierarchy and functions of Central Government (K2)
3. Explain the functions of Supreme Court and Judiciary Systems in the state (K2)
4. Discuss the structure, hierarchy and functions of State Government (K2)
5. Recall the Centre-State relationship, constitutional amendments and functionaries (K1)
6. Discuss the remedies and rights available to India Citizens (K2)

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	-	-	-	-	-
CO2	-	-	-	-	-	1	1	-	-	-	-	-
CO3	-	-	-	-	-	1	1	-	-	-	-	-
CO4	-	-	-	-	-	1	1	-	-	-	-	-
CO5	-	-	-	-	-	2	1	3	-	-	-	-
CO6	-	-	-	-	-	2	1	2	3	-	-	-

SEMESTER - V

20ICPC501 SDG NO. 4,9	PROCESS CONTROL	L	T	P	C
		2	1	0	3

OBJECTIVES:

- To introduce the technical terms and nomenclature associated with Process control
- To familiarize the students with the characteristics, selection, sizing of control valves
- To provide an overview of the features associated with Industrial type PID controller
- To make the students apply the various tuning methods for designing PID controller for the given process model
- To elaborate different types of control schemes such as cascade control, feed-forward control and Model Based control schemes

UNIT I PROCESS MODELLING AND DYNAMICS **9**

Need for process control – P&ID diagram –Nomenclature of Process instruments- Servo and regulatory operations ---Mathematical Modeling of Processes: Level, Flow, Pressure and Thermal processes – Self regulation – Interacting and Non interacting system - Continuous and Batch processes - Lumped and Distributed parameter models – Heat exchanger – CSTR– Linearization of nonlinear systems.

UNIT II FINAL CONTROL ELEMENTS **9**

Actuators: Pneumatic and Electric actuators – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves – Cavitation and flashing – Control Valve selection for flow and level process.

UNIT III CONTROL ACTIONS **9**

Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation Issues: Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques – Direct/reverse action.

UNIT IV PID CONTROLLER TUNING **9**

PID Controller Design Specifications: Evaluation criteria - IAE, ISE, ITAE-Criteria based on Time Response and Criteria based Frequency Response -

PID Controller Tuning: Z-N and Cohen- Coon methods, Continuous cycling method and Damped oscillation method, Optimization methods, Auto tuning – Cascade control – Feed-forward control.

UNIT V MODEL BASED CONTROL SCHEMES 9

Smith Predictor Control Scheme - Internal Model Controller – IMC PID controller – Three- element Boiler drum level control -Introduction to Multi-loop Control Schemes – Control Schemes for CSTR, and Heat Exchanger

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A.,"Process Dynamics and Control", Wiley John and Sons, 4th Edition, September 2016.
2. Stephanopoulos, G., "Chemical Process Control – An Introduction to Theory and Practice", Pearson Education India Ltd, First edition, January 2015.

REFERENCES:

1. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2004.
2. Coughanowr D.R.,"Process Systems Analysis and Control", McGraw Hill International 2nd Edition,2004.
3. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson, 2006.
4. Bela.G.Liptak., "Process Control and Optimization"., Instrument Engineers' Handbook., Volume 2, CRC press and ISA, 4th edition, 2005.
5. Ramesh C. Panda., T.Thyagarajan., "An Introduction to Process Modeling Identification and Control for Engineers" Narosa Publishing house Pvt. Ltd, 1st edition, 2017.
6. https://freevideolectures.com/course/4304/nptel-chemical-process-control.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ch11/preview
2. https://nptel.ac.in/courses/103106148/
3. https://nptel.ac.in/courses/103101142/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3126/process-control-and-instrumentation

OUTCOMES :

Upon completion of the course, the student should be able to

1. Elucidate the technical terms and nomenclature associated with Process control and mathematical model of different processes. (K2)
2. Explain the working of different types of control valves, their characteristics and selection of a control valve for flow and level process applications.(K2)
3. Characterize on-off, floating and composite controller and illustrate about PID implementation issues.(K2)
4. Apply the various PID tuning methodologies to meet out the desired specifications and illustrate Autotuning, Cascade and Feed forward control schemes.(K3)
5. Illustrate the Model based control schemes for single loop and multi loop processes like Boiler drum level control, CSTR and Heat exchanger applications. (K2)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	1	-	3
CO2	2	2	-	-	-	-	-	-	-	-	-	1	-	3
CO3	2	2	2	-	-	-	-	-	-	-	-	1	1	2
CO4	2	2	2	-	-	1	-	-	-	-	-	1	2	3
CO5	2	2	2	1	-	1	-	-	-	-	-	1	1	2

SEMESTER - V

20EIPC501 SDG NO. 4, 9	ANALYTICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy
- To impart fundamental knowledge on gas chromatography and liquid chromatography

- To integrate a fundamental understanding of the underlying principles of physics as they relate to specific instrumentation used for gas analyzers and pollution monitoring instruments
- To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions
- To understand the working principle, types and applications of NMR and Mass spectroscopy

UNIT I SPECTROPHOTOMETRY 9

Spectral methods of analysis – Beer-Lambert law UV-Visible spectroscopy – IR Spectrophotometry -FTIR spectrophotometry – Atomic absorption spectrophotometry - Flame emission and atomic emission photometry – Construction, working principle, sources, detectors and applications.

UNIT II CHROMATOGRAPHY 9

General principles – classification – chromatographic behavior of solutes – quantitative determination –Gas chromatography – Liquid chromatography – High-pressure liquid chromatography – Applications.

UNIT III INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS 9

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

UNIT IV pH METERS AND DISSOLVED COMPONENT ANALYZERS 9

Selective ion electrodes - Principle of pH and conductivity measurements - dissolved oxygen analyzer –Sodium analyzer – Silicon analyzer – Water quality Analyzer

UNIT V NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY9

NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A "Instrumental methods of analysis", CBS publishing & amp; distribution, 7th Edition, 2014.
2. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2006.

REFERENCES:

1. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw-Hill publishing Co. Ltd.,2 nd Edition 2007.
2. Ewing, G.W., "Instrumental Methods of Chemical Analysis", McGraw-Hill,5th Edition reprint 1985.(Digitized in2007).
3. Robert E. Sherman., "Analytical Instrumentation", Instruments Society of America,1996.
4. Liptak, B.G., "Process Measurement and Analysis", CRC Press, 5th Edition,2015.
5. Nelu Grinberg, Sonia Rodriguez Ewing's Analytical Instrumentation Handbook, Fourth Edition,Published March 12, 2019 by CRC Press
6. NPTEL lecture notes on, "Modern Instrumental Methods of Analysis" by Dr.J.R.Mudakavi, IISC,Bangalore.

WEB REFERENCES:

1. https://www.analytical-training-solutions.com/
2. http://www.anachem.umu.se/jumpstation.htm
3. http://roswell.ca.sandia.gov/~mmyoung
4. https://www.classcentral.com/course/analyticalchem-838

ONLINE RESOURCES:

1. https://www.my-mooc.com/en/mooc/analyticalchem/
2. https://www.spectroscopyonline.com/topic/analytical-instrumentation
3. https://onlinelibrary.wiley.com/

OUTCOMES:

Upon completion of the course, the student should be able to:

1 Explain the fundamental principle of UV, IR, Flame and Atomic spectrophotometer. (K2)
2 Describe the chromatographic behavior of solutes in gas chromatography and liquid chromatography. (K2)
3 Illustrate the function of Oxygen, NO2 H2S, IR industrial gas analyzers and dust and smoke measurements. (K2)
4 Discuss about the working principle of pH, sodium, silicon & water quality analyzer. (K2)
5 Explain about the working principle of NMR and Mass Spectrometry. (K2)

CO - PO, PSO MAPPING:

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

SEMESTER - V

20EIPC502 SDG NO. 4, 9	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Introduce the Architectures and programming of 8 bit and 16 bit proce ssors
- To Familiarize students with Communication protocols and Peripheral interfacing
- To impart Microcontroller programming skills in students
- To provide an overview of Advanced processors.

UNIT I 8085 PROCESSOR **9**

Hardware Architecture-Instruction set- programming concepts- Timing Diagram – Interrupts - Stack.

UNIT II 8051 MICRO CONTROLLER **9**

Hardware Architecture, pinouts – Memory organization – I/O ports and data transfer concepts– Interrupts- Instruction set- programming concepts, Comparison to Programming concepts with 8085.

UNIT III PERIPHERAL INTERFACING **9**

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8279, - A/D and D/A converters &Interfacing with 8085& 8051.

UNIT IV MICRO CONTROLLER PROGRAMMING & APPLICATIONS **9**

Simple programming exercises- key board and display interface –Control of servo motor- stepper motor control- Application to automation systems.

UNIT V ADVANCED PROCESSOR **9**

Introduction to computer architecture and organization, Architecture of 16 bit, 32-bit and 64- bit microprocessors, CISC/RISC design philosophy, bus configurations, CPU module. Embedded system overview.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sunil Mathur & Jeebananda Panda, "Microprocessor and Micro-controllers", PHI Learning Pvt. Ltd, 2016.
2. R.S. Gaonkar, "Microprocessor Architecture Programming and Application", with 8085, 6th Edition, Wiley Eastern Ltd., New Delhi,2013.

REFERENCES:

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. B.RAM, "Computer Fundamentals Architecture and Organization" New age International Private Limited, Fifth edition,2017.
3. Soumitra Kumar Mandal, "Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085, 8086, 8051", McGraw Hill Edu, 2013.
4. Ajay V.Deshmukh, "Microcontroller Theory & Applications", McGraw HillEdu, 2016.
5. Douglas V.Hall, 'Microprocessor and Interfacing', McGraw HillEdu, 2016.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee42/preview
2. https://onlinecourses.nptel.ac.in/noc22_ee12/preview

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3018/microprocessors-and-microcontrollers

OUTCOMES:

Upon completion of the course, the student should be able to

1. Describe the architecture of 8085 processor with its internal features, instruction set and Timing Diagram (K2).
2. Illustrate the architecture of 8051 microcontroller with its internal features, instruction set and its programming concepts (K2).
3. Illustrate various interfacing peripherals and programming using 8085 processor and 8051 controller (K2).

4. Apply the programming concepts of microcontroller for developing simple programming exercises and applications (K3).
5. Discuss the architecture of various advanced processor and Embedded system overview (K2).

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	1	2	2	1	3	1	3	3	3	2
CO2	3	2	3	2	1	2	2	1	3	1	3	3	3	2
CO3	3	2	3	2	1	2	2	1	3	1	3	3	3	2
CO4	3	2	3	3	2	2	2	1	3	1	3	3	3	2
CO5	3	2	3	2	2	2	2	1	3	1	3	3	3	2

SEMESTER - V

20EIPC503 SDG NO. 4, 9	DIGITAL SIGNAL PROCESSING	L	T	P	C
		2	1	0	3

OBJECTIVES:

To impart knowledge about the following topics:

- To provide a higher level of understanding of discrete-time and digital signal in time and frequency domains.
- To provide knowledge to analyze linear systems with difference equations
- To design and implement different structures of FIR and IIR filters.
- To introduce DSP processors and FFT processors.

UNIT I INTRODUCTION **9**

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II DISCRETE TIME SYSTEM ANALYSIS 9

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z- transform, application to discrete systems - Stability analysis, frequency response – Convolution – Discrete Time Fourier transform, magnitude and phase representation.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 9

Discrete Fourier Transform- properties, magnitude and phase representation-Computation of DFT using FFT algorithm – DIT & DIF using radix 2 FFT – Butterfly structure.

UNIT IV DESIGN OF DIGITAL FILTERS 9

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. Analog filter design – Butterworth and Chebyshev approximations; IIR Filters, digital design using impulse invariant and bilinear transformation Warping, pre warping.

UNIT V DIGITAL SIGNAL PROCESSORS 9

Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to Commercial DS Processors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson Education, New Delhi, PHI. 2003.
2. S.K. Mitra, "Digital Signal Processing – A Computer Based Approach", McGraw Hill Edu, 2013.
3. Lonnie C.Ludeman, "Fundamentals of Digital Signal Processing", Wiley, 2013.

REFERENCES:

1. Poorna Chandra S, Sasikala. B, Vijay Nicole, "Digital Signal Processing", TMH, 2013.
2. Robert Schilling & Sandra L.Harris, "Introduction to Digital Signal Processing using Matlab", Cengage Learning, 2014.
3. B.P.Lathi, "Principles of Signal Processing and Linear Systems", Oxford University Press, 2010
4. Taan S. ElAli, "Discrete Systems and Digital Signal Processing with Mat Lab", CRC Press, 2009.

5. Sen M. Kuo, Woonseng, S.Gan, "Digital Signal Processors, Architecture, Implementations & Applications", Pearson, 2013

WEB REFERENCES:

1. http://www.nptelvideos.in/2012/12/digital-signal-processing.html
2. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/study-materials/

ONLINE RESOURCES:

1. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/video-lectures/
2. https://www.cl.cam.ac.uk/teaching/1718/DSP/materials.html
3. https://www.coursera.org/learn/dsp1

OUTCOMES:

Upon completion of the course, the student should be able to

1. Illustrate the classifications of signal and systems in time & frequency domain and the mathematical representation of signals(K2)
2. Apply Z transforms and Discrete Time Fourier transform for Linear Time Invariant (LTI) system(K3)
3. Apply Fast Fourier Transform (FFT) for the Computation of DIT (Decimation in time) and DIF (Decimation in frequency) algorithms and illustrate the properties of Discrete Fourier transform(K3)
4. Design of Finite Impulse Response (FIR) filter and Infinite Impulse Response (IIR) filter(.K3)
5. Describe the architecture and features of Digital Signal Processors (K2)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	1	-	-	2	1	3	3	2
CO2	3	3	2	2	3	1	-	-	1	2	2	2	3	3
CO3	3	3	3	3	3	2	-	-	1	1	3	1	3	3
CO4	3	2	2	3	2	-	2	-	2	2	3	3	3	2
CO5	3	2	2	2	1	1	1	-	1	1	1	3	3	2

SEMESTER - V

20EIPL501 SDG NO. 4, 11	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To provide training on programming of microprocessor and micro-controllers and understand the interface requirements
- To provide training on programming of microcontrollers and understand the interface requirements
- To simulate various microprocessors and microcontrollers using KEIL or Equivalent simulator

LIST OF EXPERIMENTS:

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions:
   (I) Ascending / Descending order, Maximum / Minimum of numbers.
   (ii) Programs using Rotate instructions.
   (iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085
   (I) A/D Interfacing. & D/A Interfacing.
4. Interrupt controller using 8085.
5. I/O Port / Serial communication
6. Programming Practices with Simulators/Emulators/open source
7. Read a key ,interface display
8. Demonstration of basic instructions with 8051 Micro controller execution, including:
   (I) Conditional jumps & looping
   (ii) Calling subroutines.
9. Programming I/O Port and timer of 8051
   (I) Study on interface with A/D & D/A
   (ii) Study on interface with DC & AC motors
10. Application hardware development using embedded processors.

TOTAL: 45 PERIODS

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

Sl.No.	Description of Equipment	Quantity required
1.	8085 Microprocessor Trainer with Power Supply	15
2.	8051 Microcontroller Trainer Kit with power supply	15
3.	8255 Interface boards	6
4.	8251 Interface boards	6
5.	8259 Interface boards	6
6.	8279 Keyboard / Display Interface boards	6
7.	8254 timer/ counters	6
8.	ADC and DAC cards	6
9.	AC & DC motor with Controllers	6
10.	Traffic Light Control Systems	5

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand and apply computing platform and software for engineering problems. (K1)
2. Understand Programming logics for code conversion.(K1)
3. Acquire knowledge on A/D and D/A. (K2)
4. Understand basics of interfacing various peripherals.(K1)
5. Understand basics of software simulators. (K1)

CO-PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	2	2	1	3	1	3	3	3	3
CO2	3	3	3	2	1	2	2	1	3	1	3	3	3	3
CO3	3	3	3	2	1	2	2	1	3	1	3	3	3	3
CO4	3	3	3	2	2	2	2	1	3	1	3	3	3	3
CO5	3	2	3	2	2	2	2	1	3	1	3	3	3	2

SEMESTER - V

20ICPL501 SDG NO. 3,4&9	INDUSTRIAL INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To impart an adequate knowledge and expertise to handle equipment generally available in an industry
- To make the students aware about calibration of meters, sensors and transmitters
- To make the students conscious about the working and operation of different types of analytical Instruments
- To identify, formulate, and analyze problems regarding sensors and transmitter

LIST OF EXPERIMENTS:

1. Measurement of speed, torque and vibration
2. Calibration of ammeter, voltmeter and wattmeter using multifunction calibrator
3. Calibration of pressure gauge using dead weight tester.
4. Measurement of level using d/p transmitter and fibre optics system
5. Measurement of flow using

a) Discharge coefficient of orifice plate
b) Calibration of Rotameter

6. Design and Testing of Electromagnetic Flow meters
7. Measurement of temperature using IR thermometer and IC sensor
8. Measurement of Absorbance and Transmittance of Test solutions using UV-Spectrometer
9. Measurement of Conductivity, Moisture and Viscosity of test solutions
10. Standardization and measurement of pH values of different solutions
11. Measurement and analysis of ECG and pulse rate

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.NO	EQUIPMENTS	
1.	Orifice plate	1No.
2.	Dead weight tester with pressure gauge	1 No.

3.	Torque trainer	1 No.
4.	Saybolt Viscometer	1 No.
5.	Vacuum gauge	1No.
6.	DP transmitter	1 No.
7.	UV – Visible spectrophotometer	1 No.
9.	pH meter	1 No.
10.	Conductivity meter	1 No.
11.	ECG trainer	1 No.
12.	Pulse rate trainer	1 No.
13.	Tacho meter	1 No.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Use laboratory standard calibration methods and get hands on experience in the calibration of Process Parameters and electrical parameters. (K2)
2. Understand the measurement of Process variables like flow, level, temperature using laboratory standard sensors and transducers.(K1)
3. Analyze the pH, conductivity, moisture and viscosity of various test solutions.(K3)
4. Understand the working of analytical instruments and able to find absorbance and transmittance characteristics of different solutions. (K1)
5. Measure and analyze physiological parameters such as BP, ECG and pulse rate.(K3)

CO- PO, PSO MAPPING:

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

SEMESTER - V

20EITE501 SDG NO. 4,11,15	LIVE-IN-LAB - III	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To provide opportunities for the students, expose to Industrial environment and real time work
- To enable hands-on experience in the electronics hardware/Software domain
- To enable development of skill set for designing and realizing prototype electronic systems/simulation model

COURSE METHODOLOGY:

- This initiative is designed to inculcate ethical principles of research and to get involve in life-long learning process for the students.
- The project work must involve engineering design with realistic constraints. It must also include appropriate elements of the following: Engineering standards, design analysis, modeling, simulation, experimentation, prototyping, fabrication, correlationof data, and software development.
- Project can be individual work or a group project, with maximum of 3 students. In case of group project, the individual project report of each student should specify the individual's contribution to the group project
- On completion of the project, the student shall submit a detailed project report. The project should be reviewed and the report shall be evaluated and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION

- First evaluation (Immediately after first internal examination) : 20 marks
- Second evaluation (Immediately after second internal examination): 30 marks
- Final evaluation Last week of the semester) : 50 marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the student should be able to

1. Conduct literature survey to identify the gap and an application oriented research problem in the specific domain. (K2)
2. Design and validate the proposed system using simulation . (K3)
3. Prototype the proposed system. (K3)
4. Analyze the obtained results and prepare a technical report . (K2)
5. Publish the work in journals and apply for the patents. (K4)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO4	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - V

20EITP501 SDG NO. 4,11,15	SKILL ENHANCEMENT	L	T	P	C
		0	0	4	2

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

- Enhance their quantitative ability.
- Enhance their reasoning ability
- Enhance their verbal ability.
- Equip with creative thinking and problem solving skills

UNIT I QUANTITATIVE ABILITY – V **10**

Square Root And Cube Root, Logarithm, Volume and Surface Area, Permutation and Combination

UNIT II QUANTITATIVE ABILITY – VI **10**

Probability, Averages, Area, Odd Man Out, Crypt Arithmetic, Flowcharts

UNIT III REASONING ABILITY – III **8**

Data Interpretation Table Charts, Data Interpretation Bar Charts, Blood Relationship, Puzzles

UNIT IV VERBAL ABILITY – III **10**

Spellings, Selecting Words, Spotting Errors, Ordering of Words, Logical Sequence of Words

UNIT V CREATIVITY ABILITY – III **7**

Logical Puzzles, Playing Cards Puzzles, Clock Puzzles, Number Puzzles, Sudoku

TOTAL: 45 PERIODS

REFERENCES:

1. Quantitative Aptitude for Competitive Exams by R. S. Agarwal
2. Quantum CAT by Sarvesh Verma
3. A Modern Approach to Logical Reasoning by R. S. Agarwal
4. Verbal Ability and Reading Comprehension by Arun Sharma

LABVIEW - PHASE II

OBJECTIVES:

- Familiarize students with NI Software- LabVIEW
- Create and simulate small applications
- Design simple Interface Sensors with NI hardware

UNIT 1 BASIC LABVIEW PROGRAMMING **6**

While Loops, Plotting , Sub VIs, Case Structures,Strings,Arrays, Clusters, Property Node, Project Explorer Programming Exercises

UNIT II LABVIEW APPLICATION EXAMPLES **7**

Interfacing with various NI DAQ device -Hardware integration with LabVIEW, Reading Analog and Digital I/O's, LabVIEW Arduino for data acquisition Interfacing Application Programs

TOTAL: 13 PERIODS

REFERENCES:

1. Jeffrey Travis, Labview for Everyone, Pearson Education
2. Jovitha Jerome, Virtual Instrumentation using Labview, Prentice Hall of India

ONLINE RESOURCES:

1. https://www.ni.com/getting-started/labview-basics/

OUTCOMES:

Upon completion of this course, the students will be able to:

1. Learn graphical language programming. (K1)
2. Understand data acquisition, and virtual instrument control. (K1)
3. Create and simulate small applications. (K4)
4. Take part in NI competitions and Prepare for CLAD exam. (K4)
5. Interface Sensors with various NI hardwares. (K4)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO4	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - VI

20EIPC601 SDG NO. 9	INDUSTRIAL COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate on the basic concepts of data networks
- To introduce the basics of internetworking and serial communications
- To provide details on HART and Field buses
- To educate on MODBUS, PROFIBUS and other communication protocol
- To introduce industrial Ethernet and wireless communication

UNIT I DATA NETWORK FUNDAMENTALS 9

Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing -CSMA/CD, TCP/IP.

UNIT II INTERNET WORKING and RS 232, Rs485 9

Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configur ation special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Devicenet.

UNIT III HART AND FIELD BUS 9

HART -Introduction - Evolution of signal standard - HART communication protocol - HART networks - HART commands - HART applications Fieldbus - Introduction - General Fieldbus Architecture Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability - Interchangeability - Introduction to OLE for process control(OPC).

UNIT IV MODBUS AND PROFIBUS PA/DP/FMSANDFF 9

MODBUS -protocol structure - function codes – troubleshooting Profibus-Introduction, Profibus protocol stack and communication model - communication objects - system operation - troubleshooting - review of foundation fieldbus - Data Highway

UNIT V INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION 9

Industrial Ethernet-Introduction,10Mbps Ethernet, 100Mbps Ethernet, Radio and wireless communication, Introduction, components of radio link - radio spectrum and frequency allocation - radio MODEMs-Introduction to wireless HART and ISA100.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, "Practical Industrial Data Networks Design, Installation and Troubleshooting", Newnes Publication, Elsevier First Edition,2004
2. William Buchanan, "Computer Buses", CRC Press, 2000.
3. Behrouz Forouzan, "Data Communications & Networking" ,3RD edition, Tata McGraw hill,2006.

REFERENCES:

1. Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", Prentice Hall of India Pvt. Ltd., 5th Edition.2011.
2. Theodore S Rappaport, "Wireless Communication: Principles and Practice", Prentice Hall of India 2nd Edition,2001.
3. William Stallings, "Wireless Communication & Networks", Prentice Hall of India,2nd Edition,2005.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112107291/
2. https://swayam.gov.in/nd1_noc20_me10/preview

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Explain communication systems emerging in the field of instrumentation. (K2)
2. Describe the basics of inter-networking and serial communications. (K2)
3. Compare the HART and Field buses communication standards. (K2)
4. Interpret the various industrial network communication protocol like MODBUS, PROFIBUS and other communication protocol. (K2)
5. Summarize the Industrial Ethernet and Wireless communication. (K2)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	3	1	-	-	-	-	-	3	1	2
CO2	3	2	1	3	2	2	-	-	-	-	-	3	1	2
CO3	2	3	3	2	3	2	-	-	-	-	-	3	2	2
CO4	3	2	3	3	2	1	-	-	-	-	-	1	1	2
CO5	2	2	3	1	3	2	-	-	-	-	-	3	2	2

SEMESTER - VI

20EIPC602 SDG NO. 4,9,11	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of building blocks of Embedded system
- To familiarize the Embedded Networking Technologies
- To provide the Knowledge of Embedded Firmware development Environment
- To impart knowledge on RTOS based system Design
- To introduce the concept of IoT and its integration to Embedded systems

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT II EMBEDDED NETWORKING 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS422 – RS 485 - CAN Bus -Serial Peripheral Interface (SPI) –OSI Architecture- Inter Integrated Circuits (I2C)

UNIT III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object-oriented Model.

UNIT IV RTOS BASED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS - Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance.

UNIT V EMBEDDED SYSTEMS FOR IOT 9

Evolution of IoT-IoT System building blocks -IoT Architecture-IoT Protocols-

112 Raspberry Pi - Introduction to Python –Case Study on IoT using Embedded systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Raj Kamal, "Embedded Systems – Architecture, Programming and Design", Third Edition, McGraw Hill Education (India) Private Limited, 2015
2. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson,2013

REFERENCE BOOKS:

1. C.R. Sarma, "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013.
2. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
3. Peckol, "Embedded system Design", John Wiley &Sons,2010
4. N. Mathivanan, "PC Based Instrumentation: Concepts and Practice", PHI Learning Pvt. Ltd, 2017.
5. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri. Internet of Things: Architectures, Protocols and Standards, 1 st edition, Wiley Publications, 2019

WEB REFERENCE :

1. https://swayam.gov.in/nd1_noc20_cs14/preview

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand and suggest suitable embedded system for a given application (K1)
2. Understand embedded networking (K1)
3. Operate various Embedded Development Strategies (K2)
4. Study the characteristics of RTOS based systems and use them effectively in design environments.(K1)
5. Infer the concept of IoT and demonstrate its power in real world applications and to formulate design strategies for embedded applications. (K2)

CO- PO, PSO MAPPING :

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

SEMESTER - VI

20EIPC603 SDG NO. 4	POWER ELECTRONICS, DRIVES AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics
- To give exposure to Various topologies, working principle and analysis of controlled rectifiers and ac controllers
- To provide detailed knowledge on Classifications, structure, operating principle of dc choppers
- To Introduce about different types of Inverters , their principle of operation and waveform control
- To get an overview about dc and ac drives and their control using power electronic circuits.

UNIT I POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS 9

Operating principle and switching Characteristics: Power diodes, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO, MCT, Power integrated circuits (PIC) – Drive and Protection circuits – Series and parallel operation – Commutation – Simulation tools.

UNIT II CONTROLLED RECTIFIERS AND AC CONTROLLERS 9

Single phase – Three phase – Half controlled – Fully controlled rectifiers – Dual converters -Effect of source and load inductance - AC voltage controllers –Introduction to Cycloconverters, Matrix converters.

UNIT III DC TO DC CONVERTERS 9

Step up and Step down Chopper – Chopper classification - quadrant of operation – Switching mode Regulators – Buck, Boost, Buck-Boost, and Cuk Regulators.

UNIT IV INVERTERS 9

Voltage source Inverters – Half bridge – Full bridge – Three Phase Bridge Inverters – Voltage control– PWM Techniques – Current Source Inverters: Capacitor Commutated Inverter- Resonant inverters: Series, Parallel, ZVS, ZCS – Introduction to multilevel Inverters.

UNIT V DRIVES AND CONTROL 9

Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives – Principles of v/f control of AC drives – Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only) – Introduction to vector control of AC drives.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rashid, M.H., "Power Electronics – Circuits, Devices and Applications", PHI, 3rd Edition, 2004.
2. Mohan, Udeland and Robbins., "Power Electronics", John Wiley and Sons, New York,1995.

REFERENCES:

1. Singh, M.D., and Khanchandani, K.B., "Power Electronics", 2nd Edition., TataMcGraw-Hill, 2011.
2. Bose, B.K., "Modern Power Electronics and AC Drives", Pearson Education,2002.
3. Bimbra, P.S., "Power Electronics", Khanna Publishers, 5th edition, 2012.
4. Moorthi, V.R., "Power Electronics - Devices, Circuits and Industrial Applications", Oxford University Press, 2005.
5. NPTEL Lecture Series on "Power Electronics" by Dr.B.G.Fernandes, IIT Bombay

WEB REFERENCES:

1. https://sanfoundry.com/best-reference-books-electrical-drives-control
2. https:/www.st.com/en/applications/industrial-drives.html

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108108077
2. https:/swayam.gov.in/nd1_noc19_ee65/preview

OUTCOMES:

Upon completion of the course, the student should be able to

1. Explain various devices and their structure, operating characteristics in the field of electronics and to design and analyze power electronic circuits using simulation software. (K2)
2. Classify, analyze and design, Controlled rectifier and AC Controllers. (K2)
3. Obtain comprehensive knowledge on design and analyze of DC to DC and DC to AC converters. (K3)
4. Apply power electronic circuits for the control of popular applications. (K3)
5. Acquire knowledge in drives and its control. (K2)

CO-PO,PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	2	-	-	-	-	2	2	3	2
CO2	3	2	2	2	2	2	-	-	-	-	2	2	3	1
CO3	3	2	1	2	2	2	-	-	-	-	2	2	3	1
CO4	2	1	2	2	2	2	2	-	-	-	2	2	3	2
CO5	2	1	2	2	1	2	2	-	2	-	2	2	3	2

SEMESTER - VI

20ICPL601 SDG NO. 4, 9	PROCESS CONTROL AND SIMULATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To experimentally verify the process control concepts on the selected process control loops
- To impart theoretical and practical skills in process identification and PID controller tuning
- To make the students aware of basic and advanced control schemes

LIST OF EXPERIMENTS:

Simulation Based Experiments

1. Simulation of lumped /distributed parameter system
2. Mathematical model of a typical industrial process using nonparametric identification methods
3. Tuning of PID Controller for mathematically described processes
4. PID Enhancements (Cascade and Feed-forward Control Schemes)
5. Design and Implementation of Multi-loop PID Controller on the simulated model of a typical industrial process.
6. Study of AC and DC drives.

Hardware based experiments

1. Characteristics of Pneumatically Actuated Control Valve (with and without Positioner).
2. Study and control of flow process using Compact Flow Control Unit.
3. Control of Level and Pressure using Process Control Training Plant.
4. Design and implementation of ON/OFF Controller for the Temperature Process.
5. Design and implementation of Interacting and non-interacting system
6. Design and implementation of adaptive or model predictive control schemes

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS/ 4 STUDENTS PER EXPERIMENT

S.No	EQUIPMENTS
1.	Flow process station with all accessories
2.	Analog / Digital PID controller
3.	Control valve setup (with position for varying ΔP across the valve)
4.	Flow meter
5.	Level process station with all accessories
6.	Temperature process station with all accessories
7.	Pressure process station with all accessories
8.	Personal computer-15 nos
9.	MATLAB software
10.	Two tank system with following accessories

TOTAL : 45 PERIODS

OUTCOMES:

On completion of this laboratory course, the student should be able to

1. Analyze process control parameters. (K3)
2. Build dynamic models using input – output data of a process (K2)
3. Analyze real time control loops (flow/ level/ temperature/ pressure) (K3)
4. Perform simulation experiments using MATLAB/LABVIEW/ASPEN (K3)
5. Analyze simple adaptive and model based control schemes (K3)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	1	-	3
CO2	2	2	-	-	-	-	-	-	-	-	-	1	-	3
CO3	2	2	2	-	-	-	-	-	-	-	-	1	1	2
CO4	2	2	2	-	-	1	-	-	-	-	-	1	2	3
CO5	2	2	2	1	-	1	-	-	-	-	-	1	1	2

SEMESTER - VI

20EIPL601 SDG NO. 4, 9	EMBEDDED SYSTEMS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- Thestudentswilllearndesignwithsimulators/programmingenvironments
- Thestudentswilllearndesignwithsimulators/experiments,
- Thestudentswilllearndesigninprogrammingprocessorboards,processorinterfacing/designingdigitalcontrollers

LIST OF EXPERIMENTS:

1. Programming in Higherv Level Languages / Platforms
2. Programming with 8 bit Microcontrollers, Assembly programming, Study on in circuit Emulators, cross compilers, debuggers
3. I/O Programming with 8 bit Microcontrollers I/O Interfacing: Timers/ Interrupts/ Serial port programming
4. I/O Programming with 8 bit MicrocontrollersI/O Interfacing: PWM Generation/MotorControl /Sensor Interfacing
5. Programming with AVR / PIC Microcontrollers: Assembly, C programming, programming Interfacing peripherals Study on in circuit, Emulators, cross compilers, debuggers
6. I/OProgramming with AVR / PIC Microcontrollers I/O Interfacing: Timers / Interrupts / Serial port programming
7. I/O Programming with AVR / PIC Microcontrollers I/O Interfacing :PWM Generation/MotorControl /Sensor Interfacing
8. Programming with Arduino Microcontroller Board: Study on in circuit Emulators, cross compilers, debuggers

TOTAL: 45 PERIODS

LAB REQUIREMENTS FOR A BATCH:

1. C / C++ / Java / Embedded C / Embedded Java / Compilers & Platforms
2. 8051 Micro controllers with peripherals; IDE, Board Support Software Tools / C Compiler / others
3. 8051 Micro controllers with peripherals; Board Support Software Tools, peripherals with interface
4. AVR / PIC Micro controllers with peripherals; IDE, Board Support Software Tools / C Compiler / others
5. AVR / PIC Micro controllers with peripherals; Board Support Software Tools, peripherals with interface

6. Arduino Boards with peripherals; IDE, Board Support Software Tools / Compiler / others
7. Simulation Tools as Proteus / ORCAD

ONLINE RESOURCES:

1. https://www.arm.com/resources/education/online-courses
2. http://users.ece.utexas.edu/~valvano/Volume1/E-Book/C1_Embedded Systems Shape The World.htm
3. https://www.embedded.com/set-up-an-embedded-systems-training-lab-for-under-1000/
4. https://tec.ee.ethz.ch/education/lectures/embedded-systems.html

OUTCOMES:

Upon completion of the course, the student be able to

1. Design, modelling & simulation of Combinational, Sequential, Synchronous, Asynchronous circuits with simulators / experiments. (K3)
2. Design in programming processor boards, processor interfacing / designing re programmable system. (K3)
3. Design with experiments, in programming suites / simulators / Tool Bench. (K3)
4. Apply the programming knowledge for designing embedded system applications. (K2)
5. Design with digital controllers for embedded applications. (K3)

CO–PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	2	-	-	-	-	-	3	3	3
CO2	2	2	3	2	3	2	-	1	-	-	-	2	3	3
CO3	2	3	3	3	3	3	-	1	-	-	-	2	3	3
CO4	3	3	3	3	3	2	-	1	2	-	-	2	3	3
CO5	3	3	3	3	3	2	-	2	2	-	3	2	3	3

SEMESTER - VI

20HSPL501 SDG NO. 4, 8	COMMUNICATION AND SOFT SKILLS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop effective communication and presentation skills
- To enhance the employability and career skills of the learners
- To enable the learners for preparing job application and e-portfolio
- To make the learners use soft skills efficiently
- To develop their confidence and help them in attending interviews successfully

UNIT I LISTENING AND SPEAKING SKILLS 6

Conversational skills participate in formal and informal talks – general, – group discussion – time management – group dynamics – GD strategies - making effective presentations - listening/watching interviews conversations, documentaries - listening to lectures, discussions from social media – improving articulation.

UNIT II ADVANCED READING AND WRITING SKILLS 6

Reading different genres of texts - writing job applications – cover letter – résumé – emails – memos - writing abstracts – summaries – interpreting visual texts - e-portfolio.

UNIT III SKILLS FOR COMPETITIVE EXAMS 6

Reading passages for competitive exams – language focus exercise – building vocabulary tasks - FAQs related to competitive exams – current affairs - improving global reading skills – elaborating ideas – summarizing – understanding arguments – identifying opinion/attitude and making inferences - critical reading.

UNIT IV SOFT SKILLS 6

Motivation – emotional intelligence – managing changes – stress management – leadership straits – team work – career planning – intercultural communication – creative and critical thinking

UNIT V INTERVIEW SKILLS 6

Different types of interview – personal interview – panel interview – telephone/online interview - interview etiquette - answering questions – offering information – mock interviews – FAQs related to job interviews

TOTAL: 30 PERIODS

REFERENCES:

1. Business English Certificate Materials, Cambridge University Press.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge, 2011.
3. International English Language Testing System Practice Tests, Cambridge University Press.
4. Personality Development (CD-ROM), Times Multimedia, Mumbai.

WEB REFERENCES:

1. https://nptel.ac.in/courses/109/107/109107121/
2. https://swayam.gov.in/nd1_noc19_hs33/preview
3. https://ict.iitk.ac.in/courses/enhancing-soft-skills-and-personality/

ONLINE RESOURCES:

1. https://www.britishcoucil.my/english/courses-adults/learning-tips/importance-of-soft-skills
2. https://www.skillsoft.com/content-solutions/business-skills-training/soft-skills-training/

OUTCOMES:

Upon completion of the course learners should be able to

1. Demonstrate a better understanding of the communication process by articulating effectively(K2)
2. Exhibit soft skills & technical skills and construct e-portfolio effectively(K3)
3. Apply critical thinking abilities and perform well in group discussions(K2)
4. Adapt the skills towards grooming as a professional continuously(K2)
5. Identify different types of personal interview skills through mock interviews and practices(K2)
6. Execute the employability and career skills in their chosen profession(K3)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	2	3	1	1
CO2	-	-	-	-	-	-	-	2	3	3	2	1
CO3	-	-	-	-	-	-	-	2	3	2	-	1
CO4	-	-	-	-	-	-	-	1	1	3	2	2
CO5	-	-	-	-	-	2	-	1	2	3	-	1
CO6	-	-	-	-	-	-	-	1	1	3	2	2

SEMESTER - VI

20EIPJ601 SDG NO.4,11&15	INNOVATIVE DESIGN PROJECT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the engineering aspects of design with reference to simple products
- To foster innovation in design of products
- To develop design that add value to products and solve technical problems

COURSE PLAN

Study: Take minimum three simple products, processes or techniques in the area of specialization, study, analyze and present them. The analysis shall be focused on functionality, construction, quality, reliability, safety, maintenance, handling, sustainability, cost etc. whichever are applicable. Each student in the group has to present individually; choosing different products, processes or techniques.

Design: The project team shall identify an innovative product, process or technology and proceed with detailed design. At the end, the team has to document it properly and present and defend it. The design is expected to concentrate on functionality; design for strength is not expected.

Note: The one hour/week allotted for tutorial shall be used for discussions and presentations. The project team (not exceeding four) can be students from different branches, if the design problem is multidisciplinary.

EVALUATION

First evaluation (Immediately after first internal examination) : 20 marks

Second evaluation (Immediately after second internal examination): 20 marks

Final evaluation (Last week of the semester) : 60 marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade

OUTCOMES:

Upon completion of the course learners should be able to

1. Think innovatively on the development of components, products, processes or technologies in the engineering field. (K2)
2. Analyze the problem requirements and arrive workable design solutions (K3)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	2	2	3	3	3	2	3	3
CO2	3	3	3	3	3	3	2	2	3	3	3	2	3	3

SEMESTER - VI

20EITP601 SDG NO. 4,11,15	SKILL ENHANCEMENT	L	T	P	C
		0	0	4	2

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

- Enhance their quantitative ability.
- Enhance their reasoning ability
- Enhance their verbal ability.

UNIT I QUANTITATIVE ABILITY – VII **10**

Races And Games, Boats and Streams, Surds and Indices, Pipes and Cistern, Alligations And Mixtures

UNIT II QUANTITATIVE ABILITY – VIII **10**

Numbers, Problems on Numbers, Pick Wrong Number, Missing Number, Areas, Shapes, Perimeter

UNIT III REASONING ABILITY – IV **8**

Data Interpretation Pie Charts, Data Interpretation Line Charts, Data Sufficiency (DS), Data Arrangements, LR – Arrangements, LR – Ranking.

UNIT IV VERBAL ABILITY – IV **10**

Sentence Correction, Sentence Improvement, Completing Statements, Sentence Formation, Paragraph Formation

UNIT V CREATIVITY ABILITY – IV **7**

Dot Situation, Rule Detection, Embedded Images, Grouping Of Images, Image Analysis

TOTAL : 45 PERIODS

REFERENCES:

1. Quantitative Aptitude for Competitive Exams by R. S. Agarwal
2. Quantum CAT by Sarvesh Verma
3. A Modern Approach to Logical Reasoning by R. S. Agarwal
4. Verbal Ability and Reading Comprehension by Arun Sharma

SENSOR INTERFACING USING TI TOOLS - PHASE II

OBJECTIVES:

- Sensor interfacing with microcontrollers.
- Train the students to the basic concept of acquiring sensor data ,simple processing and display
- Get exposure to Texas Instruments Embedded platform.
- Enable students build a tiny prototype which involves application development with real time sensor data and also simulated environment

UNIT I TEXAS TOOLS AND IDE **6**

Installing and working with Integrated Development Environment (IDE) for TI – Code Composer Studio (CCS) and Energia software Simple programs simulation and implementation using TI tools

UNIT II Sensor Interfacing with TI **7**

Writing and Implementing programs for Interfacing sensors using Grooverboard and TI microcontroller, Displaying values on serial monitor and tera terminal. Using Wifi module and software for remote control operation Using cloud software (Pubnub) for storing the sensor values in cloud continuously Case studies related to sensor interfacing for IoT based applications

TOTAL: 13 PERIODS

REFERENCES:

1. Steven F. Barrett , Daniel J. Pack, Microcontroller Programming and Interfacing with Texas Instruments MSP430FR2433 and MSP430 FR5994: Second Edition
2. Embedded System Design using TIVA, Texas Instruments Manual

3. Embedded System Design using TM4C LaunchPadTM Development Kit, Texas Instruments Manual.
4. Micheal Barr, Programming Embedded systems using C and C++, Second Edition

ONLINE RESOURCES

1. https://www.ti.com/seclit/ml/ssqu017/ssqu017.pdf
2. https://www.ti.com/seclit/ml/ssqu015/ssqu015.pdf

OUTCOMES:

Upon completion of this course, the students will be able to:

1. Learn new concepts of interfacing sensor with controllers and peripherals Develop Projects in future. (K2)
2. Learn simple program simulation using TI Tools. (K2)
3. Identify IoT applications by understanding the fundamentals of cloud and networking concepts . (K3)
4. Analyze Case studies for Project Problem identification. (K3)
5. Take part in TI conducted Competitions. (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO2	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO3	-	-	-	-	3	2	-	-	1	3	-	2	-	-
CO4	-	-	-	-	3	2	-	3	3	3	-	2	2	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2	2	2

SEMESTER - VII

20ICPW701 SDG NO. 4 & 9	INSTRUMENTATION SYSTEM DESIGN WITH LABORATORY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To impart knowledge in the design of signal conditioning circuit for different process variables
- To introduce about control valve sizing and section of pumps for practical applications
- To familiarize with the concepts of micro controller-based design for process applications

UNIT I FLOW AND TEMPERATURE 9

Orifice meter - design of orifice for given flow condition - design of rotameter - design of RTD measuring circuit - design of cold junction compensation circuit for thermocouple using RTD - Transmitters – zero and span adjustment in D/P transmitters and temperature transmitters.

UNIT II PRESSURE AND LEVEL 9

Bourdon gauges - factors affecting sensitivity - design of Bourdon tube -design of Air purge system for level measurement. Valves: Control valves - design of actuators and positioners - types of valve bodies -valve characteristics - materials for body and trim - sizing of control valves - selection of body materials and characteristics of control valves for typical applications.

UNIT III PUMPS 9

Types of pumps - pump performance - pipe work calculation - characteristics of different pumps - pump operation - maintenance - instruments used in pumping practice - pump noise and vibration - selection of pumps.

UNIT IV MICROCONTROLLER BASED DESIGN 9

Design of logic circuits for alarm and annunciator circuits, interlocks - design of microcontroller-based system for data acquisition - design of microprocessor-based P+I+D controller.

UNIT V DESIGN OF ELECTRONIC PID 9

Electronic P, PI. PD & P+I+D controllers - design - adjustment of setpoint, bias and controller settings.

LIST OF EXPERIMENTS 15

- Design of Instrumentation amplifier.
- Design of PID controller (using operational amplifier and microprocessor)
- Design of Control valve (sizing and flow-lift characteristics)
- Design of orifice plate and rotameter.
- Piping and Instrumentation Diagram – case study.
- Preparation of documentation of instrumentation project and project scheduling for the above case study. (Process flow sheet, instrument index sheet and instrument specifications sheet, job scheduling, installation procedures and safety regulations).

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Norman AAnderson, "Instrumentation for Process Measurements and Control", Routledge-Taylor and Francis group, 3rd Edition.
2. Gregory k McMillan, Douglas M Considine, "Process /Industrial Instruments and Controls Handbook", McGraw- Hill., 5th Edition 2009.

REFERENCE BOOKS:

1. Douglas O.J.Desa, "Instrumentation fundamentals for Process Control", CRC Press-Taylor and Francis group.
2. Bela G Liptak, Proc ess Control and Optimization-Instrument Engineers Handbook-Fourth edition,CRC Press-Taylor and Francis.
3. S K Singh, "Industrial Instrumentation and Control", McGraw Hill Education, Third edition.
4. Curtis D Johnson, Process Control Instrumentation Technology, Pearson New International Edition, Eighth edition.
5. Janardhan Prasad,M N Jayaswal,Vishnu Priye, Instrumentation and Process Control,I.K.International Publishing house Pvt. Ltd..
6. https://nptel.ac.in/courses/108105064

OUTCOMES:

On completion of this course, the students will be able to,

1. Design temperature, flow measurement system for process application.
2. Design pressure and level measurement system for process application.
3. Analyze the requirement of control system components and suggest an appropriate design procedure.

4. Design of microcontroller-based measurement and control system.
5. Laboratory hardware design of flow and pressure measurement for process applications and electronic design of PID

CO- PO, PSO MAPPING:

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

SEMESTER - VII

20EIPC701 SDG NO. 4	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the various Generations of robots and Laws of robotics
- To study about sensors and sources of robot
- To introduce the various types of manipulators and End effectors
- To study the various kinematics and inverse kinematics of robots and path planning for robot.
- To study the dynamics and Control of Manipulators of robot and their applications.

UNIT I BASIC CONCEPTS **9**

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov's laws of robotics – dynamic stabilization of robots.

UNIT II POWER SOURCES, SENSORS AND ACTUATORS 9

Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements- path determination – micro machines in robotics – machine vision – ranging- Laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT III MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION 9

Construction of manipulators – manipulator dynamics and force control –electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

UNIT IV KINEMATICS AND PATH PLANNING 9

Linear and angular velocities-Manipulator Jacobin-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance Solution kinematics problem – robot programming languages.

UNIT V DYNAMICS AND CONTROL WITH APPLICATIONS 9

Lagrangian mechanics-2-DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator. Multiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mikell P. Grover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotics –Technology, Programming and Applications, Tata Mcgraw Hill Education Private Limited, 2nd Edition Paperback, 1 July 2017.
2. Saeed B Niku, "Introduction to Robotics, Analysis, Systems, Applications", Prentice Hall, 3rd edition 2014.

REFERENCES:

1. Deb .S.R., "Robotics technology and flexible Automation", Tata Mcgraw Hill Education Private Limited, 2nd Edition Paperback, 1 July 2017.
2. Asfahl C.R., "Robots and manufacturing Automation", John Wiley, USA., Second edition, 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering - An integrated approach", Prentice Hall of India, New Delhi, 1994.
4. R.K.Mittal and I.J.Nagrath, "Robotics and Control", Tata McGraw Hill, New Delhi,4th Reprint, 2005.

5. JohnJ.Craig , "Introduction to Robotics Mechanics and Control", Third edition, Pearson Education, 2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112101099/
2. https://www.udemy.com/course/robotic-process-automation-fundamentals-and-build-a-robot
3. https://swayam.gov.in/nd1_noc20_me39/preview

ONLINE RESOURCES:

1. https://futureskillsnasscom.edcast.com/insights/2018-isaac-asimov
2. https://www.edureka.co/robotic-process-automation-training

OUTCOMES:

Upon completion of the course, the student should be able to

1. Explain the evolution of robot technology and mathematically representation of different types of robot. (K1)
2. Describe the various components required to build a robot. (K2)
3. Ability to select the various end effectors and micro grippers available to design and built a robot. (K1)
4. Solve the kinematics, trajectory planning and dynamics of robots. (K3)
5. Familiarize various control schemes of Robotics control and get exposed to the case studies and design of robot machine interface. (K2)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2	1	2	-	-	-	-	-	3	3	1
CO2	2	3	2	3	2	2	-	-	-	-	-	2	2	3
CO3	3	2	3	3	1	2	-	-	-	-	-	3	3	2
CO4	2	3	2	2	2	2	-	-	-	-	-	3	2	3
CO5	3	3	2	1	2	1	-	-	-	-	-	2	3	3

SEMESTER - VII

20HSMG601 SDG NO. 4	PRINCIPLES OF ENGINEERING MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

At the end of the course, the student is expected to

- To enable the students to study the evolution of Management,
- To impart knowledge on the functions and principles of management
- To enable students to learn the application of the principles in an organization

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Management – Science or Art – Manager Vs Entrepreneur – types of managers – Engineers as Managers. Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization – Sole proprietorship, partnership, company-public and private sector enterprises – Organization culture and Environment – Current issues and future trends in Management; Industry 4.0 – Engineering management in modern business.

UNIT II PLANNING TECNNIQUES 9

Planning, Technology Planning - Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – MBO – process - Principles and functions of engineering management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANIZING FUNCTIONS 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – department alization – delegation of authority – centralization and decentrali zation – Job Design – Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV DIRECTING AND CONTROLLING PROCEDURES 9

Foundations of individual and group behaviour – Motivation – theories and techniques–Leadership – Level 5 leadership - theories – Leadership as a determinant of Engineering management - Communication – process and

barriers – effective communication – Communication and IT - System and process of controlling – budgetary and non-budgetary control techniques.

UNIT V INNOVATION AND TECHNOLOGY MANAGEMENT 9

Innovation management of Product and Services, Role of R & D in Entrepreneurship, Breakthrough Innovation, Disruptive Innovation – Modern approaches in Engineering management – Green management, Lean management, Managing diversity. IPR – Principles of Ethics for Engineering Managers.

TOTAL: 45 PERIODS

REFERENCES:

1. Stephen P. Robbins and Mary Coulter, Management, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert Management, Pearson Education, 6th Edition, 2004.
3. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management Pearson Education, 7th Edition, 2011.
4. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
5. Harold Koontz and Heinz Weihrich Essentials of management Tata McGraw Hill,1998.
6. Tripathy PC and Reddy PN, Principles of Management, Tata McGraw Hill, 1999.

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Get a clear idea on the practical implications of the management concepts in engineering with emphasis on the need for innovation in every sphere. (K1)
2. Acquire knowledge on management functions like planning on international aspects of management. (K2)
3. Understand basic knowledge about organizing and staffing in international aspects of management. (K1)
4. Understand the concepts and principles of management viz., Directing, and Controlling in the changing business scenario. (K1)
5. Get thorough knowledge on the Efficient and Effective management of Men, Money and Technology towards developing the industrial system. (K2)

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	2	3	3	1	1	1	-	1
CO2	-	-	-	-	-	2	2	3	3	1	1	1	-	1
CO3	-	-	-	-	-	2	2	3	3	1	1	1	-	1
CO4	-	-	-	-	-	2	2	3	3	1	1	1	-	1
CO5	-	-	-	-	-	2	2	3	3	1	1	1	-	1

SEMESTER - VII

20EIPL701 SDG NO. 4, 9	INDUSTRIAL AUTOMATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To impart knowledge on architecture of PLC, SCADA and DCS.
- To introduce students on how to program using all five IEC-61131-3 programming languages
- To impart knowledge on working with industrial automation systems
- To introduce students on how to interface Field devices (Conventional/ Smart) with PLC and DCS.

LIST OF EXPERIMENTS:

1. Study of PLC field device interface modules (AI,AO,DI,DO modules)
2. Programming Logic Gates Function in PLC
3. Implementing Mathematical Operations in PLC
4. Programming Jump-to-subroutine & return operations in PLC
5. PLC Exercises: - 1. Traffic Light Control.
6. PLC Exercises: - 2. Filling/Draining Control Operation.
7. PLC Exercises: - 3. Reversal of DC Motor Direction.
8. PLC Exercises: - 4. ON/OFF Controller for Thermal Process.
9. PC based control of Level Process
10. On-line Monitoring and Control of a Pilot plant using DCS
11. PLC based Control of Flow Process
12. Study of Foundation Fieldbus /IOT/Wireless HART Enabled Transmitter

TOTAL: 45 PERIODS

LABORATORY REQUIREMENTS:

1. Programmable Logic controller - 5 Nos
2. Programmable Logic controller Software - 10 User License
3. DAQ card - 2 Nos.
4. Filling /Draining System - 1 No.
5. Traffic Light Controller - 2 Nos
6. DC Motor - 5 Nos
7. Personal computer - 10 Nos
8. DCS along with Interface modules - 1 set
9. Thermal Process, Level Process & Flow Process stations – 1 set each
10. Smart Transmitter - 1 No.

OUTCOMES:

At the end of the course, the student should be able to:

1. To understand connecting hardware modules to PLC (K1)
2. To understand and impart Programming knowledge of IEC-61131-3 programming languages (K1)
3. Acquire knowledge on working with industrial automation system (K2)
4. Design and implement control schemes in PLC & DCS. (K3)
5. Acquire knowledge on interfacing field devices with PLC & DCS (K2)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	1	-	-	-	-	-	2	3	3	2
CO2	3	3	1	3	1	-	-	-	-	-	2	3	3	2
CO3	3	3	1	3	1	-	-	-	-	-	2	3	3	2
CO4	3	3	1	3	1	-	-	-	-	-	2	3	3	2
CO5	3	3	1	3	1	-	-	-	-	-	2	3	3	2

SEMESTER - VII

20EIPJ701 SDG NO. 4, 6,7,8, 9, 11, 12, 13, 17	PROJECT PHASE - I	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students face reviews and viva voce examination.

GUIDELINES TO BE FOLLOWED:

The students may be grouped into 3 to 4 and work under a project supervisor and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor (faculty member). The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. The Project Work Phase-I will have the following Sequence:

I. Problem Identification

1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
2. List of possible solutions including alternatives and constraints
3. Cost benefit analysis
4. Time Line of activities

II. A report highlighting the design finalization [based on functional requirements and standards (if any)]

III. A presentation including the following:

1. Implementation Phase (Hardware / Software / both)
2. Testing and Validation of the developed system
3. Learning in the Project

IV. Consolidated report preparation

TOTAL: 60 PERIODS

OUTCOMES

Upon completion of the course, the students should be able to

1. Comprehend an industrial or real life problem and identify right/ real issue with solution. (K3)
2. Complete the necessary studies and review the literature, design a setup of equipment, complete the analysis. (K3)
3. Write a project report based on the findings. (K3)

CO- PO & PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - VII

20ECTP701 SDG NO. 4 & 9	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

APTITUDE REFRESHER & APTITUDE COMPANY SPECIFIC TRAINING – PHASE 1

OBJECTIVES:

- Enhance their quantitative ability.
- Enhance their reasoning ability
- Enhance their verbal ability.

UNIT I PRODUCT COMPANY SPECIFIC TRAINING – I 6 Hours

Product Specific Training for Amazon, Microsoft, IBM, ThoughtWorks, Juspay, Paypal, Mu Sigma, Zoho Corporation, VM Ware, Directi, Oracle, Wells Fargo, Goldman Sachs, Chargebee, Coda Global, Temenos, Freshworks, Adobe Systems.

UNIT II PRODUCT COMPANY SPECIFIC TRAINING – II 6 Hours

Product Specific Training for Ernst and Young, BA Continuum, Standard Chartered, AON Hewitt, Soliton Technologies, Payoda Technologies, Infoview Technologies, Athena Health Technology.

UNIT III SERVICE COMPANY SPECIFIC TRAINING - I 6 Hours

TCS, Wipro, TechMahindra, InfoView, Robert Bosch, , NTT Data, Verizon, Payoda Technologies.

UNIT IV SERVICE COMPANY SPECIFIC TRAINING - II 6 HOURS

CTS, Accenture, MindTree, MPhasis, Odessa Technologies, Vuram Technologies, Hewlett Packard, HCL.

UNIT V SERVICE COMPANY SPECIFIC TRAINING - III 6 Hours

Capgemini, Infosys, IBM, UGAM Solutions, Skava Systems, L&T Infotech, Bahwan Cybertech, Dhyan Infotech.

TOTAL : 30 PERIODS

REFERENCES

- Quantitative Aptitude for Competitive Exams by R. S. Agarwal
- Quantum CAT by Sarvesh Verma
- A Modern Approach to Logical Reasoning by R. S. Agarwal
- Verbal Ability and Reading Comprehension by Arun Sharma

HIGH END TECHNICAL & TECHNICAL COMPANY SPECIFIC TRAINING AND TENSOR FLOW - PHASE II

OBJECTIVES:

- Analyze simple algorithms and data structures.
- design of computer algorithms
- Understand the basic and advanced concept of machine learning and deep learning

UNIT I SERVICE COMPANY SPECIFIC TRAINING – I 6 Hours

TCS – Technical MCQ and Coding; Wipro – Automata Programming; TechMahindra, InfoView, RobertBosch, , NTT Data, Verizon, Payoda Technologies.

UNIT II SERVICE COMPANY SPECIFIC TRAINING – II 6 Hours

CTS – Code Debugging & Coding Section; Accenture – Pseudo code, Network Fundamentals, Basics of Computers; MindTree – Automata Coding & Technical MCQ, MPhasis – Automata Coding; Odessa Technologies, Vuram Technologies, Hewlett Packard, HCL

UNIT III SERVICE COMPANY SPECIFIC TRAINING – III 6 Hours

Capgemini – Pseudo Code & Coding, Infosys – Pseudo Code; IBM – Coding; UGAM Solutions, Skava Systems, L&T Infotech, Bahwan Cybertech, Dhyan Infotech.

UNIT IV BASICS OF TENSOR FLOW 6 HOURS

Tensors- Create a Tensor - Tensor Operations - The nn.Module -A word about Layers - Datasets and DataLoaders - Understanding Custom Datasets - Understanding Custom DataLoaders

UNIT V TRAINING A NEURAL NETWORK 6 Hours

Training a Neural Network - Loss functions - Custom Loss Function - Optimizers - Using GPU/Multiple GPUs

TOTAL : 30 PERIODS

REFERENCES

1. https://www.tensorflow.org/guide/basics
2. https://www.javatpoint.com/tensorflow-introduction

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Recognize their quantitative ability. (K2)
2. Describe the ability of arithmetic reasoning along with creative thinking and problem solving skills. (K2)
3. Describe their verbal ability through vocabulary building and grammar. (K2)
4. Realize coding languages to write programs, important algorithmic design paradigms and methods of analysis. to solve the problems. (K2)
5. Describe the fundamentals of computers and networks.(K2)

6. Explain the basics of tensor flow to train and run the deep neural networks. (K2)

CO - PO - PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO2	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO3	-	-	-	-	3	2	-	-	1	3	-	2	-	-
CO4	-	-	-	-	3	2	-	3	3	3	-	2	2	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2	2	2
CO6	-	-	-	-	3	2	-	-	2	3	-	2	2	2

SEMESTER - VIII

20EIPJ801 SDG NO. 4,6,7, 8, 9,11,12,13,17	PROJECT PHASE-II	L	T	P	C
		0	0	8	4

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students face reviews and viva voce examination.

GUIDELINES TO BE FOLLOWED:

The students may be grouped into 3 to 4 and work under a project supervisor and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor (faculty member). The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. The Project Work Phase-II will have the following Sequence:

I. Problem Identification

1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
2. List of possible solutions including alternatives and constraints
3. Cost benefit analysis
4. Time Line of activities

II. A report highlighting the design finalization [based on functional requirements and standards (if any)]

III. A presentation including the following:

1. Implementation Phase (Hardware / Software / both)
2. Testing and Validation of the developed system
3. Learning in the Project

IV. Consolidated report preparation

TOTAL: 120 PERIODS

OUTCOMES :

Upon completion of the course, the students should be able to:

1. Comprehend an industrial or real life problem and identify right/ real issue with solution. (K3)
2. Complete the necessary studies and review the literature, design a setup of equipment, complete the analysis (K3)
3. Write a project report based on the findings. (K3)

CO- PO & PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2

PROFESSIONAL ELECTIVES - I

20EIEL501 SDG NO. 4, 9	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators.
- To introduce different materials used for MEMS.
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical Engineering

UNIT I INTRODUCTION **9**

History of MEMS, Intrinsic Characteristics of MEMS, Introduction to Micro fabrication - Microelectronic fabrication process flow, Silicon based MEMS processes flow. Review of Electrical and Mechanical concepts in MEMS: Conductivity of Semiconductor devices, Stress and strain analysis, Flexural beam bending, Torsional deflection.

UNIT II MICROSYSTEM FABRICATION PROCESS **9**

Photolithography, Ion Implantation, Diffusion, Oxidation: Thermal Oxidation-Oxidation by color, Chemical Vapour Deposition, Physical Vapour Deposition, Sputtering, Etching techniques: Chemical- Plasma, Micromaching: Bulk Micromachining - Surface Micromachining, LIGA Process - Assembly of 3D MEMS - Foundry process.

UNIT III SENSORS **9**

Piezoresistive sensors - Stress analysis of mechanical elements, Piezoresistive sensor materials, Applications to Inertia, Pressure, Tactile and Flow sensors. Piezoelectric sensors and actuators - piezoelectric effects, piezoelectric materials, Applications to Inertia, Acoustic, Tactile and Flow sensors, Surface elastic waves.

UNIT IV ACTUATORS **9**

Electrostatic sensors - Parallel plate capacitors and its applications, Interdigitated Finger capacitor, Comb drive devices: Micro Grippers, Micro Motors. Thermal Sensing and Actuation based on thermal expansion - Thermal couples, Thermal resistors, Thermal Bimorph and its applications

Case studies of actuation using Shape Memory Alloys. Magnetic Actuators - fabrication of Micromagnetic components, Case studies of MEMS in magnetic actuators.

UNIT V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS - Polimide - SU - 8 - Liquid Crystal Polymer (LCP) - PDMS - PMMA - Parylene - Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors. Optical MEMS - Lenses and Mirrors, actuators for Active Optical MEMS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2012.
2. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.

REFERENCES:

1. Tai Ran Hsu "MEMS and Microsystems Design: Manufacture and Nano Scale Engineering", John Wiely & Sons, INC., 2nd Edition, 2008.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2001.
3. Nadim Maluf, "An Introduction to Micro Electro Mechanical System design", Artech House, 2000.
4. B.S.Sonde, "System Design using Integrated Circuits", 2ndEdition, New Age Pub, 2001.
5. G Timp, "Nanotechnology", AIP press/Springer, 1999.
6. William N John Dinardo, "Nanoscale characterization of surfaces & Interfaces", Second edition, Weinheim Cambridge, Wiley-VCH, 2000.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117105082/
2. https://www.mooc-list.com/tags/mems
3. https://swayam.gov.in/nd1_noc20_ee52/preview

ONLINE RESOURCES:

1. https://www.edx.org/course/micro-and-nanofabrication-mems
2. https://www.coursera.org/lecture/sensor-manufacturing-process-control/2-mems-construction-0tHJV

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the operation of micro devices, micro systems and their applications. (K1)
2. Design the micro devices, micro systems using the MEMS fabrication process. (K4)
3. Understand different fabrication processes. (K1)
4. Understand different polymers used for MEMS and its application. (K1)
5. Understand different optical MEMS and its applications. (K1)

CO- PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - I

20ICEL501 SDG NO. 4, 9	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of virtual instrumentation
- To develop basic VI programs using loops, case structures etc
- To understand the basics of Data Acquisition
- To design VI programs for applications in image, signal processing and motion control
- To analyze the case studies with the VI environment

UNIT I INTRODUCTION TO VIRTUAL INSTRUMENTATION 9

Historical perspective, Virtual instrumentation (VI) – Definition, flexibility – Block diagram and Architecture of Virtual Instruments , Virtual instruments versus traditional instruments , System buses, Interface buses: PCMCIA, VXI, SCXl, PXI, etc.

UNIT II DATA-FLOW TECHNIQUES 9

Graphical programming in data flow, Comparison with conventional progra mming, Software in virtual instrumentation - VI programming techniques – VIS & Sub VIS, loops and charts, arrays, clusters, graphs, case and sequence structures, formula nodes, local and global variable, string and file functions

UNIT III DATA ACQUISITION BASICS 9

DAQ cards for VI applications – DAQ modules with serial communi cation. ADC, DAC, DIO, Counters and timers, RS232C/ RS485, GPIB, PC Hardware structure, DMA software and hardware installation.

UNIT IV USE OF ANALYSIS TOOL 9

Advanced analysis tools such as Fourier transforms, Power spectrum, Correlation methods, Windowing and filtering and their applications in signal and image processing, Motion Control.

UNIT V CASE STUDIES 9

Components of Lab VIEW, Celsius to Fahrenheit conversion, Debugging, Sub-VI, Multi plot charts, Case structures, ASCII files, Function Generator, Property Node, Formula node, Shift registers, Array, Strings, Clusters, DC voltage measurement using DAQ.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jovitha, Jerome., "Virtual Instrumentation using LabVIEW", PHI Learning. 2010.
2. Johnson, G., "LabVIEW Graphical Programming", McGraw Hill 2006.

REFERENCES:

1. Gupta, S. and Gupta, J.P., "PC Interfacing for Data Acquisition and Process Control", Instrument Society of America (1988).
2. Lisa K Well, "Labview for Everyone", Prentice Hall of India.
3. Sokoloft, L., "Basic Concepts of LabVIEW 4", Prentice Hall Inc. (2004).
4. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996).

WEB REFERENCES:

1. https://www.ni.com

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Demonstrate the working of LabVIEW.(K4)
2. Explain the various types of structures used in LabVIEW. (K2)
3. Analyze and design different type of programs based on data acquisition.(K3, K4)
4. Demonstrate the use of LabVIEW for signal processing, image processing etc (K4)
5. Design and develop programs for different case studies (K4)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	2	-	-	-	-	1	2	2	2
CO2	3	2	2	1	2	1	-	-	-	-	1	3	2	3
CO3	3	2	3	2	3	2	-	-	-	-	2	2	2	3
CO4	3	3	2	3	3	2	-	-	-	-	2	3	3	3
CO5	3	2	3	3	2	2	-	-	-	-	1	3	3	3

PROFESSIONAL ELECTIVES - I

20ICEL502 SDG NO. 4, 9	ADVANCED CONTROL SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis
- To give basic knowledge in describing function analysis
- To study the design of an optimal controller
- To study the design of optimal estimator including Kalman Filter

UNIT I STATE VARIABLE ANALYSIS **9**

Introduction- concepts of state variables and state model-State model for linear continuous time systems, Diagonalisation- solution of state equations-Concepts of controllability and observability.

UNIT II STATE VARIABLE DESIGN 9

Introduction to state model: Effect of state feedback - Pole placement design: Necessary and sufficient condition for arbitrary pole placement, State regulator design of state observers-Separation principle- Design of servo systems: State feedback with integral control.

UNIT III PHASE PLANE ANALYSIS 9

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method-Delta method.

UNIT IV DESCRIBING FUNCTION ANALYSIS 9

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

UNIT V OPTIMAL CONTROL 9

Introduction: Classical control and optimization, formulation of optimal control problem, Typical optimal control performance measures - Optimal state regulator design: Lyapunov equation, Matrix Riccati equation - LQR steady state optimal control – Application examples.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2nd edition, 2008.
2. G. J. Thaler, " Automatic Control Systems", Jaico Publishing House, 2nd edition, 2006.
3. M.Gopal, "Modern Control System Theory",Wiley publications, 2002.

REFERENCES:

1. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
2. Ashish Tewari, "Modern Control Design with Matlab and Simulink", John Wiley, New Delhi, 2002.
3. K. Ogata, "Modern Control Engineering", 4th Edition, PHI, New Delhi, 2002.
4. T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002.
5. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2003

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_ee45/preview
2. https://nptel.ac.in/courses/108107115/
3. https://swayam.gov.in/nd1_noc20_ee54/preview
4. https://www.electrical4u.com/different-types-non-linearities-in-control-system/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3488/advanced-control-systems
2. https://freevideolectures.com/course/3081/optimal-control

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Design a state feedback controller and state observer.(K4)
2. Understand and analyse linear and nonlinear systems using phase plane method.(K1, K2)
3. Understand and analyse nonlinear systems using describing function method. (K1,K2)
4. Understand and design optimal controller.(K1,K4)
5. Apply advanced control strategies to practical engineering problems. (K3)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	2	2	2	2	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	2	2
CO3	3	3	2	3	3	-	-	-	-	2	1	2	2	1
CO4	3	3	2	3	2	-	-	-	-	3	3	2	2	1
CO5	3	3	3	3	2	-	-	-	-	3	2	2	2	1

PROFESSIONAL ELECTIVES - I

20EI EL503 SDG NO. 4,	ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the basics of EMI and EMC
- To instill knowledge on the EMI coupling mechanism and its mitigation techniques.
- To impart comprehensive insight about the current EMC standards and about various measurement techniques
- To gain knowledge in various test methods and Instrumentation in EMI
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues

UNIT I BASIC CONCEPTS **9**

Definition of EMI and EMC; Intra and Inter system EMI; Sources and victims of EMI, Conducted and Radiated EMI emission and susceptibility; Transient & ESD; Case Histories; Radiation Hazards to humans.

UNIT II COUPLING MECHANISM **9**

Common made coupling; Differential mode coupling; Common impedance coupling; Ground loop coupling; Field to cable coupling; Cable to cable coupling; Power mains and Power supply coupling.

UNIT III EMI MITIGATION TECHNIQUES **9**

Shielding – principle, choice of materials for H, E and free space fields, and thickness; EMI gaskets; Bonding; Grounding – circuits, system and cable grounding; Filtering; Transient EMI control devices and applications; PCB Zoning, Component selection, mounting, trace routing.

UNIT IV STANDARDS AND REGULATION **9**

Units of EMI; National and International EMI Standardizing Organizations – IEC, ANSI, FCC, CISPR, BIS, CENELEC; FCC standards; EN Emission and Susceptibility standards and specifications; MIL461E Standards.

UNIT V TEST METHODS AND INSTRUMENTATION 9

EMI test sites - Open area site; TEM cell; Shielded chamber; Shielded Anechoic chamber; EMI test receivers; Spectrum Analyzer; Transient EMI Test wave Simulators; EMI coupling Networks - Line impedance Stabilization Networks; Feed through capacitors; Antennas and factors; Current probes and calibration factor; MIL-STD test methods; Civilian STD Test methods, Government policies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. V.P. Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, Newyork, 2nd Edition, 2010.
2. Henry W.Ott., "Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 2nd Edition, 2009.

REFERENCES:

1. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V,1988.
2. Bemhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, Norwood, 3rd Edition,1987.
3. C.R.Paul, "Introduction to Electromagnetic Compatibility", John Wiley& Sons Inc. 2nd edition, 2005.
4. DraganPoljak, "Advanced Modeling in Computational Electromagnetic Compatibility", John Wiley &Sons., 2nd edition, March 2007.
5. Dipak L. Sengupta and Valdis V. Liepa,"Applied Electromagnetics and Electromagnetic Compatibility", John Wiley & Sons, November 2005.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/106/108106138/

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=YtY4QpOyNk8
2. https://www.youtube.com/watch?v=LNLytTPkmEQ
3. https://www.youtube.com/watch?v=AHbrVad86xw

OUTCOMES:

Upon completion of the course, the student should be able to

1. Illustrate the various sources of EMI and the impact of radiation hazards..(K3)
2. Elucidate various schemes of coupling mechanisms. (K2)

3. Explain the various EMI mitigation techniques. (K2)
4. Describe the National and International EMI standards and specifications. (K2)
5. Describe the working of different types of EMI Testers and analyzers in adherence to Government policies. (K2)

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	1	-	-	-	-	-	-	1	1
CO2	2	1	1	-	-	1	-	-	-	-	-	-	2	1
CO3	2	1	1	-	-	1	-	-	-	-	-	-	2	1
CO4	2	1	1	-	-	1	-	-	-	-	-	-	2	2
CO5	2	2	1	-	-	1	-	-	-	-	-	-	2	3

PROFESSIONAL ELECTIVES - I

20EIEL504 SDG NO. 4,9	SMART AND WIRELESS INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose to the basics of sensors used in industries
- To provide adequate knowledge on smart instrumentation and wireless sensor networks
- To impart knowledge on various standard protocols used in wireless instrumentation
- To apply the knowledge of sensors, transceivers, controllers and power supplies to implement a WSN for a required application

UNIT I INDUSTRIAL SENSORS 9

Sensor Classification-Thermal sensors -Humidity sensors -Capacitive Sensors-Planar Inter digital Sensors-Planar Electromagnetic Sensors-Light Sensing Technology-Moisture Sensing Technology- Carbon Dioxide (CO2) sensing technology-Sensors Parameters

UNIT II WIRELESS COMMUNICATION **9**

Frequency of Wireless communication -Development of Wireless Sensor Network based Project- Wireless sensor based on microcontroller and communication device-Zigbee Communication device.

UNIT III POWER SOURCES **9**

Power sources- Energy Harvesting –Solar and Lead acid batteries-RF Energy /Harvesting-Energy Harvesting from Vibration-Thermal Energy Harvesting-Energy Management Techniques-Calculation for Battery Selection

UNIT IV DATA TRANSMISSION **9**

Brief description of API mode data Transmission-Testing the communication between coordinator and remote XBee- Design and development of graphical user interface for receiving sensor data using C++; A brief review of signal processing techniques for structural health monitoring.

UNIT V WIRELESS SENSOR NETWORK **9**

WSN based physiological parameters monitoring system- Intelligent sensing system for emotion recognition-WSN based smart power monitoring system. Digital light processor (DLP)

TOTAL PERIODS:45

TEXT BOOKS:

1. Subhas Chandra Mukhopadhyay, "Smart Sensors, Measurement and Instrumentation", Springer Heidelberg, New York, Dordrecht London, 2013.
2. Halit Eren, "Wireless Sensors and Instruments: Networks, Design and Applications", CRC Press, Taylor and Francis Group, 2006.

REFERENCES:

1. Uvais Qidwai, "Smart Instrumentation: A data flow approach to Interfacing", Chapman & Hall, 1st Edition, 2013.

OUTCOMES:

On completion of this course, the students will be able to,

1. Understand about smart instrumentation system (K1)
2. Acquire knowledge on ZigBee transceivers (K2)
3. Design self-diagnosing instrumentation system (K4)
4. Identify the issues in power efficient systems and implement energy management techniques in WSN (K3)
5. Design wireless instrumentation systems for the given requirement(K4)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	2	-	-	-	-	1	2	2	2
CO2	3	2	2	1	2	1	-	-	-	-	1	3	2	3
CO3	3	2	3	2	3	2	-	-	-	-	2	2	2	3
CO4	3	3	2	3	3	2	-	-	-	-	2	3	3	3
CO5	3	2	3	3	2	2	-	-	-	-	1	3	3	3
CO6	3	2	3	3	2	2	-	-	-	-	1	3	3	3

PROFESSIONAL ELECTIVES - I

20ICEL504 SDG NO. 4,9	CONTROL SYSTEM COMPONENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to various electrical components used in industrial control systems.
- To expose the students to various mechanical components used in industrial control systems
- To teach various mechanical and pneumatic systems used in industrial control systems.
- To introduce the concept of hydraulic pumps, actuators and valves.

UNIT I MOTORS **9**

Motors: Types, working principle, characteristic, and mathematical model of following: Motors AC/DC motors, Brushless DC motor, stepper, servo, linear, Synchronous, Generators, and Alternator

UNIT II SWITCHES AND RELAYS **9**

Types, working principle, characteristics, and symbolic representation of following: Switches: Toggle, Slide, DIP, Rotary, Thumbwheel, Selector, Limit, Proximity, Combinational switches, zero speed, belt sway, pull cord. Relays: Electromechanical, Solid state relays, relay packages. Contactors: Comparison between relay & contactor, contactor size and ratings. Timers: On Delay, off delay and Retentive.

UNIT III SEQUENCING AND INTERLOCKING FOR MOTORS 12

Sequencing & Interlocking for motors: Concept of sequencing & Interlocking, Standard symbols used for Electrical Wiring Diagram, Electrical Wiring diagrams for Starting, Stopping, Emergency shutdown, (Direct on line, star delta, soft starter) Protection devices for motors: Short circuit protection, Overload Protection, Over/ under voltage protection, Phase reversal Protection, high temperature and high current Protection, over speed, Reversing direction of rotation, Braking, Starting with variable speeds, Jogging/Inching Motor Control Center: Concept and wiring diagrams

UNIT IV PNEUMATIC COMPONENTS 9

Pneumatic components: Pneumatic Power Supply and its components: Pneumatic relay (Bleed & Non- bleed, Reverse & direct), Single acting & Double acting cylinder, Special cylinders: Cushion, Double rod, Tandem, Multiple position, Rotary Filter Regulator Lubricator (FRL), Pneumatic valves (direction controlled valves, flow control etc), Special types of valves like relief valve, pressure reducing etc.

UNIT V HYDRAULIC COMPONENTS 6

Hydraulic components: Hydraulic supply, Hydraulic pumps, Actuators (cylinder & motor), Hydraulic valves

TOTAL PERIODS:45

TEXT BOOKS:

1. M. D. Desai, "Control System Components", PHI, 2008.
2. J. E. Gibson and F. B. Tuteur, "Control system components", McGraw Hill, 2013
3. S. R. Majumdhar, "Pneumatic Systems", Tata McGraw-Hill Publisher, 2009.

REFERENCES:

1. Meixner H and Sauer E, "Introduction to Electro-Pneumatics", Festo didactic, 1st Edition, 1989.
2. Hasebrink J P and Kobler R, "Fundamentals of Pneumatic Control Engineering", FestoDidactic: Esslinger (W Germany), 1989.
3. Petruzella, "Industrial Electronics", McGraw-Hill International 1st Edition, 1996.

OUTCOMES:

At the end of the course the student will be able to:

1. Understand the basics of control system used in automobiles (K1)

2. Recognize the electronically controlled system used in driving mechanics. (K2)
3. Understand the working principle of driver modelling and power train control systems. (K1)
4. Identify the control system used in hybrid and electrical vehicles. (K2)
5. Illustrate the need of automated transport systems. (K4)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	2	-	-	-	-	1	2	2	2
CO2	3	2	2	1	2	1	-	-	-	-	1	3	2	3
CO3	3	2	3	2	3	2	-	-	-	-	2	2	2	3
CO4	3	3	2	3	3	2	-	-	-	-	2	3	3	3
CO5	3	2	3	3	2	2	-	-	-	-	1	3	3	3

PROFESSIONAL ELECTIVES - I

20EIEL503 SDG NO. 4,9	SPECIAL MACHINES AND CONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Construction, principle of operation, control and performance of stepper motor and switched reluctance motors
- To understand the Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors and permanent magnet synchronous motors
- To understand the Construction, principle of operation and performance of other special machines

UNIT I STEPPER MOTORS **9**

Constructional features –Principle of operation –Types – Torque predictions – Linear Analysis – Characteristics – Drive circuits – Closed loop control – Concept of lead angle - Applications.

UNIT II SWITCHED RELUCTANCE MOTORS(SRM) 9

Constructional features –Principle of operation- Torque prediction– Characteristics Steady state performance – Analytical Method – Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.

UNIT III PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations- Power Converter Circuits and their controllers - Characteristics and control- Applications.

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) 9

Constructional features -Principle of operation – EMF and Torque equations - Sine wave motor with practical windings - Phasor diagram - Power controllers – performance characteristics -Digital controllers – Applications.

UNIT V SYNCHRONOUS RELUCTANCE MOTOR AND SPECIAL MACHINES 9

Constructional features – Principle of operation and Characteristics of Synchronous Reluctance Motor – Torque equation - Hysteresis motor-–Linear Induction Motor-Repulsion motor- Applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. T. Kenjo, “Stepping Motors and Their Microprocessor Controls”, Clarendon Press London,2nd edition, 1995
2. T.J.E.Miller, “Brushless Permanent-Magnet and Reluctance Motor Drives”, Oxford University Press, 1989.

REFERENCE BOOKS:

1. R.Krishnan, “Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application”, CRC Press, 2017.
2. T. Kenjo and S. Nagamori, “Permanent Magnet and Brushless DC Motors”, Clarendon Press, London,1988.
3. E.G. Janardanan, “Special Electrical Machines”, PHI learning Private Limited, Delhi, 2014.
4. K.Venkataratnam, “Special Electrical Machines”, Universities Press (India) Private Limited,2008.

WEB REFERENCES:

1. https://www.designworldonline.com/stepper-motor-basics/
2. https://www.electronicshub.org/brushless-dc-motor-bldc-motor/

ONLINE RESOURCES:

1. https://www.electrical4u.com/brushless-dc-motors/
2. https://freevideolectures.com/course/3114/advanced-electric-drives/

COURSE OUTCOMES:

Upon completion of the course, the student should be able to

1. Describe the construction and operation of different types of stepper motors. (K2)
2. Acquire knowledge in construction and operation of switched reluctance motor. (K1)
3. Acquire knowledge in construction and operation of permanent magnet DC motors. (K1)
4. Acquire Knowledge in construction and operation of permanent magnet brushless A.C. motors and permanent magnet synchronous motors.(K1)
5. Select a special machine for particular applications.(K3)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	-	1	3	2
CO2	3	3	2	-	-	-	-	-	-	-	-	1	3	2
CO3	3	3	2	-	-	-	-	-	-	-	-	1	3	2
CO4	3	3	2	-	-	-	-	-	-	-	-	1	3	2
CO5	3	3	2	-	-	-	-	-	-	-	-	1	3	2

PROFESSIONAL ELECTIVES - I

20ICEL505 SDG NO. 4,9	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose students to understand the basics of Metrology
- To familiarize about linear and angular measurements with respect to metrology
- To introduce form measurement with respect to metrology
- To discuss the advances in metrology along with advanced measurement techniques

UNIT I BASICS OF METROLOGY **9**

Introduction to Metrology — Need — Elements — Work piece, Instruments — Persons — Environment — their effect on Precision and Accuracy — Errors — Errors in Measurements — Types — Control — Types of standards.

UNIT II LINEAR AND ANGULAR MEASUREMENTS **9**

Linear Measuring Instruments — Evolution — Types — Classification — Limit gauges — gauge design — terminology — procedure — concepts of interchangeability and selective assembly — Angular measuring instruments — Types — Bevel protractor clinometers angle gauges, spirit levels sine bar — Angle alignment telescope — Autocollimator — Applications.

UNIT III ADVANCES IN METROLOGY **9**

Basic concept of lasers Advantages of lasers — laser Interferometers — types — DC and AC Lasers interferometer — Applications — Straightness — Alignment. Basic concept of CMM — Types of CMM — Constructional features — Probes — Accessories — Software — Applications — Basic concepts of Machine Vision System — Element — Applications.

UNIT IV FORM MEASUREMENT **9**

Principles and Methods of straightness — Flatness measurement — Thread measurement, gear measurement, surface finish measurement, Roundness measurement — Applications.

UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE **9**

Force, torque, power — mechanical , Pneumatic, Hydraulic and Electrical type.

Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube — Temperature: bimetallic strip, thermocouples, electrical resistance thermometer — Reliability and Calibration — Readability and Reliability.

TOTAL PERIODS:45

TEXT BOOKS:

1. N. V. Raghavendra ,L.Krishnamurthy, "Engineering Metrology and Measurements", OUP India,2013.
2. R. Venkat Reddy, "Basics in Metrology and Measurements", Invincible Publishers,2021.

REFERENCE BOOKS:

1. James R Holto, Gregory J Hakim, "An Introduction to Dynamic Meteorology", Academic Press,
2. A.K. Sawhney and PuneetSawhney, "Mechanical Measurements and Instrumentation and Control", DhanpatRai& Co. (P) Limited, 2015.
3. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
4. Jain R.K., "Engineering Metrology", Khanna Publishers, 2009.
5. Anand K Bewoor,Vinay A Kulkarni, "Metrology and Measurement", Tata McGraw-Hi;; Education private limited.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc21_ch26/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Describe the basics of metrology,error and standards (K2)
2. Explain the principle of linear and angular measuring instruments and apply the acquired knowledge for the accurate and precise measurement of a given quantity (K2)
3. Illustrate the advanced measuring instruments and machine tool metrology and to describe application of principle of metrology and measurements in industries (K3)
4. Understand the fundamentals of various methods for the measurements of screw threads, surface roughness parameters and its applications (K1)
5. Explain the working of devices for measuring power,flow and temperature. (K2)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	2	2	-	-	-	-	-	3	2	2
CO2	3	2	2	1	2	2	-	-	-	-	-	2	2	2
CO3	3	2	3	2	2	1	-	-	-	-	-	3	3	2
CO4	3	2	2	2	2	1	-	-	-	-	-	2	2	3
CO5	3	2	2	2	2	2	-	-	-	-	-	2	3	2

PROFESSIONAL ELECTIVES - I

20ESCS501 SDG NO. 4,9	COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To identify the functional units in a digital computer system.
- To distinguish between the various ISA styles.
- To trace the execution sequence of an instruction through the processor.
- To evaluate different computer systems based on performance metrics.
- To understand the fundamentals of memory and I/O systems and their interface with the processor.

UNIT I FUNDAMENTALS OF COMPUTER SYSTEMS 9

Functional Units of a Digital Computer – Operation and Operands of Computer Hardware –Software Interface – Translation from a High Level Language to Machine Language – Instruction Set Architecture – RISC and CISC Architectures – Addressing Modes –Performance Metrics – Power Law – Amdahl's Law.

UNIT II ARITHMETIC FOR COMPUTERS 9

Addition and Subtraction – Fast Adders – Multiplication: Booths Algorithm, Bit Pair Recoding – Division: Restoring and Non-Restoring – Floating Point Numbers: Single and Double Precision – Arithmetic Operations – ALU Design.

UNIT III PROCESSOR **9**

Design Convention of a Processor – Building a Datapath and designing a Control Unit – Execution of a Complete Instruction – Hardwired and Micro programmed Control –Instruction Level Parallelism – Basic Concepts of Pipelining – Pipelined Implementation of Datapath and Control Unit – Hazards – Structural, Data and Control Hazards.

UNIT IV MEMORY AND I/O **9**

Types of Memories – Need for a hierarchical memory system – Cache memories– Memory Mapping – Improving Cache Performance – Virtual Memory – Memory Management Techniques – Accessing I/O devices – Programmed Input/output – Interrupts – Direct Memory Access.

UNIT V PARALLEL PROCESSING **9**

Exploitation of more ILP – Dynamic Scheduling: Tomasulo's Algorithm – Introduction to Multicore – Graphics Processing Units – Overview of Next Generation Processors.

TOTAL:45 PERIODS

TEXT BOOKS:

1. David A. Patterson, John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Fifth Edition, Morgan Kaufmann/ Elsevier, 2013.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. William Stallings, "Computer Organization and Architecture – Designing for Performance", Tenth Edition, Pearson Education, 2016.
2. John L. Hennessey, David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier Publishers, Fourth Edition, 2007.
3. V.P. Heuring, H.F. Jordan, "Computer Systems Design and Architecture", Second Edition, Pearson Education, 2004.
4. Behrooz Parhami, "Computer Architecture", Oxford University Press, 2007.
5. Douglas E. Comer, "Essentials of Computer Architecture", Sixth Edition, Pearson Education, 2012.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106147

OUTCOMES:

On completion of the course, the students will be able to:

1 Interpret assembly language instructions. (K2)
2 Design and analyze ALU circuits. (K4)
3 Implement a control unit as per the functional specification. (K2)
4 Design and analyze memory, I/O devices and cache structures for processor. (K4)
5 Evaluate the performance of computer systems. (K4)
6 Point out the hazards present in a pipeline and suggest remedies. (K2)

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	3	2	2	1	2	1	-	1	3	2
CO2	3	3	2	-	-	-	1	-	-	-	-	-	2	1
CO3	3	3	2	-	1	-	1	1	-	1	-	1	3	1
CO4	3	3	2	-	-	-	1	1	-	1	-	-	2	2
CO5	3	3	2	-	1	-	2	2	-	1	-	1	3	2

PROFESSIONAL ELECTIVES - I

20EIEL505 SDG NO. 4,8	TELEMETRY AND REMOTE CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the need for telemetry and concepts of information transfer
- To study various modulation codes and techniques
- To study various multiplexing techniques for telemetry
- To introduce telemetry for satellite applications
- To introduce telemetry for fiber optic applications

UNIT I BASICS OF TELEMETRY **9**

Purpose of telemetry, basic scheme, voltage, current and frequency telemetry, Concepts of information transfer- BCD, ASCII, BAUDOT, Manchaster, Hamming.

UNIT II MODULATION CODES AND TECHNIQUES **9**

Modulation codes: PAM, PFM, PTM, PCM, Review of modulation and multiplexing: FM-AM, FM-FM, PAM-FM, PAM-AM, PCM-AM. Quantization and conversion methods

UNIT III MULTIPLEXING TECHNIQUES FOR TELEMETRY **9**

FDM systems, FDM Telemetry, Quadrature FM and PLL TDM systems (architecture)- TDM, PAM, PAM-PM, TDM-PCM PCM generation, reception and detection

UNIT IV SATELLITE TELEMETRY **9**

Satellite telemetry, TT and C services, subsystems, The earth station, Need for Multiple access, Concept of TDMA, FDMA and CDMA

UNIT V FIBER OPTIC TELEMETRY **9**

Fiber optic telemetry, Fiber as transmission medium, Interconnections, Repeaters, Sources, Detectors, WDM Remote control: Case study for a typical industrial situation

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Prithvish Nag, M. Kudrat, "Digital Remote Sensing", Concept Publishing Company, 1998.
2. Gunther Swoboda, "Telecontrol: Methods and Applications of Telemetering and Remote Control", Van Nostrand-Reinhold, 1971

REFERENCES:

1. Stiltz Harry L, "Aerospace Telemetry"-Vol I and II, McGraw Hill Edu, 2013.
2. Patranabis, D, "Telemetry principles", Tata McGraw Hill, 2004
3. Brig N. Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
4. Emanuel Fthenakis, "Manual of Satellite Communications", McGraw Hill Book Co., 1984
4. Sawhney A.K, "Electronic Instruments and Measurements",Dhanpat Rai, 2012.
5. Gruenberg E.L., "Handbook of Telemetry and Remote Control", 1967

WEB REFERENCES:

1. https://www.electronics-tutorials.ws/
2. https://nptel.ac.in/content/storage2/courses/117101105/downloads/L2.pdf

ONLINE RESOURCES:

1. https://www.usna.edu/ECE/ee426/Reading/Telemetry_WSN_Comms_Supp.pdfhttps://nptel.ac.in/courses/108/105/108105132/
2. https://apps.dtic.mil/sti/pdfs/AD1038198.pdf

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Study the basics of telemetry and information coding (K1)
2. Study about various modulation and multiplexing techniques (K1)
3. Apply telemetry and remote sensing for satellite applications. (K4)
4. Apply telemetry and remote sensing for fiber optic applications (K4)
5. Analyze telemetry and remote sensing concept for real time industrial situation.(K3)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	-	-	-	-	-	1	-	2	2	3
CO2	3	1	1	1	-	-	-	-	-	1	-	2	2	3
CO3	2	2	2	1	-	2	-	-	-	-	2	2	2	3
CO4	2	2	2	1	-	2	-	-	-	-	2	2	2	3
CO5	2	3	3	3	2	2	-	-	-	-	3	3	3	3

PROFESSIONAL ELECTIVES - I

20MGEL501 SDG NO. 4,89,12	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get an introductory insight about the IPR in national and international context
- To understand the procedures for IPR, registration and its enforcement

UNIT I INTRODUCTION **9**

Intellectual property: Introduction, Meaning, Nature and significance types of intellectual property, importance of intellectual property rights, Protection of human innovations by IPR such as Patents, Trademarks, Copyright, Industrial Designs Geographical Indications, and Trade Secrets

UNIT II AGREEMENTS AND TREATIES **9**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, General agreement on trade and tariff (GATT), Ben convention, Rome convention ,Role of WTO and WIPO

UNIT III PATENTS **9**

Concept of Patent – Historical view of Patent system in India and International Scenario, patent searching process, ownership rights and transfer, compulsory licenses, Procedure for filing of patents, Grants of patent , Benchmarks for patentability of inventions, Recent key changes and development.

UNIT IV TRADEMARKS AND COPYRIGHTS **9**

Concept of Trademarks and copyrights – Rationale behind the protection-Purpose, function and acquisition, ownership issues, Procedure for Registration, Industrial design and integrated circuits, protection of geographical indications and plant varieties, Recent Trends in copyrights and Trademark., Trade secrets -liability for misappropriations of trade secrets

UNIT V LEGAL ASPECTS AND NEW DEVELOPMENTS **9**

Infringements of patents– Criteria of Infringement – Modes of Infringement-remedies and modification Protection against unfair competition, enforcement of intellectual property rights, Intellectual property audits, New developments of intellectual property, Impact of international instruments

relating to the protection of intellectual properties Future of IPR in National and International levels.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.V. Satarkar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.
2. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
3. P.Narayanan, Intellectual property rights Eastern law house-2018 3rd Edition (revised and updated)
4. Deborah, E. Bouchoux, Intellectual property right, Cengage learning-2018 5th Edition

REFERENCES

1. Sterling, J. L. A., World copyright law, (2008) 3rd Edition, London, Sweet & Maxwell
2. GP Reddy, Intellectual property rights & other laws, Gogia law agency
3. Barrett, Margreth, Intellectual Property, (2009) 3rd Edition, New York Aspen publishers
4. Inventing the Future: An introduction to Patents for small and medium sized Enterprises; WIPO publication
5. Cornish, William Intellectual Property: Patents, Copyright, Trademarks and allied rights, (2010) 7th Edition, London Sweet & Maxwell.
6. Kankanala and Kalyan.C : Indian Patent Law and Practice (2010), India, Oxford University Press

WEB RESOURCES:

1. https://www.wipo.int/edocs/lexdocs/laws/en/ws/ws020en.pdf
2. http://caaa.in/Image/34_Hb_on_IPR.pdf
3. http://www.ipindia.nic.in/patents.htm
4. http://www.ipindia.nic.in/trade-marks.htm
5. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627956/IP-Rights-in-India.pdf
6. https://economictimes.indiatimes.com/small-biz/resources/startup-handbook/intellectual-property-rights- registration/articleshow/59126802.cms?from=mdr

ONLINE RESOURCES:

1. https://www.coursera.org/learn/introduction-intellectual-property
2. https://www.edx.org/course/intellectual-property-law-and-policy-part-1
3. https://www.classcentral.com/tag/intellectual-property
4. https://swayam.gov.in/nd1_noc19_mg58/preview

OUTCOMES:

Upon completion of the course, the students will be able to:

1 Describe the concepts of Intellectual property rights. (K2)
2 Explain the agreements and treaties of Intellectual property rights. (K2)
3 Identify the needs and avenues for patents. (K2)
4 Discuss the necessity of Trade marks and Copy rights. (K2)
5 Explain the legal context and developments of Intellectual property rights. (K2)

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	-	1	1	1	1	1	-	-	1
CO2	3	1	3	1	2	-	1	1	-	-	-	1
CO3	1	1	2	2	2	-	1	1	-	-	-	1
CO4	2	1	1	2	2	-	1	1	-	-	-	1
CO5	1	1	1	2	2	2	1	1	-	-	-	1

PROFESSIONAL ELECTIVES - II

20ICEL601 SDG NO. 4, 9	POWER PLANT INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students familiarize about various power generation methods.
- To identify various parameters in thermal power plant
- To impart knowledge about the different types of Combustion controls
- To understand about the different types of Boiler control and its loops.
- To familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines and their control.

UNIT I POWER GENERATION METHODS **9**

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

UNIT II MEASUREMENTS IN POWER PLANTS **9**

Electrical measurements: current, voltage, power, frequency, power factor – non electrical parameters: flow of feed water, fuel, air, steam pressure and steam temperature – smoke density measurement – Flue gas oxygen analyzer – pollution monitoring instruments.

UNIT III FURNACE CONTROL **9**

Furnace Draught: natural draught, forced draught, induced draught, power requirements for draught systems - Combustion control: Fuel/Air ratio, combustion efficiency, excess air, parallel and cross limited combustion control- soot-blowing operation.

UNIT IV BOILER CONTROL **9**

Boiler feed water processing and control - drum level measurement methods - steam temperature control: main steam and reheat steam temperature control, superheater control, deaerator control – distributed control system in power plants – interlocks in boiler operation.

UNIT V TURBINE CONTROL **9**

Speed measurement, rotor and casing movement- vibration - shell

temperature monitoring and control - steam pressure control - lubricant oil temperature - cooling system.

TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

1. Liptak B.G., "Instrumentation in Process Industries", Chilton Book Company, 2005
2. Tamilmani P, "Power plant instrumentation", Sams Publishers, 2011.
3. P.K. Nag, "Power plant Engineering", Tata McGraw-Hill Education, 3rd edition, 2007
4. Elonka.S.M. and Kohal A.L., "Standard Boiler Operations", McGraw-Hill, New Delhi, 1994.
5. Jain R.K., "Mechanical and industrial Measurements", Khanna Publishers, New Delhi, 2008.
6. https://nptel.ac.in/courses/112107291/

WEB REFERENCES:

1. https://www.electrical4u.com/thermal-power-generation-plant-or-thermal-power-station/
2. https://www.oreilly.com/library/view/power-plant-instrumentation/9780128009406/
3. https://www.sciencedirect.com/book/9780128009406/power-plant-instrumentation-and-control-handbook
4. https://www.elsevier.com/books/power-plant-instrumentation-and-control-handbook/basu/978-0-08-102804-9

ONLINE RESOURCES:

1. https://swayam.gov.in/nd1_noc20_me10/preview

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Familiarize about various power generation methods (K1)
2. Identify various parameters in thermal power plant (K1)

3. Impart knowledge about the different types of controls and control loops (K3)
4. Familiarize the student with the methods of monitoring and control different parameters like main steam, reheat steam temperature and steam pressure control (K1)
5. Understand about turbine control techniques (K1)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	2	2	-	-	-	1	2	2	3
CO2	2	2	2	2	2	2	3	-	-	-	1	2	2	3
CO3	2	2	3	3	3	2	3	-	-	-	1	2	2	3
CO4	2	2	3	3	3	2	3	-	-	-	1	3	2	3
CO5	2	2	3	3	3	2	3	-	-	-	1	3	2	3

PROFESSIONAL ELECTIVES - II

20ICPC602 SDG NO. 4,9	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering.
- To study the communication mechanics in a biomedical system with few examples.
- To study measurement of certain important electrical and non-electrical parameters.
- To understand the basic principles in imaging techniques.
- To have a basic knowledge in life assisting and therapeutic devices.

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Electro Physiological Measurement - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – incubators, drug delivery devices - Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery –Orthopedic prostheses fixation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, NewDelhi, 2007.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, NewDelhi,2nd edition,2003.
3. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th edition,2012.

REFERENCES:

1. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York,1998.
2. Duane Knudson, “Fundamentals of Biomechanics, Springer”, 2nd Edition,2007.

3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., "Health Care Systems, Technology and Techniques", Springer, 1st Edition,2011.
4. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", Third Edition, Boca Raton, CRC Press LLC,2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies,2003.
6. Geddes L. A. and Baker L. E., "Principles of Applied Biomedical Instrumentation", John Wiley, New York, 1989.
7. Richard Aston, "Principles of Biomedical Instrumentation and Measurement", Merril Publishing Company, New York, 1990.

WEB REFERENCES:

1. https://www.nhlbi.nih.gov
2. https://psychology.wikia.org/wiki/Medical_therapeutic_devices

ONLINE RESOURCES:

1. https://www.udemy.com/course/biomechanics-cervical-spine-module-1/
2. https://academicearth.org/biomedical-engineering/
3. https://www.edx.org/learn/biomedical-engineering
4. https://www.coursera.org/courses?query=biomedical
5. https://www.distancelearningportal.com/study-options-c/short/269778974/bio-biomedical-engineering-united-states.html
6. https://www.classcentral.com/tag/biomedical-engineering

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the philosophy of the heart, lung, blood circulation and respiration system. (K1)
2. Describe latest ideas on non-electrical devices used in health care industries. (K2)
3. Summarize the various sensing and measurement devices of electrical origin for bio-medical applications. (K2)
4. Describe the important and modern methods of imaging techniques and their analysis. (K2)
5. Explain the medical assistance/techniques, robotic and therapeutic equipment. (K2)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	2	1	3	-	-	-	-	-	3	1	3
CO2	3	2	2	2	2	3	-	-	-	-	-	2	1	2
CO3	3	2	3	2	1	2	-	-	-	-	-	3	2	3
CO4	2	2	2	3	2	2	-	-	-	-	-	3	1	2
CO5	3	3	1	3	2	1	-	-	-	-	-	3	2	3

PROFESSIONAL ELECTIVES - II

20EIEL601 SDG NO. 4	FIBER OPTICS AND LASER INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the basic concepts of optical fibers and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibers.
- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about Industrial application of lasers.
- To provide adequate knowledge about holography and Medical applications of Lasers.

UNIT I OPTICAL FIBERS AND THEIR PROPERTIES 9

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, Principles of light propagation through a fiber: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode, Different types of fibers and their properties: Single and multimode fibers and Step index and graded index fibers. fiber characteristics: Mechanical characteristics and Transmission characteristics, Absorptionlosses, Scatteringlosses, Dispersion Connectors and splicers, Fibre termination, Optical sources: Light Emitting Diode (LED), Optical detectors: PIN Diode.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBERS 9

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor-Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre

Optic Sensor and Displacement sensor (Extrinsic Sensor) Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques, Different types of modulators: Electro-optic modulator (EOM), Interferometric method of measurement of length, Moire fringes, Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness –Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers; – Gas lasers, solid lasers, liquid lasers and semiconductor lasers.

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting – Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction And Working Advantages – Material Removal and vaporization: Process Of Material Removal.

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography: Basic Principle, Holography vs. photography, Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image– Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynecology and oncology.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. J.M. Senior, "Optical Fibre Communication – Principles and Practice", Prentice Hall of India, 1985.
2. J. Wilson and J.F.B. Hawkes, "Introduction to Opto Electronics", Prentice Hall of India, 2001.
3. Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011.

REFERENCES:

1. G. Keiser, "Optical Fibre Communication", McGraw Hill, 1995.
2. M. Arumugam, "Optical Fibre Communication and Sensors", Anuradha Agencies, 2002.
3. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in2008.
4. Monte Ross, "Laser Applications", McGraw Hill, 1968.
5. John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002.

WEB REFERENCES:

1. http://nptel.ac.in/courses/117101002
2. https://swayam.gov.in/ndl_noc20_ph07/preview

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the principle, transmission, dispersion and attenuation characteristics of optical fibers (K1)
2. Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications (K3)
3. Understand laser theory and laser generation system (K1)
4. Gain ability to apply laser theory for the selection of lasers for a specific Industrial and medical application (K3)
5. Understand about Industrial application of Holography and Medical applications of Lasers (K1)

CO, PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2	1	1	-	-	-	-	-	1	1	2
CO2	3	1	1	1	1	1	-	-	-	-	-	3	1	3
CO3	3	1	1	1	1	2	-	-	-	-	-	2	2	3
CO4	3	1	2	1	1	1	-	-	-	-	-	1	2	2
CO5	3	1	3	1	1	1	-	-	-	-	-	1	1	3

PROFESSIONAL ELECTIVES - II

20EIEL602 SDG NO. 4, 9	INSTRUMENTATION DETAIL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire basic knowledge in piping and instrumentation diagram
- To enable students to design piping and instrumentation diagram for different application
- To acquire basic knowledge in understanding the piping and instrumentation diagrams.
- To understand the standards used in industry for different applications.

UNIT I PIPING AND INSTRUMENTATION 9

Symbols and layout , loop diagram , tagging conventions , line and function symbols , equipment, representation - Pump selection , pressure drop in pipelines , power requirements for pumping liquids , characteristics curves for centrifugal pumps , system curve , net positive suction head , pump and other shaft seals - Wall thickness: pipe schedule ,pipe supports , pipe fittings , pipe stressing , layout and design ,pipe size selection , examples: Basic neutralizer control system, basic column control, batch reactor control system, continuous feed and recycle tank - Process design of fluid moving devices , flow meters , process design of orifice meter , process design of rotameter (P&I) , two phase flow , troubleshooting of fluid flow system, Motor control, Standards (included)

UNIT II P&ID – Understanding of P&ID, Design of Interlocks 9

Introduction to ISA 5.1, Understanding and selection of various symbols, Instrumentation as per API 554, Design and Development of interlocks, Instruments specification for pressure, Instruments specification for level,

Instruments specification for temperature, Instruments specification for flow, Selection of various Instruments and sizing standards

UNIT III Instrument Detailing **9**

Preparation of Instrument Index sheet, Instrument Installation BOQ, Preparation of Instrument datasheet, Preparation of Instrument Hook-up Diagram

UNIT IV Control System Integration Design **9**

Cable schedule, Loop schematics, JB Detailing, Field – Control system communication protocols and integration methods, Control system architecture designing

UNIT V Installation, Testing and Commissioning **9**

Instrumentation Installation standards and calibration methods, Instrument site testing and loop checking standards, System commissioning and stabilization

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Paul Gruhn, P.E., CFSE and Harry Cheddie, P.E., "Safety Instrumented Systems: Design, Analysis, and Justification", 2nd Edition, ISA,2006.
2. B.G.Liptak, "Instrumentation Engineers Handbook (Process Measurement & Analysis)", Fourth Edition, Chilton Book Co, CRC Press, 2005.

REFERENCES:

1. Terrence L. Blevins, Mark Nixon, "Control Loop Foundation: Batch and Continuous Processes", ISA, 2017.
2. R. K. Sinnott, John Metcalfe Coulson, John Francis Richardson, "Chemical engineering design", Elsevier Butterworth-Heinemann, 2014
3. S.B Thakore, B.I Bhatt, "Introduction to Process Engineering and Design",Tata McGraw-Hill, 2007
4. Instrumentation symbols and identification - ISA 5.1, International Society of Automation
5. Process Measurement Instrumentation - API RP 551, International Society of Automation

WEB REFERENCES:

1. https://www.isa.org/standards-and-publications/isa-standards

ONLINE RESOURCES:

1. https://instrumentationtools.com/instrumentation-standards
2. http://iceweb.eit.edu.au/Standards/Instrument%20&%20Automation%20Standards.pdf

OUTCOMES:

At the end of the course the students will be able to

1. Summarize the concepts piping and instrumentation (K1)
2. Illustrate the Design of piping and instrumentation for given application (K2)
3. Acquire basic knowledge in understanding the piping and instrum entation diagrams (K2)
4. Understand the standards used in industry for different applications (K1)
5. Select the needed technology for the proposed safety instrumented system (K2)

CO- PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - II

20ESCS601 SDG NO. 4,9	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the protocol layering and physical level communication
- To analyze the performance of a network
- To understand the various components required to build different networks
- To learn the functions of network layer and the various routing protocols
- To familiarize the functions and protocols of the Transport layer

UNIT I INTRODUCTION AND PHYSICAL LAYER 9

Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.

UNIT II DATA-LINK LAYER & MEDIA ACCESS 9

Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP - Media Access Control - Wired LANs: Ethernet - Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.

UNIT III NETWORK LAYER 9

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

UNIT IV TRANSPORT LAYER 9

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

UNIT V APPLICATION LAYER 9

WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data Communications and Networking", Fifth Edition TMH, 2013.

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.

WEB REFERENCES:

1. https://swayam.gov.in/nd2_cec19_cs07/preview
2. https://nptel.ac.in/courses/106105081/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/2276/computer-networks
2. https://www.youtube.com/watch?v=g8iY36onLeM&list=PLWPirh4EWFpHJrW1D9UB24wsbM3zx7QMx

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the basic layers and its functions in computer networks (K1)
2. Evaluate the performance of a network (K5)
3. Understand the basics of how data flows from one node to another. (K1)
4. Analyze and design routing algorithms (K4)
5. Design protocols for various functions in the network and understand the working of various application layer protocols (K4)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	3	2	2	1	2	1	-	1	3	2
CO2	3	3	2	-	-	-	1	-	-	-	-	-	2	1
CO3	3	3	2	-	1	-	1	1	-	1	-	1	3	1
CO4	3	3	2	-	-	-	1	1	-	1	-	-	2	2
CO5	3	3	2	-	1	-	2	2	-	1	-	1	3	2

PROFESSIONAL ELECTIVES - II

20EIEL603 SDG NO. 3,4,9	BIO SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the importance of biomedical signals and analysis
- To introduce different types of biosignals and their characteristics
- To study different noise removal mechanisms for biomedical signals
- To analyze the signals using time and frequency domain measures

UNIT I INTRODUCTION TO SIGNALS **9**

Introduction to signals, Continuous time and discrete time signals and LTI systems, Introduction and properties of Fourier transform, Laplace transform and Z-transform

UNIT II BIOMEDICAL SIGNALS: ORIGIN AND DYNAMICS 9

Nature of biomedical signals; origin and dynamics of electroneurogram (ENG), electromyogram (EMG), electrocardiogram (ECG), electroencephalogram (EEG), event related potentials (ERP), electrogastrogram (EGG), phonocardiogram (PCG), vibromyogram (VMG) and vibroarthogram (VAG), Objectives of biomedical signal analysis and difficulties in biomedical signal analysis

UNIT III NOISES AND FILTERING 9

Random, structured and physiological noise, noises and artefacts in ECG, EMG and EEG signals, Filtering for removal of artefacts; Introduction to filter design; Time domain filters, Frequency domain filters, and optimal filters and selection of appropriate filters

UNIT IV BIOSIGNAL EVENT DETECTION 9

Event detections in ECG, EEG and heart sounds, Analysis of wave shape and waveform complexity, QRS complex, analysis of ERPs and analysis of electrical activity using time and frequency domain measures

UNIT V SIGNAL ANALYSIS 9

Analysis of non-stationary and multicomponent signals, heart sound and murmurs, EEG rhythms and waves and case studies

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rangayyan, R. M., "Biomedical signal analysis" 2nd Edition, Wiley-IEEE Press, 2015.
2. Eugene N. Bruce, "Biomedical Signal Processing and Signal Modeling", Wiley-Interscience Publication, JOHN WILEY & SONS, INC, 2000
3. B.P. Lathi, "Principles of Linear Systems and Signals", Oxford University Press, 2nd Edition, 2009.

REFERENCES:

1. Le Cerutti, S., & Marchesi, C. (Eds.), "Advanced methods of biomedical signal processing", John Wiley & Sons, vol.27, 2011.
2. Webster, J. G., "Medical instrumentation application and design", John Wiley & Sons, 2009.
3. Mitra, S.K., "Digital Signal Processing: A Computer-Based Approach", McGraw Hill, NY, 4th Edition, 2011.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc20_ee41/

OUTCOMES:

On completion of the course, the students will be able to

1. Understand the issues associated with the interpretation of biomedical signals (K1)
2. Familiar with different signals such as ECG, EMG and EEG (K2)
3. Remove the noises in biosignals by selecting appropriate filters (K3)
4. Implement appropriate signal processing methods to extract reliable information (K4)
5. Analyze the bio signals for the detection of abnormalities (K3)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	2	-	-	-	-	1	2	2	2
CO2	3	2	2	1	2	1	-	-	-	-	1	3	2	3
CO3	3	2	3	2	3	2	-	-	-	-	2	2	2	3
CO4	3	3	2	3	3	2	-	-	-	-	2	3	3	3
CO5	3	2	3	3	2	2	-	-	-	-	1	3	3	3

PROFESSIONAL ELECTIVES - II

20EIEL605 SDG NO. 4, 9	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of microcontroller based system development
- To familiarize the Clocking and Memory Circuits
- To provide the Knowledge of Communication Modules
- To impart knowledge on RTOS based system Design
- To introduce the concept of Embedded Systems for IOT

UNIT I EMBEDDED HARDWARE DESIGN 9

Power supply - reset circuit - programming interface - GPIO options (slew rate, hysteresis, source, sink capability)- Digital input interfacing and protection - High side and low side drivers - unused pins - Internal ADC options - Brown out reset - optimizing power consumption.

UNIT II CLOCKING AND MEMORY 9

Internal vs External clock - PLL - Clocking tree - System clock/Peripheral clock - Frequency modulated clock - Progressive clock switch - Flash memory - Memory Management unit - Crossbar switch - Caching modes (write through, write back, inhibit) - Flushing vs Invalidating cache - Accessing External Memories - EEPROM cycles - Organization of C variables in memory.

UNIT III COMMUNICATION MODULES 9

Circuit design, clock and driver algorithm, Inter-Integrated Circuits (I2C) - Serial Communication Using SPI - Differences between SPI and I2C.- UART - Controller Area Network (CAN) - OSI Architecture - PHY (Ethernet - Wifi).

UNIT IV RTOS BASED SYSTEM DESIGN 9

Non RTOS - Interrupts - Nested Interrupts - System Tick - RTOS - Scheduler code - Tasks - Idle task – co-routine - Stack management - Resources - Semaphores - Mutex - Reentrancy - Priority Inversion - Priority Inheritance - Priority Ceiling -RAM management – Watchdog.

UNIT V EMBEDDED SYSTEMS FOR IOT IN LINUX 9

Raspberry Pi - Introduction to Linux - Process - Thread Safety - Ethernet TCP/IP Stack - Socket programming - Security Introduction - Demo project on IoT using Embedded systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Dawoud Shenouda Dawoud R. Peplow, "Digital System Design — Use of Microcontroller" River Publishers, 2010
2. MPC5777C Microcontroller Data Sheet, NXP Semiconductors. Rev. 13, 08/2018.

REFERENCE BOOKS:

1. Raj Kamal, "Embedded Systems – Architecture, Programming and Design", Third Edition, McGraw Hill Education (India) Private Limited, 2015.
2. Peatman, J.B., "Design with PIC Micro Controllers", Pearson Education, 3rd Edition, 2004.

3. Datasheet of Microcontroller based on ARM CORTEX M4, NXP Semiconductors, Rev. 7, 05/2017
4. AVR Microcontroller Hardware Design Considerations, Microchip Technology Inc. 2017

WEB REFERENCES:

1. https://www.nxp.com/docs/en/application-note/AN5408.pdf
2. https://www.nxp.com/docs/en/application-note/AN4812.pdf
3. https://www.instructables.com/id/Complete-tutorial-for-raspberry-pi-beginners

OUTCOMES:

On completion of this course, the student should be able to

1. Explain the constitutional components of a microcomputer system and their significance (K2)
2. Extend suitable communication protocols in accordance with the application in hand (K3)
3. Analyze the functioning of various memory modules(K3)
4. Compare the operational characteristics of Non-RTOS and RTOS based systems and use them efficiently in design environments (K2)
5. Infer the concept of IoT and demonstrate its power in real world applications(K2)
6. Develop design strategies for embedded applications (K3)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	2	-	-	-	-	1	2	2	2
CO2	3	2	2	1	2	1	-	-	-	-	1	3	2	3
CO3	3	2	3	2	3	2	-	-	-	-	2	2	2	3
CO4	3	3	2	3	3	2	-	-	-	-	2	3	3	3
CO5	3	2	3	3	2	2	-	-	-	-	1	3	3	3
CO6	3	2	3	3	2	2	-	-	-	-	1	3	3	3

PROFESSIONAL ELECTIVES - II

20EIEL604 SDG NO. 4, 9	BIOMETRIC SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To illustrate the technologies of biometrics.
- To be aware of the general principles of design of fingerprint technology.
- To introduce the techniques involved in face recognition, hand geometry, feature extraction and pattern classification
- To learn about the Multimodal biometrics and performance evaluation measurement methods.
- To introduce about the authentication methods in biometric systems.

UNIT I INTRODUCTION TO BIOMETRICS 9

Introduction and back ground – biometric technologies – passive biometrics – active biometrics - Biometric systems – Enrollment – templates – algorithm – verification – Biometric applications – biometric characteristics- Authentication technologies –Need for strong authentication - Protecting privacy and biometrics and policy – Biometric applications – biometric characteristics

UNIT II FINGERPRINT TECHNOLOGY 9

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modeling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching

UNIT III FACE RECOGNITION AND HAND GEOMETRY 9

Introduction to face recognition, Neural networks for face recognition – face recognition from correspondence maps – Hand geometry – scanning – Feature Extraction - Adaptive Classifiers - Visual-Based Feature Extraction and Pattern Classification - feature extraction – types of algorithm – Biometric fusion- Simulation of feature extraction with examples.

UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION9

Voice Scan – physiological biometrics –Behavioral Biometrics - Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy –training and adaptability – examples of

multimodal biometric systems – Performance evaluation- Statistical Measures of Biometrics – FAR – FRR – FTE – EER – Memory requirement and allocation.

UNIT V BIOMETRIC AUTHENTICATION 9

Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition. -. Expectation Maximization theory - Support Vector Machines. Biometric authentication by fingerprint –biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multi biometrics and Two-Factor Authentication

TOTAL: 45PERIODS

TEXT BOOKS:

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation", Springer, 2005 (Units I, II, III & IV)
2. S.Y. Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach" Prentice Hall, 2005(Unit V)

REFERENCES:

1. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.
2. Nalini K Ratha, Ruud Bolle, "Automatic fingerprint Recognition System", Springer, 2003
3. L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint and Face Recognition" CRC Press, 1999.
4. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley, 2003.
5. Arun A. Ross, Karthik Nanda Kumar, Anil K. Jain, "Handbook of Multibiometrics", Springer, 2006.

WEB REFERENCES:

1. https://freevideolectures.com/course/3252/biometrics

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106/104/106104119/
2. https://www.javatpoint.com/ https://www.javatpoint.com/biometrics-tutorial
3. https://www.udemy.com/course/biometrics-masterclass-a-complete-guide-on-biometrics/

OUTCOMES:

At the end of the course, the student should be able to:

1. Demonstrate knowledge about the engineering principles underlying the technologies of biometric systems (K2)
2. Identify finger print using pattern recognition techniques and imaging techniques (K1)
3. Recognize face and hand geometry using Feature Extraction and Pattern Classification techniques (K1)
4. Explain about various Multimodal biometric techniques and evaluate the performance using Statistical measures (K2)
5. Explain about various biometric authentication methods (K2)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

20ICEL602 SDG NO. 4, 9	HYDRAULICS AND PNEUMATIC ACTUATORS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide student with knowledge on the application of fluid power in process, construction and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of

Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V TROUBLESHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, TroubleShooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.

TOTAL:45 PERIODS

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw Hill, 2001.

REFERENCES:

1. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
2. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
3. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995 4. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
4. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.

WEB REFERENCES:

1. nptel.ac.in/courses/112/105/112105047/

OUTCOMES:

Upon the completion of this course the students will be able to

1. Explain the Fluid power and operation of different types of pumps (K1)
2. Summarize the features and functions of Hydraulic motors, actuators and Flow control valves (K2)
3. Explain the different types of Hydraulic circuits and systems (K1)
4. Explain the working of different pneumatic circuits and systems (K1)
5. Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems (K2)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	2	-	-	-	-	1	2	2	2
CO2	3	2	2	1	2	1	-	-	-	-	1	3	2	3
CO3	3	2	3	2	3	2	-	-	-	-	2	2	2	3
CO4	3	3	2	3	3	2	-	-	-	-	2	3	3	3
CO5	3	2	3	3	2	2	-	-	-	-	1	3	3	3

PROFESSIONAL ELECTIVES - II

20EIEL606 SDG NO. 4, 9	BIO MEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the materials used for MEMS.
- To study various MEMS fabrication techniques.
- To study about different types of sensors and actuators.
- To Implement different types of sensors and actuators at the micro scale level.
- To apply MEMS technology in different field of medicine.

UNIT I MEMS MATERIALS AND FABRICATION 9

Typical MEMs and Microsystems, materials for MEMS - active substrate materials-Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, quartz, polymers. Micromachining photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA.

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever –microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys-Inertia sensor, flow sensor

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators-Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.

UNIT IV MICROFLUIDIC SYSTEMS 9

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in micro conduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system, micromixers

UNIT V APPLICATIONS OF BIOMEMS **9**

CAD for MEMS, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR),DNA sensor, MEMS based drug delivery, Biosensors- sensors for glucose, uric acid, urea and triglyceride sensor.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002.
2. Wanjun Wang, Stephen A.Soper, "BioMEMS: Technologies and Applications", CRC Press, New York, 2007.

REFERENCES:

1. Marc J. Madou "Fundamentals of Microfabrication: the Science of Miniaturization", CRC Press, 2002.
2. Nadim Maluf, Kirt Williams. "An introduction to Microelectro Mechancial Systems Engineering", Second Edition, Artech House Inc, MA, 2004.
3. Chang Liu, "Foundations of MEMS", Pearson Education International, New Jersey, USA,2006
4. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/104/112104181/
2. https://en.wikipedia.org/wiki/Bio-MEMS

ONLINE RESOURCES:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3705549/
2. https://www.arrow.com/en/research-and-events/articles/recent-advances-in-implantable-and-biomems-electronics

OUTCOMES:

At the end of the course, the student should be able to:

1. Gain knowledge about materials used for MEMS (K1)
2. Demonstrate the various MEMS fabrication techniques (K2)
3. Identify the different types of sensors and actuators (K1)
4. Implementation of different types of sensors and actuators at the micro scale level (K3)
5. Apply MEMS technology in different fields of medicine (K3)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	1	-	-	-	1	-	2	2	3
CO2	2	2	1	1	-	2	-	-	-	2	-	1	2	3
CO3	3	2	2	1	-	2	-	-	-	2	2	2	2	3
CO4	2	2	2	1	1	2	-	-	-	-	2	2	2	3
CO5	2	3	3	3	2	2	-	-	-	-	3	3	3	3

20MGEL601 SDG NO. 4,8,9,12	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts and philosophies of Quality Management
- To know the impact and significance of TQM principles on organizations in recent times.

UNIT 1 INTRODUCTION **8**

Need and Evolution of Quality, Quality-Definitions, statements and dimensions of product and service quality TQM-concepts, Elements and Framework, Benefits & Obstacles of TQM , TQM-Culture, Stategic Quality Management, Costs of Quality.

UNIT II CONTRIBUTIONS AND APPROACHES TO QUALITY MANAGEMENT **9**

Renowned quality gurus- Deming, Juran, Crosby and Ishikawa, Contributions of Taguchi – Loss Function, Signal to Noise Ratio and design of experiments, Kaizen -principles and practices-5 S tools, Poka Yoke-8Discipline Methodology, Just in time, Continous process improvement-PDCA cycle and 5 why analysis

UNIT III CUSTOMER FOCUS AND TEAMWORK **8**

Identifying Customer Needs, QFD - Process, Building HoQ, Customer Satisfaction Measurement Techniques. Employee Involvement Practices. Individual Participation - Suggestion Systems & Empowerment, Motivation, Leadership, Partnerships - Cross-Functional Teams, Supplier/Customer Partnerships, Problem -Solving Teams - Quality Circles.

UNIT IV STATISTICAL TOOLS & TECHNIQUES **11**

SQC - Tools For Data Collection And Analysis – Seven tools(old and new), Statistical Process Control (SPC) – Construction of Control Chart – Variables and Attributes. Process Capability – concepts and measurement. Six Sigma models ,Lean six sigma, BPR, TPM, FMEA and Benchmarking.

UNIT V QUALITY SYSTEMS AND STANDARDS **9**

Need for ISO 9000- ISO 9001: 2015 quality system-guidelines and clausewise requirements, Quality audits-types and responsibilities, ISO 14001:2004 EMS, ISO / TS 16949:2002, ISO 27001:2005 ISMS, SEI – CMMIand Awards - Demings Prize, MBNQA and criteria.

TEXT BOOKS

1. Besterfield, Total Quality Management, 3rd Edition, Pearson India
2 Shridhara K Bhat, Total Quality Management. Himalaya Publishing House, 2010.

REFERENCE BOOKS

1. Bedi Kanishka, Quality Management, Oxford University Press
2. Kiran D.R., Total Quality Management - Key Concepts and Case Studies, Butterworth-Heinemann, 2016.
3. Poornima M Charantimath, Total Quality Management. Pearson India, 2017
4. Sharma DD, Total Quality Management, Principles, Practice and Cases, Sultan Chand and Sons.
5. Douglas C. Montgomory, Introduction to Statistical Quality Control, Wiley Student Edition, 4 th Edition, Wiley India Pvt Limited, 2008

MOOC REFERENCES

1. https://www.coursera.org/lecture/supply-chain-management/total-quality-management-wLrvy
2. https://swayam.gov.in/nd1_noc20_mg34/preview
3. https://www.openlearning.com/courses/total-quality-management/
4. https://www.udemy.com/course/tqm-in-academics/

ONLINE RESOURCES

1. https://www.unido.org/sites/default/files/2009-04/A_roadmap_to_quality_volume_1_0.pdf
2. https://www.investopedia.com/terms/t/total-quality-management-tqm.asp

3. https://www.researchgate.net/publication/237006071_Total_Quality_Management_in_Academic_Libraries_A_Study
4. https://www.isixsigma.com/methodology/total-quality-management-tqm/introduction-and-implementation-total-quality-management-tqm/
5. https://study.com/academy/lesson/five-principles-of-total-quality-management-tqm.html

OUTCOME:

1 Understand quality concepts and philosophies of TQM. (K2)
2 Apply TQM principles and concepts of continuous improvement. (K3)
3 Explain the quality tools, management tools and statistical fundamentals to improve quality. (K2)
4 Demonstrate the various TQM tools as a means to improve quality. (K2)
5 Illustrate quality tools and procedures for better quality output. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	-	1	-	1	1	-	-	-	1
CO2	3	3	3	2	2	-	1	1	-	-	-	1
CO3	3	3	2	2	2	-	1	1	-	-	-	1
CO4	2	2	3	2	2	-	1	1	-	-	-	1
CO5	3	3	3	2	2	2	1	1	-	-	-	1

PROFESSIONAL ELECTIVES - III

20ICEL701 SDG NO. 4, 9	INTRODUCTION TO PROCESS DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To introduce students the basic concepts of

- Experimental Design
- Linear Regression Analysis
- Linear Model Selection and Regularization
- Classification
- Process Identification, Performance Monitoring and Soft Sensor Design.

UNIT I INTRODUCTION **9**

Introduction to Process data analytics and Statistical learning - Review of Linear Algebra Concepts – Review of Probability & Statistics - Design of experiments - Industrial case studies on factorial experiments

UNIT II REGRESSION **9**

Linear Regression:- Simple Linear Regression, Multiple Linear Regression-K-nearest neighbors regression – Practical Consideration in the Regression Model - Validation methods to assess model quality:-The validation set approach, Leave-One-Out Cross Validation, k-Fold 92 Cross Validation – Bias-variance Trade-off for k-Fold Cross Validation

UNIT III LINEAR MODEL SELECTION & REGULARIZATION **9**

Subset Selection: - Best Subset Selection, Step-wise Selection and Choosing the Optimal Model – Shrinkage Methods: - LASSO, Ridge regression, Elastic nets – Dimension reduction Methods:- Principal Components Regression, Partial Least Squares.

UNIT IV SUPERVISED LEARNING WITH REGRESSION AND CLASSIFICATION TECHNIQUES **9**

Logistic regression– Linear Discriminant Analysis - Quadratic Discriminant Analysis – Regression & Classification Trees – Support Vector Machines - Random forests, Bagging and boosting - Neural Networks – Deep Learning

UNIT V APPLICATIONS **9**

Process data analysis for system identification (under open and closed loops) - Controller Performance Monitoring - Principal components analysis (PCA) for

Process Monitoring and Partial Least Squares (PLS) for soft-sensor design - Data-based causality analysis for identification of process topology

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "An Introduction to Statistical Learning with Applications in R", Springer Texts in Statistics,2013.
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press,2013
3. Thomas A. Runkler, "Data Analytics: Models and Algorithms for Intelligent Data Analysis", Springer Vieweg, 2nd Edition, 2016.

REFERENCES:

1. Arun K. Tangirala, "Principles of System Identification – Theory and Practice", CRC Press,2015.
2. Huang, B. and Shah, S.L., "Performance Assessment of Control Loops: Theory and Applications", Springer-Verlag,1999
3. Fan Yang, Ping Duan, Sirish L Shah,Tongwen Chen,"Capturing Connectivity and Causality in Complex Industrial Processes", Springer,2014.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee13/preview
2. https://nptel.ac.in/courses/107106081/
3. https://www.tutorialspoint.com/control_systems/index.htm

ONLINE RESOURCES:

1. https://freevideolectures.com/course/5301/dynamics-and-control
2. https://freevideolectures.com/course/2337/control-engineering

OUTCOMES:

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

1. Understand the statistical terms related to data analytics (K1)
2. Select the right regression method for a given application (K2)
3. Analyze and compare the performance of various model selection and regularization methods (K3)
4. To suggest and develop right classifier for a given application (K3)
5. Use appropriate software tools for data driven analysis (K3)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	-	-	-	1	3	2
CO2	3	3	1	1	2	-	-	-	-	-	-	1	3	2
CO3	3	2	2	2	1	-	-	-	-	-	-	2	3	2
CO4	3	2	1	2	2	-	-	-	-	-	-	2	3	2
CO5	3	2	2	1	2	-	-	-	-	-	-	2	3	2

PROFESSIONAL ELECTIVES - III

20EIEL701 SDG NO. 4,9	APPLIED SOFT COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks
- To provide adequate knowledge about fuzzy and neuro-fuzzy systems
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- To provide adequate knowledge of genetic algorithms and other optimization techniques.

UNIT I ARCHITECTURES – ANN **9**

Introduction, Biological neuron, Artificial neuron, Neuron model ,Supervised and unsupervised learning, Single layer, Multi layer feed forward network, Learning algorithm, Back propagation Network.

UNIT II NEURAL NETWORKS FOR CONTROL **9**

Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum.

UNIT III FUZZY SYSTEMS **9**

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules - Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system.

UNIT IV APPLICATION OF FUZZY LOGIC SYSTEMS 9

Fuzzy logic control: Home heating system - liquid level control - aircraft landing-inverted pendulum –fuzzy PID control, Fuzzy based motor control.

UNIT V GENETIC ALGORITHMS 9

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters-Solution of typical control problems using genetic algorithm-Concept on some other search techniques Like tabu search and ant colony search techniques for solving optimization problems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Laurance Fausett, Englewood Cliffs, N.J., "Fundamentals of Neural Networks", Pearson Education,1992.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Tata McGraw Hill, 3rd Edition , 2010.
3. Sivanandam, S., N., Deepa, S., N., "Principles of Soft Computing", Wiley India Edition, 2nd Edition,2013.

REFERENCES:

1. Simon Haykin, "Neural Networks", Pearson Education, 2003.
2. John Yen & Reza Langari, "Fuzzy Logic – Intelligence Control & Information", Pearson Education, New Delhi, 2003.
3. M.Gen and R,Cheng, "Genetic algorithms and optimization", Wiley Series in Engineering Design and Automation, 2000.
4. Hagan, Demuth, Beale, "Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford, 2013.
6. WilliamS.Levine, "Control System Advanced Methods," The Control Handbook, CRC Press 2011.

WEB REFERENCES:

1. https://www.classcentral.com/course/swayam-introduction-to-soft-computing-10053
2. https://swayam.gov.in/nd1_noc20_cs17

ONLINE RESOURCES:

1. https://www.tutorialspoint.com/fuzzy_logic/index.htm
2. https://www.tutorialspoint.com/artificial_neural_network/artificial

_neural_network_pdf_version.htm

3. https://www.tutorialspoint.com/genetic_algorithms/index.htm

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the concepts of feed forward neural networks (K1)
2. Understand about feedback networks and the applications of neural controller (K1)
3. Understand about fuzzy and neuro-fuzzy systems (K1)
4. Understand the concepts of fuzzy logic control to real time systems (K1)
5. Understand the concepts of genetic algorithms and its application (K1)

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	2	-	-	-	-	-	2	3	2
CO2	3	2	2	1	2	2	-	-	-	-	-	2	3	2
CO3	3	3	2	1	2	2	-	-	-	-	-	2	3	2
CO4	2	2	2	2	3	2	-	-	2	2	-	2	3	2
CO5	2	2	2	2	3	2	-	-	2	2	-	2	3	2

PROFESSIONAL ELECTIVES - III

20ICEL703 SDG NO. 4,9	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the concept of Industrial Internet of Things (IIoT) and its application in industries.
- To understand the various IoT technologies.
- To modify the various existing industrial systems which links the automation system with enterprise, planning and product life cycle.
- To apply the concept of Industry 4.0 for the transformation of industrial processes.
- To integrate modern technologies such as sensors, communication, and computational processing.

UNIT I INTRODUCTION TO IoT **9**

Introduction: Sensing & actuation, Communication, Networking, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

UNIT II IoT TECHNOLOGIES **9**

Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis, Cyber security in Industry 4.0, Basics of Industrial IoT: Industrial Processes- Industrial Sensing & Actuation, Industrial Internet Systems.

UNIT III INDUSTRIAL IoT LAYERS **9**

IIoT-Introduction, Industrial IoT: Business Model and Reference Architerture: IIoT-Business Models, IIoT Reference Architecture, Industrial IoT- Layers: IIoT Sensing, IIoT Processing- IIoT Communication, Industrial IoT- Layers: IIoT Communication- IIoT Networking.

UNIT IV INDUSTRIAL IIoT PROGRAMMING **9**

Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science, R and Julia Programming, Data Management with Hadoop. Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT.

UNIT V IIoT APPLICATIONS 9

Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Case studies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Alasdair Gilchrist, "Industry 4.0, Industrial Internet of Things", Apress, 2017.
2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, "Industrial Internet of Things: Cyber manufacturing Systems", Springer, 2017.

REFERENCES:

1. Giacomo Veneri, Antonio Capasso, "Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0", Kindle edition, 2018.
2. Sravani Bhattacharjee, Practical Industrial Internet of Things Security: A practitioner's guide to securing connected industries, Kindle edition.
3. R. Anandan, Suseendran Gopalakrishnan, Souvik Pal, Noor Zaman, "Industrial Internet of Things (IIoT): Intelligent Analytics for Predictive Maintenance", Scrivener Publishing-Wiley, 2022.
4. Sudip Misra, Chandana Roy and Anandarup Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0", CRC Press-Taylor & Francis group, 2021.
5. Alena Traukina, Jayant Thomas, Prashant Tyagi, Kishore Reddipalli, "Industrial Internet Application Development", Packt Publishing,2018.
6. https://onlinecourses.nptel.ac.in/noc20_cs69/preview

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_cs24
2. https://nptel.ac.in/106105195
3. https://swayam.gov.in/nd1_noc20_cs22

ONLINE RESOURCES:

1. https://www.academia.edu/38736167/The_Industrial_Internet_of_Things_-_Industry_4.0
2. https:// link.springer.com/book/10.1007/978-3-319-42559-7
3. https://www.researchgate.net/publication/327991572_The_industrial_internet_of_things_IIoT_An_analysis_framework

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Implement the concept of IIoT in industries (K3)
2. Understand and apply various technologies of IIoT (K1)
3. Implement existing industrial set up with Industry 4.0 standards (K3)
4. Apply Industry 4.0 standards to industrial applications (K3)
5. Apply modern IIoT technologies with industrial process (K3)

CO - PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	2	-	-	-	-	-	2	2	3
CO2	3	2	2	2	2	3	-	-	-	-	-	2	2	3
CO3	3	3	2	2	2	2	-	-	-	-	-	2	2	3
CO4	3	2	2	2	3	2	-	-	-	-	-	2	2	2
CO5	3	2	3	2	2	1	-	-	-	-	-	3	1	3

PROFESSIONAL ELECTIVES - III

20EIEL702 SDG NO. 4 & 7	ELECTRICAL AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To present a comprehensive overview of Electric and Hybrid electric vehicles,
- To make the students understand the fundamental concepts, principles and design of electric vehicles and hybrid electric vehicles.
- To give an understanding about battery Management systems in electric vehicles

UNIT I INTRODUCTION **9**

History of electric Vehicles and hybrid vehicles- social and environmental importance of hybrid and electric vehicles - Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance- impact of modern drive-trains on energy supplies

UNIT II HYBRID ELECTRIC DRIVE TRAINS **9**

Basic concept of hybrid traction- introduction to various hybrid drive-train

topologies- power flow control in hybrid drive-train topologies- fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies- power flow control in electric drive-train topologies- fuel efficiency analysis.

UNIT III ELECTRIC PROPULSION AND DRIVE SYSTEM 9

Introduction to electric components used in hybrid and electric vehicles- Configuration and control of DC Motor drives- Configuration and control of Induction Motor drives. Sizing the drive system- Matching the electric machine and the internal combustion engine (ICE)- Sizing the propulsion motor-sizing the power train.

UNIT IV BATTERY MANAGEMENT 9

Energy Storage- Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles- Battery based energy storage and its analysis- Fuel Cell based energy storage and its analysis- Hybridization of different energy storage devices-Battery pack mechanism..

UNIT V COMMUNICATIONS, SUPPORTING SUBSYSTEMS 9

In vehicle networks- CAN- Energy Management Strategies- Introduction to energy management strategies used in hybrid and electric vehicles-classification of different energy management strategies- comparison of different energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003

REFERENCES:

1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, 2003.
2. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2004.
3. Wei Liu, "Hybrid Electric Vehicle System Modeling and Control", General Motors, USA, John Wiley & Sons, Inc., 2017.
4. Teresa Donateo, "Hybrid Electric Vehicles", ExLi4EvA, 2017.
5. Gianfranco Pistoia, "Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market Consultant", Rome, Italy, Elsevier Publications, 2017.

6. Mehrdad Ehsani Yimin Gao Stefano Longo Kambiz M. Ebrahimi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles", Taylor & Francis Group, LLC, 2018.
7. Jack Erjavec, "Hybrid, Electric & Fuel-Cell Vehicles", Delmar, Cengage Learning.
8. Tom Denton, "Electric and Hybrid Vehicles", Taylor & Francis, 2018.

WEB REFERENCES:

1. https://www.energy.gov/eere/videos/energy-101-electric-vehicles

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108/102/108102121/
2. https://nptel.ac.in/courses/108/103/108103009/
3. http://support.skillscommons.org/showcases/open-courseware/energy/e-vehicle-tech-cert/

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the environmental impact of electric vehicles and be able to compare electric vehicles with conventional vehicles (K1)
2. Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources (K2)
3. Design and develop basic schemes of electric vehicles and hybrid electric vehicles (K3)
4. Choose proper energy storage systems for vehicle applications (K2)
5. Identify various communication protocols and technologies used in vehicle networks (K1)

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	-	-	2	3	-	-	-	2	2	2	2
CO2	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO4	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO5	2	2	3	3	-	2	1	-	-	2	2	2	2	2

PROFESSIONAL ELECTIVES - III

20CSPC302 SDG NO. 4,9	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study SQL and relational database design.
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design.
- To understand the fundamental concepts of transaction processing-concurrency control techniques and recovery procedures.
- To have an introductory knowledge about the Storage and Query processing Techniques

UNIT I RELATIONAL DATABASES **10**

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.

UNIT II DATABASE DESIGN **8**

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multivalued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT III TRANSACTIONS **9**

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT IVIMPLEMENTATION TECHNIQUES **9**

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for

SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT V ADVANCED TOPICS **9**

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL – XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2011.
2. RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition, Pearson Education, 2011.

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, "Database Management Systems", Fourth Edition, McGraw-Hill College, Publications, 2015.
3. G.K.Gupta,"Database Management Systems", Tata McGraw Hill, 2011.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_cs46/
2. http://www.nptelvideos.in/2012/11/database-management-system.html
3. https://www.classcentral.com/course/swayam-database-management-system-9914

ONLINE RESOURCES:

1. http://learnsql.com
2. https://www.w3schools.com/sql/default.asp
3. https://www.khanacademy.org/computing/computer-programming/sql

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Classify the modern and futuristic database applications based on size

and complexity (K2)

2. Map ER model to Relational model to perform database design effectively (K2)
3. Write queries using normalization criteria and optimize queries (K1)
4. Compare and contrast various indexing strategies in different database systems (K2)
5. Appraise how advanced databases differ from traditional databases (K3)

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	3	-	-	3	-	1	3	2	1
CO2	3	3	3	2	3	3	-	-	3	-	3	3	3	2
CO3	3	3	3	3	3	3	-	-	3	-	3	3	3	2
CO4	3	3	3	3	3	3	-	-	2	-	-	-	2	1
CO5	3	3	3	3	3	3	-	-	3		3	3	2	1

PROFESSIONAL ELECTIVES - III

20EIEL702 SDG NO. 4&9	INTRODUCTION TO IMAGE AND VIDEO PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the formation of an image and its acquisition
- To introduce the application of transforms in image processing
- To study techniques for improving quality of information in images
- To get familiarized with image and video processing techniques
- To apply image and video processing in industrial application

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Elements of digital image processing systems – Digital Image Representation- Elements of visual perception – Image acquisition - Image sampling and Quantization – Image geometry – Discrete Image Transforms- Properties- Color image fundamentals:- RGB, HSI models.

UNIT II IMAGE PREPROCESSING AND ENHANCEMENT 9

Point processing methods:-Contrast stretching – Gray level slicing-Histograms, Histogram equalization and specification techniques, Spatial filtering, Directional Smoothing, Median, Geometric mean and Harmonic mean filters- Color image enhancement.

UNIT III IMAGE SEGMENTATION AND ANALYSIS 9

Detection of Discontinuities, Edge linking, Boundary detection, Thresholding – Region oriented segmentation-Watershed segmentation – Object detection - Pattern Recognition – Classification.

UNIT IV DIGITAL VIDEO PROCESSING 9

Video acquisition - Inter-frame processing, Motion Estimation and Compensation – Filtering – Video segmentation – Tracking by detection – Tracking multiple objects.

UNIT V APPLICATIONS OF IMAGE AND VIDEO PROCESSING 9

Applications in measurements, manufacturing, medicine, agriculture and food industry – Case studies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. RafaelC.Gonzalez, Richard E.Woods, Digital Image Processing', Pearson, Education, Inc., Second Edition,2004.
2. AnilK.Jain, Fundamentals of Digital Image Processing', Pearson Education, Inc., 2002.

REFERENCES:

1. S Sridhar, Digital Image Processing, Oxford University Press, 2nd Edition,2016.
2. William K Pratt, “Digital Image Processing”, Jhon Wiley, Newyork,2002.
3. Thomas. B. Moeslund, “Introduction to Video and Image Processing”, Springer, 2012.
4. Alan C.Bovik, “ Handbook of image and Video Processing”, Elsevier Academic Press, 2005.
5. A.MuratTekalp, “Digital Video Processing” , Prentice Hall,2nd edition, 2015

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/117/105/117105135/

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the technical terms associated with image and video processing (K1)
2. Select the appropriate preprocessing techniques for manipulation of images (K2)
3. Utilize the different approaches of image enhancement, segmentation and analysis techniques (K3)
4. Apply different digital video processing methods (K3)
5. Design automated technique for image based applications (K4)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	3	2	-	-	-	-	-	-	-	2	2
CO3	3	2	2	2	2	-	-	-	-	-	-	-	2	2
CO4	2	1	2	3	2	-	-	-	-	-	-	-	2	2
CO5	2	2	2	1	2	-	-	-	-	-	-	-	3	3

PROFESSIONAL ELECTIVES - III

20ICEL704 SDG NO. 4,9	INSTRUMENTATION AND CONTROL IN PETROCHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the various petroleum production processes
- To impart knowledge on various processes involved in petroleum refinery
- To provide knowledge on specific measurement techniques practiced in petrochemical industry
- To provide knowledge on control systems and automation involved in petrochemical industry
- To Design Multivariable Controllers for multivariable system

UNIT I PETROLEUM REFINING PROCESS **9**

Brief survey of petroleum formation, petroleum exploration, Petroleum production, Petroleum refining and its methods, Refining capacity and

consumption in India, constituents of Crude Oil, Recovery techniques – Oil – Gas separation , Processing wet gases.

UNIT II UNIT OPERATIONS IN PETROLEUM REFINING PROCESS 9

P & I diagram of petroleum refinery, Atmospheric distillation process, Vacuum distillation process, Thermal cracking, Catalytic cracking, Catalytic reforming, and Utility plants – Air, N2, and cooling water.

UNIT III INSTRUMENTATION IN PETROLEUM REFINING PROCESS 9

Basics of field instruments, Parameters to be measured in Petrochemical industry, Distillation Column control, Selection of instruments, Basics of intrinsic safety of instruments, Area classification.

UNIT IV CONTROLS IN PETROLEUM REFINING PROCESS 9

Control of furnace, Reboiler Control, Reflux Control, Control of catalytic crackers, Control of heat exchanger, Control of cooling tower.

UNIT V STANDARDS & SAFETY INSTRUMENTS IN PETROLEUM INDUSTRIES 9

Basics of PLC, and Safety interlocks in furnace, separator, pump, and compressor. Basics of SIL, Introduction to Standards.

TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

1. Liptak B.G., "Instrument Engineers", Handbook, CRC PRESS, 4th Edition, 2003.
2. Austin G.T. Shreeves, "Chemical Process Industries", McGraw Hill International Student Edition, Singapore, 1985.
3. Uttam Ray Chaudhuri "Fundamentals of Petroleum and Petrochemical Engineering",CRC Press,2011.
4. G.Margaret Wells BSc,FPRI "Handbook of Petrochemicals and Process",Taylor and Francis Group,2018.
5. Frank (Xin X.) Zhu, James A. Johnson, David W. Ablin, Gregory A. Ernst,"Efficient Petrochemical Processes: Technology, Design and Operation,2019
6. https://nptel.ac.in/courses/103103029.

WEB REFERENCES:

1. https://www.branom.com/instruments-industry/oil-gas.html
2. https://www.controleng.com/articles/control-system-integration-projects-petrochemical/
3. https://www.afpm.org/industries/operations/how-petrochemical-produced

ONLINE RESOURCES:

1. https://www.britannica.com/technology/petroleum-refining/Petrochemicals.
2. https://www.spartancontrols.com/~/media/resources/rosemount/brochure/rosemount_instrumentation_petrochemical_brochure.pdf?la=en
3. https://www.valvemagazine.com/magazine/sections/beyond-valves/8891-process-instrumentation-in-oil-and-gas.html

OUTCOMES:

Upon completion of the course, the students should be able to

1. Describe the oil gas production process and operations in petrochemical refineries (K2)
2. Explain the process of important unit operations in a refinery (K2)
3. Illustrate the parameters, intrinsic safety in the petrochemical industry (K3)
4. Elucidate the control schemes involved in and the control of petrochemical processes (K2)
5. Explain the automation and safety standards of a petrochemical industry (K2)

CO, PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	2	-	-	-	-	-	2	1	3
CO2	2	2	2	1	2	2	-	-	-	-	-	1	2	2
CO3	2	2	1	2	1	2	-	-	-	-	-	1	2	2
CO4	2	2	2	1	2	1	-	-	-	-	-	1	2	3
CO5	2	2	1	1	2	3	-	-	-	-	-	1	2	3

PROFESSIONAL ELECTIVES - III

20EIEL704 SDG NO. 4,9	CYBER PHYSICAL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the nature of continuous and discrete systems
- To develop synchronous and asynchronous model of processes
- To specify both safety and liveness requirements in temporal logic and to debug the Correctness of the protocol using model checking
- To develop and analyze model of timed and hybrid systems

UNIT I INTRODUCTION 9

Introduction-key features of cyber physical systems- Continuous dynamics: Newtonian mechanics-actor models-properties of systems-feedback control-Discrete dynamics: Discrete systems- Finite state machines

UNIT II SYNCHRONOUS AND ASYNCHRONOUS MODEL 9

Synchronous model: Reactive components-properties of components-composing components-synchronous design, Asynchronous model-asynchronous processes- asynchronous design primitives- coordination protocols.

UNIT III SAFETY AND LIVENESS REQUIREMENT 9

Safety specifications- verifying invariants- Enumerative search- Temporal logic- Model checking-reachability analysis- proving liveness.

UNIT IV TIMED MODEL AND REAL-TIME SCHEDULING 9

Timed processes- Timing based protocols: Timing-Based Distributed Coordination-Audio Control Protocol- Timed automata: Model of Timed Automata-Region Equivalence-Matrix-Based Representation for Symbolic Analysis, Real-time scheduling

UNIT V HYBRID SYSTEMS 9

Classes of Hybrid Systems-Hybrid dynamic models: Hybrid Processes-Process Composition-Zeno Behaviors-Stability- designing hybrid systems- linear hybrid automata.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rajeev Alur, "Principles of cyber-physical systems", The MIT press, 2015.
2. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems - A Cyber-Physical Systems Approach", Lulu.com, First Edition, Jan 2013.

REFERENCE BOOKS:

1. Sang C.Suh, U.JohnTanik and John N.Carbone, "Applied Cyber-Physical Systems", Springer,2014.
2. T. D. Lewis, "Network Science: Theory and Applications", Wiley, 2009.
3. P. Tabuada, "Verification and control of hybrid systems: a symbolic approach", Springer-Verlag 2009.
4. C. Cassandras, S. Lafortune, "Introduction to Discrete Event Systems", Springer 2007.
5. Constance Heitmeyer and Dino Mandrioli, "Formal methods for real-time computing", Wiley publisher, 1996.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106105195

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand knowledge, opportunities, challenges and Logical Foundations of Cyber Physical Systems (K1)
2. Develop model for synchronous, asynchronous, continuous and discrete systems (K3)
3. Identify safety specifications and critical properties of Cyber Physical Systems (K1)
4. Design and analyze the stability of hybrid systems (K3)
5. Apply automata for timed systems (K3)

CO-PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - III

20EIEL705 SDG NO. 4&9	FAULT DETECTION AND DIAGNOSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an overview of different Fault Detection and Diagnosis methods
- To present an overview of various types of fault detection schemes using Limit Checking, Parameter estimation methods, Principle Component Analysis
- To impart knowledge and skills needed to design and detect sensor and actuators faults using structured residual approach as well as directional structured residual approach
- To impart knowledge and skills needed design and detect faults in sensor and actuators using GLR and MLR based Approaches
- To impart knowledge and skills needed to detect and quantify and compensate stiction in Control valves

UNIT I INTRODUCTION & ANALYTICAL REDUNDANCY CONCEPTS 9

Introduction–Types of faults and different tasks of Fault Diagnosis and Implementation–Different approaches to FDD: Model free and Model based approaches- Introduction- Mathematical representation of Faults and Disturbances: Additive and Multiplicative types – Design of Residual generator – Residual specification and Implementation.

UNIT II FAULT DETECTION AND DIAGNOSIS USING LIMIT CHECKING AND PROCESS IDENTIFICATION METHODS 9

Limit Checking of absolute values – Trend Checking– Change detection using binary thresholds– adaptive thresholds – Change detection with Fuzzy thresholds – Fault detection using Process Identification methods and Principle Component Analysis.

UNIT III FAULT DETECTION AND DIAGNOSIS USING PARITY EQUATIONS 9

Introduction – Residual structure of single fault Isolation: Structural and Canonical structures- Residual structure of multiple fault Isolation: Diagonal and Full Row canonical concepts – Introduction to parity equation implementation and alternative representation - Directional Specifications: Directional specification with and without disturbances – Parity Equation Implementation.

UNIT IV FAULT DIAGNOSIS USING STATE ESTIMATORS 9

Introduction – Review of State Estimators – Fault Detection and Diagnosis using Generalized Likelihood Ratio Approach and Marginalized Likelihood Ratio Approach

UNIT V CASE STUDIES 9

Fault detection and diagnosis of DC Motor Drives – Fault detection and diagnosis of a Centrifugal pump-pipe system – Fault detection and diagnosis of an automotive suspension and the tire pressures - Automatic detection, quantification and compensation of valve stiction.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. JanosJ.Gertler, "Fault Detection and Diagnosis in Engineering systems", 2ndEdition, Marcel Dekker, 1998.
2. Rolf Isermann, "Fault-Diagnosis Systems an Introduction from Fault Detection to Fault Tolerance", Springer Verlag, 2006.

REFERENCES:

1. Steven X. Ding, "Model based Fault Diagnosis Techniques: Schemes, Algorithms, and Tools", Springer Publication, 2012.
2. HassanNoura, DidierTheilliol, Jean-Christophe Ponsart and Abbas Chamseddine, "Fault-Tolerant Control Systems: Design and Practical Applications", Springer Publication, 2009.
3. Blanke, Mogens; Kinnaert, Michel; Lunze, Jan; Staroswiecki, Marcel, "Diagnosis and Fault- Tolerant Control", Springer, 2015.
4. Ali Ahammad Shoukat Choudhury, Sirish L. Shah and Nina F. Thornhill, "Diagnosis of Process Nonlinearities and Valve Stiction: Data Driven Approaches", Springer, 2008.
5. Jie Chen, R.J. Patton, "Robust Model-Based Fault Diagnosis for Dynamic Systems", Springer , 1999.

WEB REFERENCES:

1. https://gregstanleyandassociates.com/whitepapers/FaultDiagnosis/faultdiagnosis.htm

ONLINE RESOURCES:

1. http://www.ece.lsu.edu/mcu/lawss/add_materials/FaultDetection Part1 .pdf

2. https://www.sciencedirect.com/science/article/pii/S1474667016359274

OUTCOMES:

Upon completion of the course, the student should be able to

1. Describe the different approaches to Fault Detection and Diagnosis (K2)
2. Detect faults using Limit Checking, Parameter estimation methods and Principle Component Analysis (K3)
3. Detect sensors and actuators faults using structured residual approach as well as directional structured residual approach (K3)
4. Detect and isolate faults in sensor and actuators using Generalized Likelihood Ratio and Marginalized Likelihood Ratio based Approaches (K3)
5. Detect, quantify and compensate stiction in control valves(K3)

CO-PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - III

20CSPC702 SDG NO. 4 &11	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for machine learning for various problem solving
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To understand the latest trends in machine learning
- To design appropriate machine learning algorithms for problem solving

UNIT I INTRODUCTION **9**

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT II NEURAL NETWORKS AND GENETIC ALGORITHMS **9**

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

UNIT III BAYESIAN AND COMPUTATIONAL LEARNING **9**

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT IV INSTANT BASED LEARNING **9**

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.

UNIT V ADVANCED LEARNING **9**

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

TOTAL: 45 PERIODS

TEXT BOOK:

1. Tom M. Mitchell, — "Machine Learning", McGraw-Hill Education (India) Private Limited, 2013.

REFERENCES:

1. Ethem Alpaydin, — "Introduction to Machine Learning (Adaptive Computation and Machine Learning)", The MIT Press 2004.
2. 2. Stephen Marsland, — "Machine Learning: An Algorithmic Perspective", CRC Press, 2009

WEB REFERENCES:

1. https://towardsdatascience.com/best-resources-for-ai-machine-learning-data-science-d72625d4689d

2. https://www.analyticsvidhya.com/resources-machine-learning-deep-learning-neural-networks/
3. https://www.ritchieng.com/machine-learning-resources/
4. https://www.guru99.com/machine-learning-tutorial.html

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Gain knowledge about basic concepts of Machine Learning and Differentiate between supervised, unsupervised, semi-supervised machine learning approaches (K2)
2. Discuss and apply the back propagation algorithm and genetic algorithms to various problems (K2, K3)
3. Discuss the decision tree algorithm and identity and overcome the problem of over fitting and Apply the Bayesian concepts to machine learning (K2, K3)
4. Solve the problems using various machine learning techniques and apply instant based learning techniques (K3)
5. Analyze and suggest appropriate machine learning approaches for various types of problems (K3)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	1	-	3	3	2	2	3	2
CO2	3	3	3	3	3	2	1	-	3	3	2	2	3	2
CO3	3	3	3	3	3	2	1	-	3	3	2	2	3	2
CO4	3	3	3	3	3	2	2	-	3	3	2	2	3	2
CO5	3	3	3	3	3	3	2	-	3	3	2	2	3	2

PROFESSIONAL ELECTIVES - III

20MGEL701 SDG NO. 9 & 12	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services.
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems.
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification.
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics.
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer.

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software.

Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal.

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, 5th Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, 11th Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, 2nd Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, 7th Edition, 2013.

WEB REFERENCES:

1. https://www.udemy.com/course/strategic-product-management-and-leadership/

2. https://www.udemy.com/course/building-insanely-great-products/
3. https://www.coursera.org/learn/customer-insights-orientation

ONLINE RESOURCES:

1. https://pursuite-production.s3-ap-southeast-1.amazonaws.com/media/cms_page_media/162/FSIPD+OBF+-+2012+F0_1.pdf
2. https:// futureskillsnasscom. edcast. com/ pathways/ product-management-primer-pathway/cards/5603673#

OUTCOMES:

At the end of the course, the student should be able to:

1 Explain the basic essentials of product development. (K2)
2 Discuss the learnings to incorporate effective design for product development. (K2)
3 Describe the various tools of innovation & product development process in the Business context. (K2)
4 Identify the various process and choose the appropriate tools for designing, development and testing. (K2)
5 Discuss disruptive models / process to manage a product development from start to finish. (K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	2	1	1	-	-	2	-	-
CO2	3	3	3	3	2	1	1	-	3	-	2	-
CO3	3	2	3	3	3	1	2	1	3	-	2	3
CO4	3	3	2	3	2	-	-	-	-	2	-	-
CO5	3	3	3	3	2	1	2	1	3	-	3	-

PROFESSIONAL ELECTIVES - IV

20EIEL801 SDG NO. 4, 9	CYBER SECURITY FOR INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Industrial security environment and cyberattacks
- To analyze and assess risks in the industrial environment
- To access, design and implement cybersecurity
- To test and troubleshoot the industrial network security system

UNIT I INTRODUCTION **9**

Industrial security environment-Industrial automation and control system (IACS) culture Vs IT Paradigms-Cyberattacks: Threat sources and steps to successful cyberattacks.

UNIT II RISK ANALYSIS **9**

Risk identification, classification and assessment, Addressing risk: Cybersecurity Management System (CSMS), organizational security, physical and environmental security, network segmentation, access control, risk management and implementation.

UNIT III ACCESSING THE CYBERSECURITY OF IACS **9**

Identifying the scope of the IACS- generation of cybersecurity information-identification of vulnerabilities- risk assessment-evaluation of realistic threat scenarios- Gap assessment-capturing Ethernet traffic- documentation of assessment results.

UNIT IV CYBERSECURITY DESIGN AND IMPLEMENTATION **9**

Cybersecurity lifecycle- conceptual design process- detailed design process-firewall design remote access design- intrusion detection design.

UNIT V TESTING AND MAINTENANCE **9**

Developing test plans- cybersecurity factory acceptance testing- site acceptance testing- network and application diagnostics and troubleshooting-cybersecurity audit procedure- IACS incident response.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ronald L and Krutz, "Industrial Automation and Control System Security Principles", ISA,2013.
2. David J.Teumim, "Network Security", Second edition,ISA,2010

REFERENCE BOOKS:

1. Edward J.M. Colbert and Alexander Kott, "Cyber-security of SCADA and other industrial control systems", Springer, 2016.
2. Perry S. Marshalland John S. Rinaldi, "Industrial Ethernet", Second edition, ISA, 2004.
3. K S MANOJ, "Cyber Security: in industrial automation", Kindle Edition October 2010.

WEB REFERENCES:

1. https://www.youtube.com/watch?v=fQ3ESFfvchg&list=PLUtfVcb-iqn834VGI9faVXGIGSDXZMGp8- nptel vidoes
2. https://swayam.gov.in/nd1_noc20_ee33/preview

ONLINE RESOURCES:

1. https://www.ul.com/offerings/industrial-automation-and-control-system-cybersecurity
2. https://www.isa.org/training-certifications/isa-training/instructor-led/course-descriptions/ic32e/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Apply the basis of science and engineering to understand the Industrial security environment and cyber-attacks (K3)
2. Analyze and assess risks in the industrial environment (K4)
3. Access the cybersecurity of IACS (K2)
4. Design and implement cyber security (K4)
5. Test and troubleshoot the industrial network security system and to understand, investigate and explore feasible solution for a moderate industrial problem (K3)

CO-PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - IV

20MGEL801 SDG NO. 4 & 9	PROJECT MANAGEMENT AND FINANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the concepts of managing projects
- To facilitate the students in enriching knowledge on the Nature, scope and process of Project Management

UNIT I INTRODUCTION TO PROJECT MANAGEMENT 9

Concepts of Project Management: Project – Meaning – Nature and scope of Project management- Types of project- project life cycle- Project management as a profession- Role of project manager-Formal organization – types of Project organization

UNIT II PROJECT IDENTIFICATION AND PLANNING 9

Project identification - Project environment – identification of investment opportunities – project screening – prefeasibility study – project selection - project formulation - stages in project- formulation - Project Planning Process – Work Break down Structure – Role of Multidisciplinary teams- Risk and uncertainty in projects.

UNIT III PROJECT APPRAISAL 9

Project Appraisal: Objectives, essential of a project methodology – Market appraisal – Technical appraisal – Financial appraisal –Commercial appraisal- Managerial appraisal- Social Cost Benefit Analysis (SCBA) – L&M approach & UNIDO approach – Capital Budgeting techniques and its relevance.

UNIT IV PROJECT CONTROL **9**

Project designing and project scheduling and time estimate – Estimation of cost of project – Project Overrun –causes – types of overrun - PERT & CPM Networks - Crashing – Gantt Charts – Project Control- techniques

UNIT V PROJECT FINANCE **9**

Concepts and sources of financing-Traditional and private investments-various financial instruments-public private partnership models-types of PPP models and contractual structure-BOT, BOOT, value for money (VFM) evaluation-Venture capital financing-Private equity-angel investors-Incubators-role of government in successful PPP projects.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Prasanna Chandra, "Project Preparation, Appraisal and Implementation", Tata McGraw Hill Delhi. 2019.
2. Chaudhary, S, "Project Management", Tata McGraw Hill, New Delhi.

REFERENCES:

1. Pitale, R.L. "Project Appraisal Techniques", Oxford and IBH. Publishing Pvt. Ltd., New Delhi .
2. Timothy, D.R. and W.R. Sewell, "Project Appraisal and Review", Macmillan, India.
3. Little I.M.D. and Mirrless JA., "Project Appraisal and Planning for Developing Countries", London Heinemann Education Books,1975.
4. Dennis Lock, "Project Management", Routledge ,10th Edition ,2013.
5. P.K. Joy, "Total Project Management", Lakshmi Publications ,2017.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105106149
2. https://www.digimat.in/nptel/courses/video/110107081/L01.html

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc19_mg30/preview.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand the concepts of Project management (K1)
2. Identify Projects, Planning Process and Perform risk analysis involved in carrying out Projects (K1)
3. Study the Fundamentals and types of Project Appraisal (K2)

4. Understand the concepts of Project control essentials (K1)
5. Study different Project financing Models and financing sources available for obtaining Project funds(K2)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	3	3	1	1	1
CO2	-	-	-	-	-	2	2	3	3	1	1	1
CO3	-	-	-	-	-	2	2	3	3	1	1	1
CO4	-	-	-	-	-	2	2	3	3	1	1	1
CO5	-	-	-	-	-	2	2	3	3	1	1	1

PROFESSIONAL ELECTIVES - IV

20ICEL803 SDG NO. 4 & 9	SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the practical application through case studies.
- To study the model reference adaptive control.
- To study the self-tuning of PID controllers based on parameter identification.
- To study the parameter identification of systems.
- To study the definition of adaptive control and methods of adaptation.

UNIT I INTRODUCTION **9**

Introduction to adaptive control – Effects of process variations –Adaptive control schemes – Adaptivecontrol problem – Non-parametric identification – Step response method – Impulse response methodFrequency response method.

UNIT II PARAMETRIC INDENTIFICATION **9**

Linear in parameter models - ARX – ARMAX – ARIMAX – Least square estimation – Recursive leastsquare estimation – Extended least square

estimation – Maximum likelihood estimation – Introductionto non-linear systems identification - Pseudo random binary sequence.

UNIT III SELF - TUNING REGULATOR 9

Deterministic in-direct self-tuning regulators – Deterministic direct self-tuning regulator,Introduction to stochastic self-tuning regulators – Stochastic indirect self-tuning regulator.

UNIT IV MODEL REFERENCE ADAPTIVE CONTROLLER 9

The MIT rule – Lyapunov theory – Design of model reference adaptive controller using MIT rule and Lyapunov theory – Relation between model reference adaptive controller and self-tuning regulator.

UNIT V TUNING OF CONTROLLERS AND CASE STUDIES 9

Design of gain scheduling controller - Auto-tuning of PID regulator – Stability analysis of adaptive controllers – Application of adaptive control in chemical reactor, distillation column and variable area tank system.

TOTAL:45PERIODS

TEXT BOOKS:

1. Karl J. Astrom& Bjorn Witten mark, "Adaptive Control", Pearson Education Singapore), Second Edition, 2003.
2. Shankar Sastry and Marc Bodson, "Adaptive Control: Stability, Convergence, and Robustness", Prentice-Hall, 1994.
3. I. D. Landau, R. Lozano, and M. M'Saad, "Adaptive Control", NY: Springer-Verlag, 1998.

REFERENCES:

1. Chalam, "Adaptive Control Systems: Techniques and Applications", CRC Press, 1987.
2. Landau, I.D., Lozano, R., M'Saad, M., Karimi, A, '\"Adaptive Control Algorithms, Analysis and Applications", 2nd edition, Springer,2011
3. T. C.H.A. Hsia, "System Identification", Lexington books, 1974.
4. Stephanopoulis G. "Chemical Process Control", Prentice Hall of India, New Delhi, 1990.
5. Miroslav Krstic, Ioannis Kanellakopoulos, Petar V. Kokotovic, "Nonlinear and Adaptive Control Design", 1st Edition, Wiley,1995.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee19/preview
2. https://nptel.ac.in/courses/108102113/

3. https://www.engineeringonline.ncsu.edu/course/ece-792-603-adaptive-control-and reinforcement-learning/

ONLINE RESOURCES:

1. https://www.coursera.org/lecture/intelligent-machining/introduction-to-adaptive-control-uZlZf
2. https://www.ntnu.edu/studies/courses/TTK4215#tab=omEmnet

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the effect of parameter variation and principle of adaptive control schemes (K1)
2. Distinguish different parametric identification methods (K2)
3. Understand Deterministic and Stochastic Self-Tuning Regulators (K1)
4. Design of model reference adaptive controller (K4)
5. Design gain scheduling controller and apply adaptive control schemes for industrial processes (K3, K4)

CO- PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - IV

20EIEL803 SDG NO. 4, 9	VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.

- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmmit Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification Of Digital System, Synchronous Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson , 2017.
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits:A Design perspective", Second Edition , Pearson , 2016.

REFERENCES:

1. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley,1997.
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim "CMOS Digital Integrated Circuits: Analysis & Design",4th edition McGraw Hill Education,2013.
3. Wayne Wolf, "Modern VLSI Design: System On Chip", Pearson Education,2007.
4. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India2005.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee29/preview
2. https://nptel.ac.in/courses/117101058/

ONLINE RESOURCES:

1. https://elearn.maven-silicon.com/
2. http://www.asic-world.com/
3. https://www.vlsiguru.com/

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Realize the concepts of digital building blocks using MOS transistor (K1)
2. Design combinational MOS circuits and power strategies(K4)
3. Design and construct Sequential Circuits and Timing systems (K4)
4. Design arithmetic building blocks and memory subsystems (K4)
5. Apply and implement FPGA design flow and testing (K3)

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	-	-	-	3	2	2	3
CO2	2	3	1	2	-	-	-	-	-	-	3	2	2	2
CO3	2	-	-	2	2	-	-	-	-	-	3	2	3	3
CO4	2	-	-	2	2	-	-	-	-	2	3	2	3	3
CO5	2	3	2	2	-	-	-	-	3	2	2	2	3	1

PROFESSIONAL ELECTIVES - IV

20ICEL803 SDG NO. 4,9	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and Machine learning.

UNIT I PROBLEM SOLVING **9**

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. Solving problems by searching - Informed search and exploration - Constraint satisfaction problems - Adversarial search, knowledge and reasoning- knowledge representation - first order logic.

UNIT II PLANNING **9**

Planning with forward and backward State space search - Partial order planning - Planning graphs - Planning with propositional logic - Planning and acting in real world.

UNIT III REASONING **9**

Uncertainty - Probabilistic reasoning - Filtering and prediction - Hidden Markov models - Kalman filters - Dynamic Bayesian Networks, Speech recognition, making decisions.

UNIT IV LEARNING **9**

Forms of learning - Knowledge in learning - Statistical learning methods - reinforcement learning, communication, perceiving and acting, Probabilistic language processing, and perception.

UNIT V AI IN ROBOTICS **9**

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India, 2016.
2. Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems", Harlow: Addison Wesley, 2002.

REFERENCE BOOKS:

1. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992.
2. Robin Murphy, Robin R. Murphy, Ronald C. Arkin, "Introduction to AI Robotics", MIT Press, 2000.
3. Francis.X.Govers, "Artificial Intelligence for Robotics", Packt.Publishing, 2018.
4. Huimin Lu, Xing Lu, "Artificial Intelligence and Robotics", Springer, 2017.
5. Michael Brady, Gerhardt, Davidson, "Robotics and ArtificialIntelligence", Springer, 2012.

WEB REFERENCES:

1. https://www.simplilearn.com/tutorials/artificial-intelligence-tutorial/what-is-artificial-intelligence1

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ge20
2. https://onlinecourses.nptel.ac.in/noc20_de11

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Identify problems that are amenable to solution by AI methods (K1)
2. Identify appropriate AI methods to solve a given problem (K1)
3. Formalize a given problem in the language/framework of different AI methods (K2)
4. Summarize the learning methods adopted in AI (K2)
5. Design and perform an empirical evaluation of different algorithms on a problem formalization (K4)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	-	2	-	-	-	1	-	2	2	3
CO2	3	1	1	1	-	2	-	-	-	1	-	2	2	3
CO3	2	2	2	1	-	2	-	-	-	-	2	2	2	3
CO4	2	2	2	1	-	2	-	-	-	-	2	2	2	3
CO5	2	3	3	3	2	2	-	-	-	-	3	3	3	3

PROFESSIONAL ELECTIVES - IV

20EIEL804 SDG NO. 4,8	TELE HEALTH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn the key principles for telemedicine and health
- Understand telemedical technology.
- Know telemedical standards, mobile telemedicine and its applications.

UNIT I FUNDAMENTALS OF TELEMEDICINE 9

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine.

UNIT II TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE 9

Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

UNIT III ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE 9

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights.

UNIT IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM 9

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

UNIT V APPLICATIONS OF TELEMEDICINE 9

Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, e Health and Cyber Medicine.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Norris A C, "Essentials of Telemedicine and Telecare", John Wiley, New York, 2002.
2. H K Huang, "PACS and Imaging Informatics: Basic Principles and Applications" Wiley, New Jersey, 2010.

REFERENCES:

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, "Handbook of Telemedicine", IOS Press, Netherland, 2002.
2. Khandpur R S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.
3. Keith J Dreyer, Amit Mehta, James H Thrall, "Pacs: A Guide to the Digital Revolution", Springer, New York, 2002.
4. Khandpur R S, "TELEMEDICINE – Technology and Applications", PHI Learning Pvt Ltd., New Delhi, 2017.
5. Gogia Shashi, "Fundamentals of Telemedicine and Telehealth",Acad Pr,2019.
6. https://www.coursera.org/lecture/healthcare-it/module-4-telehealth-IKo2k

WEB REFERENCES:

1. https://www.acponline.org/cme-moc/online-learning-center/telemedicine-a-practical-guide-for-incorporation-into-your-practice

ONLINE RESOURCES:

1. https://www.udemy.com/course/online-course-in-telemedicine-teleconsultation
2. https://ecornell.cornell.edu/courses/healthcare/telemedicine

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the fundamentals of telehealth and telemedicine (K1)
2. Apply multimedia technologies in telemedicine (K3)
3. Explain protocols behind encryption techniques for secure transmission of data (K2)
4. Summarize radiology information system (K2)

5. Apply telemedicine in telesurgery and cyber medicine (K3)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	1	-	-	-	-	-	2	2	1
CO2	2	1	1	1	-	2	-	-	-	-	-	2	2	1
CO3	2	2	2	1	-	1	-	-	-	-	2	1	2	1
CO4	2	2	2	1	-	2	-	-	-	-	1	2	2	1
CO5	2	1	1	1	2	1	-	-	-	-	3	1	1	1

PROFESSIONAL ELECTIVES - IV

20ICEL804 SDG NO. 4,9	MACHINE VISION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the principles and applications of vision system in modern manufacturing environment
- To learn about the algorithms in vision
- To know about the recognition of object
- To be familiar about the applications regarding vision
- To know about the components used for vision

UNIT I SENSORS AND MACHINE VISION 9

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data Signal Conversion, Image Storage, Lighting Techniques,

UNIT II VISION ALGORITHMS 9

Fundamental Data Structures: Images, Regions, Sub-pixel Precise Contours – Image Enhancement : Gray value transformations, image smoothing, Fourier Transform – Geometric Transformation – Image segmentation – Segmentation

of contours, lines, circles and ellipses – Camera calibration – Stereo Reconstruction

UNIT III OBJECT RECOGNITION 9

Object recognition, Approaches to Object Recognition, Recognition by combination of views – objects with sharp edges, using two views only, using a single view.

UNIT IV VEHICLE INTEGRATION AND NAVIGATION SYSTEM 9

Looking out sensors and Looking in sensors, Intelligent vision system, Vehicle Integration system. Global Positioning System. Vehicle Navigation System. Road Network.V2V, SAE levels of automation.

UNIT V ROBOT VISION 9

Basic introduction to Robotic operating System (ROS) – Real and Simulated Robots – Introduction to OpenCV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to OpenCV – The cv_bridge Package.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Fu. K.S, Gonzalez. R.C, Lee. C.S.G "Robotics – Control, Sensing, Vision, and Intelligence", McGraw Hill, 2015
2. GrooverMikell .P, "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2014.

REFERENCES:

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2009
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 2013.
3. Koren Y., "Robotics for Engineers", McGraw Hill Book Co., 1992.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee13/preview
2. https://nptel.ac.in/courses/107106081/
3. https://www.tutorialspoint.com/control_systems/index.htm

ONLINE RESOURCES:

1. https://freevideolectures.com/course/5301/dynamics-and-control
2. https://freevideolectures.com/course/2337/control-engineering

OUTCOMES:

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

1. Understand the sensors related to machine vision (K1)
2. Select various vision algorithms (K2)
3. Analyze object recognition techniques (K3)
4. Suggest and develop vehicle navigation system (K2)
5. Apply robot vision softwares for applications (K3)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	-	2	-	-	-	1	-	2	2	3
CO2	3	1	1	1	-	2	-	-	-	1	-	2	2	3
CO3	2	2	2	1	-	2	-	-	-	-	2	2	2	3
CO4	2	2	2	1	-	2	-	-	-	-	2	2	2	3
CO5	2	3	3	3	2	2	-	-	-	-	3	3	3	3

PROFESSIONAL ELECTIVES - IV

20EIEL805 SDG NO. 4,9,11	BIOMECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand and explain principles of basic mechanics
- Discuss the mechanics of physiological systems.
- Explain the mechanics of joints.
- Illustrate the mathematical models used in the analysis of biomechanical systems
- Develop mechanical aspects of designing implants and biological assistive devices.

UNIT I INTRODUCTION OF MECHANICS 9

Develop mechanical aspects of designing implants and biological assistive devices. Review of the principles of mechanics, Vector mechanics- Resultant forces of Coplanar & Non-coplanar and Concurrent & non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia. Skeletal joints, forces and

stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle.

UNIT II BIOFLUID MECHANICS 9

Intrinsic fluid properties – Density, Viscosity, Compressibility and Surface Tension, Viscometers-Capillary, Coaxial cylinder and cone and plate, Rheological properties of blood, Pressure-flow relationship for Non-Newtonian Fluids, Fluid mechanics in straight tube – Steady Laminar flow, Turbulent flow, Flow development, Viscous and Turbulent Sheer Stress, Effect of pulsatility, Boundary Layer Separation, Structure of blood vessels, Material properties and modeling of Blood vessels, Heart -Cardiac muscle characterization, Native heart valves – Mechanical properties and valve dynamics, Prosthetic heart valve fluid dynamics.

UNIT III BIOSOLID MECHANICS 9

Constitutive equation of viscoelasticity – Maxwell &Voight models, anisotropy, Hard Tissues -Structure, blood circulation, elasticity and strength, viscoelastic properties, functional adaptation, Soft Tissues – Structure, functions, material properties and modeling of Soft Tissues – Cartilage, Tendons and Ligaments Skeletal Muscle – Muscle action, Hills models, mathematical modeling, Bone fracture mechanics, Implants for bone fractures.

UNIT IV APPLIED BIO-MECHANICS 9

Engineering approaches to standing, sitting and lying, Biomechanics of gait, application of gait and locomotion analysis, Fluid mechanics and energetics: Forms of energy and energy transfer. Design of orthopedic implant, specifications for a prosthetic joint, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants.

UNIT V MODELING AND ERGONOMICS 9

Introduction to Finite Element Analysis, finite element analysis of lumbar spine; Ergonomics-Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted vibrations. Mechanism of air flow, respiratory cycle, lung ventilation model

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Y.C. Fung, "Bio-Mechanics- Mechanical Properties of Tissues", Springer-Verlag, 1998.

2. N. Ozkaya and M. Nordin, "Fundamentals of Biomechanics-Equilibrium, Motion and Deformation", springer-verlag, 2nd edition, 1999.
3. Subrata Pal, "Textbook of Biomechanics", Viva Books Private Limited, 2009.
4. Duane knudson, "Fundamental of biomechanics", springer, 2nd edition 2007
5. D. J. Schneck and J. D. Bronzino, "Biomechanics- Principles and Applications", CRC Press, 2nd Edition, 2000.

REFERENCES:

1. Krishna B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers, "Biofluid Mechanics: The Human Circulation", Taylor and Francis, 2007.
2. Sheraz S. Malik and Shahbaz S. Malik, "Orthopaedic Biomechanics Made Easy", Cambridge University Press, 2015.
3. Jay D. Humphrey, Sherry De Lange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design", Springer Science Business Media, 2004.
4. Shrawan Kumar, "Biomechanics in Ergonomics", Second Edition, CRC Press 2007.
5. Neil J. Mansfeild," Human Response to Vibration", CRC Press, 2005.
6. https://nptel.ac.in/courses/127103225

WEB REFERENCES:

1. http://www.profedf.ufpr.br/rodackibiomecanica_arquivos/Books/Duane%20Knudson-%20Fundamentals%20of%20Bio mechanics% 202ed. pdf
2. https://ftramonmartins.files.wordpress.com/2016/09/basic-biom echanics-susan-hall-6th-edition 1.pdf

ONLINE RESOURCES:

1. https://www.coursera.org/learn/bioengineering

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the principles of mechanics (K1)
2. Analyze the mechanics of physiological systems (K3)
3. Design a bio-mechanical system by knowing its characteristics (K4)
4. Describe the mechanical aspects of designing implants (K2)
5. Give examples of computational mathematical modeling applied in biomechanics (K1)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3	2	2	-	-	-	-	-	-	3	2
CO2	2	2	3	3	2	2	-	-	1	-	2	-	3	2
CO3	3	2	3	3	2	2	-	-	2	-	2	1	3	2
CO4	2	2	2	2	2	-	-	-	-	-	1	1	3	2
CO5	2	2	2	2	2	-	-	-	-	-	-	2	3	3

PROFESSIONAL ELECTIVES - IV

20EIEL806 SDG NO. 4,9	ROBOTICS IN MEDICINE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the basics of Robotics, Kinematics.
- Understand the basics of Inverse Kinematics.
- Explore various kinematic motion planning solutions for various Robotic configurations.
- Explore various applications of Robots in Medicine.

UNIT I INTRODUCTION **9**

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot

UNIT II KINEMATICS **9**

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three-Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

UNIT III ROBOT VISION **9**

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink

operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

UNIT IV PLANNING **9**

Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

UNIT V APPLICATIONS **9**

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynaecology, Orthopaedics, Neurosurgery

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Robert Schilling, "Fundamentals of Robotics-Analysis and control", Prentice Hall, 2003.
2. J.J.Craig, "Introduction to Robotics", Pearson Education, Third edition,2008.

REFERENCES:

1. Staugaard, Andrew C,"Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning", Prentice Hall Of India, 1987
2. Grover, Wiess, Nagel, Oderey, "Industrial Robotics: Technology, Programming and Applications", McGraw Hill, 2017
3. Wolfram Stadler, "Analytical Robotics and Mechatronics", McGraw Hill, 1995
4. Saeed B. Niku, "Introduction to Robotics: Analysis, Systems, Applications", Prentice Hall, 2001.
5. K. S. Fu, R. C. Gonzales and C. S. G. Lee, "Robotics", McGraw Hill, 2008.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112107289
2. https://www.qmul.ac.uk/library/library-skills/resource-guides-by-subject/electronic-engineering-and-computer-science/useful-websites/robotics/
3. https://onlinelibrary.wiley.com/action/doSearch?AllField=robotics+in+medicine&SeriesKey=1478596x

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the basics of robotic systems (K1)
2. Understand the basics of Kinematics (K1)
3. Design basic Robotics system and formulate Kinematics (K4)
4. Construct Inverse Kinematic motion planning solutions for various Robotic configurations (K4)
5. Design Robotic systems for Medical applications (K4)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	2	2	2	-	2	1	3	3	2	3
CO2	2	3	3	3	2	2	2	-	2	1	3	3	2	3
CO3	2	3	3	3	2	2	2	-	2	1	3	3	2	3
CO4	2	3	3	3	2	2	2	-	2	1	3	3	2	3
CO5	2	3	3	3	2	2	2	-	2	1	3	3	2	3

PROFESSIONAL ELECTIVES - IV

20EIEL807 SDG NO. 4,9	VEHICLE CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of control system used in automobiles
- To recognize the electronically controlled system used in driving mechanics.
- To understand the working principle of driver modeling and power train control systems.
- To identify the control system used in hybrid and electrical vehicles.
- To illustrate the need of automated transport systems.

UNIT I INTRODUCTION TO VEHICLE CONTROL SYSTEM 9

Trends, overview and examples of vehicle control system- Sensors, actuators and controller modules-Vehicle communication Network-System Engineering V-diagram- Algorithm Development- Steps in vehicle control system design-Degree of freedom for vehicle control- selection of controlled, manipulated, measured disturbance variables- classification of the variables in various

automotive systems like engines, suspension, braking, air conditioning – General types of vehicle controller configurations- Feedback, Inferential, Feed-Forward, Ratio control.

UNIT II CONTROL SCHEMES, CRUISE AND HEADWAY CONTROL 9

Feed - Forward control - Cascade control- Design considerations for cascade control, Time delay compensation, Inferential control- Nonlinear control- Adaptive control etc. Cruise control design- Autonomous cruise control- Anti locking brakes- Traction control system- Vehicle stability control linear and non-linear vehicle model- VSC Design Principles – four-wheel steering – Goals of 4WS Algorithms – active suspensions.

UNIT III DRIVER MODELING AND POWERTRAIN CONTROL SYSTEMS 9

Driving simulators- percentage of road departure- Driver modeling- Transfer function models- Preview/ Predictive models- longitudinal driver models Control oriented engine modeling- Air intake model- Fuel dynamics model- Air Fuel ratio dynamics- Engine Control Loops- Air Fuel Ratio control- EGR Control- Spark Timing control- Idle speed control- Knock control-Adaptive knock control- Combustion torque estimation- Transmission control.

UNIT IV CONTROL OF HYBRID AND FUEL CELL VEHICLES 9

Series-Parallel- Split Hybrid Configurations- Hybrid Vehicle Control Hierarchy- Control Concepts of Series Hybrids- Equivalent Consumption minimization strategy- control concepts for split hybrid modelling of fuel cell systems- fuel stack model- control of fuel cell system.

UNIT V HUMAN FACTORS AND INTELLIGENT TRANSPORT SYSTEM 9

Human factors in vehicle automation- crossover model principle- Risk-Homeostatic Theory- Driving simulators- percentage of road departure Advanced traffic management system- Advanced traveler information system- commercial vehicle operation- Advanced vehicle control system- Preventing collisions- Longitudinal motion control and platoons- Site specific information- comparison of longitudinal control approaches- String stability- Automated steering and lateral control – Lane sensing- automated lane change and follow control.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Galip Ulsoy, "Automotive Control System", Cambridge University Press, 2012.
2. Uwe Kiencke and Lars Nielson, "Automotive Control System", SAE Publications, 2006.

REFERENCES:

1. Bosch Automotive Handbook, Sixth Edition,2004
2. Benjamin C.Kuo and Farid Golnaraghi, "Automatic Control System", John Wiley & Sons, Eight edition, 2003.
3. Katsuhiko Ogata, "System Dynamics", Prentice Hall International, Inc. Third Edition,1998
4. Richard C.Dorf and Robert H.Bishop, "Modern Control Systems", Pearson Prentice Hall,2008

OUTCOMES:

At the end of the course the student will be able to:

1. Understand the basics of control system used in automobiles (K1)
2. Recognize the electronically controlled system used in driving mechanics (K1)
3. Understand the working principle of driver modeling and power train control systems (K1)
4. Identify the control system used in hybrid and electrical vehicles (K1)
5. Illustrate the need of automated transport systems (K3)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	2	-	-	-	-	1	2	2	2
CO2	3	2	2	1	2	1	-	-	-	-	1	3	2	3
CO3	3	2	3	2	3	2	-	-	-	-	2	2	2	3
CO4	3	3	2	3	3	2	-	-	-	-	2	3	3	3
CO5	3	2	3	3	2	2	-	-	-	-	1	3	3	3
CO6	3	2	3	3	2	2	-	-	-	-	1	3	3	3

PROFESSIONAL ELECTIVES - IV

20MGEL801 SDG NO. 3,4,5,8,10, 13,14,15,16	PROFESSIONAL ETHICS AND VALUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- An understanding of their duties and responsibilities as professionals through gaining knowledge of the philosophies of ethics, professional practice, and world culture.
- Basic knowledge to make informed ethical decisions when confronted with problems in the working environment.
- Improved awareness of potential ethical issues within an engineering context.
- Team skills through working in teams on assignments and in-class assignments.
- Subjective analytical skills through investigation and evaluation of ethical problems in engineering settings using accepted tests for moral problem solving.
- An understanding of how societal morals vary with culture and its influence on ethical thought and action.
- Improved communications skills with regard to ethical and professional issues in engineering.
- Know some of the classic cases as well as contemporary issues in engineering ethics.

UNIT I HUMAN VALUES

Morals, Values, and Ethics – Integrity –Trustworthiness – Work Ethics – Service-Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value Time – Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character.

UNIT II PRINCIPLES FOR HARMONY

Truthfulness – Customs and Traditions -Value Education – Human Dignity – Human Rights – Fundamental Duties – Aspirations and Harmony (I, We & Nature) – Gender Bias – Emotional Intelligence – Salovey – Mayer Model – Emotional Competencies – Conscientiousness.

UNIT III ENGINEERING ETHICS AND SOCIAL EXPERIMENTATION

History of Ethics – Need of Engineering Ethics – Senses of Engineering Ethics- Profession and Professionalism ––Self Interest – Moral Autonomy – Utilitarianism – Virtue Theory – Uses of Ethical Theories – Deontology- Types

of Inquiry –Kohlberg's Theory – Gilligan's Argument – Heinz's Dilemma – Comparison with Standard Experiments –– Learning from the Past – Engineers as Managers – Consultants and Leaders – Balanced Outlook on Law – Role of Codes – Codes and Experimental Nature of Engineering.

UNIT IV ENGINEERS' RESPONSIBILITIES TOWARDS SAFETY AND RISK

The concept of Safety – Safety and Risk – Types of Risks – Voluntary v/sInvoluntary Risk – Consequences – Risk Assessment –Accountability – Liability – Reversible Effects – Threshold Levels of Risk – Delayed v/sImmediate Risk – Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

UNIT V ENGINEERS' DUTIES AND RIGHTS

Concept of Duty – Professional Duties – Collegiality – Techniques for Achieving Collegiality – Senses of Loyalty – Consensus and Controversy – Professional and Individual Rights – Confidential and Proprietary Information – Conflict of Interest-Ethical egoism – Collective Bargaining – Confidentiality – Gifts and Bribes – Problem solving-Occupational Crimes- Industrial Espionage- Price Fixing-Whistle Blowing.

UNIT VI GLOBAL ISSUES

Globalization and MNCs –Cross Culture Issues – Business Ethics – Media Ethics – Environmental Ethics – Endangering Lives – Bio Ethics – Computer Ethics – War Ethics – Research Ethics -Intellectual Property Rights.

TEXT BOOKS:

1. Engineering Ethics & Human Values by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd – 2009

REFERENCE BOOKS:

1. Ethical Choices in Business Response Books, Sekhar, R.C: 1997, New Delhi,Sage Publications.
2. The Ethical Organisation, Kitson, Alan and Campebell, Robert: 1996. Great Britain Macmillan Press Ltd.
3. Engineering Ethics, Pinkus, Rosa Lyun B., Larry J Shulman, Norman Phummon, Harvey Wolfe:1997, New York, Cambridge Uty., Press
4. Professional Ethics by R. Subramaniam – Oxford Publications, New Delhi.
5. Ethics in Engineering by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.

6. Professional Ethics and Morals by Prof.A.R.Aryasri, Dharanikota Suyodhana – Maruthi Publications.
7. Engineering Ethics by Harris, Pritchard, and Rabins, Cengage Learning, New Delhi.
8. Human Values & Professional Ethics by S. B. Gogate, Vikas Publishing House Pvt. Ltd., Noida.
9. Professional Ethics and Human Values by A. Alavudeen, R.Kalil Rahman and M. Jayakumaran – University Science Press.
10. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill – 2013
11. Human Values And Professional Ethics by Jayshree Suresh and B. S. Raghavan, S.Chand Publications

WEB RESOURCES

1 Ethos Education provides a concise guide on developing a code of ethics for primary and secondary schools.
2 The Ethics Resource Center has a toolkit available for use. When used for commercial purposes, a nominal license fee is required.
3 Creating A Code Of Ethics for Your Organization, with many suggested books, by Chris MacDonald
4 The Deloitte Center for Corporate Governance offers a variety of resources for those who are active in governance, including a variety of resources and a set of suggested guidelines for writing a code of ethics or a code of conduct.

MOOC REFERENCES:

1 https://www.udemy.com/course/worlplace-ethics-and-attitude/
2 https://www.udemy.com/course/business-ethics-how-to-create-an-ethical-organization/
3 https://nptel.ac.in/courses/110/105/110105097/Ethics in Engineering Practice
4 https://nptel.ac.in/courses/109/104/109104068/Human Values
5 https://www.coursera.org/learn/ethics-technology-engineering
6 https://www.classcentral.com/course/ethics-technology-engineering-10485

OUTCOMES:

Upon completion of the corse, the students will be able to

1 Classify between ethical and non-ethical situations. (K2)
2 Discuss and practice moral judgment in conditions of dilemma. (K2)

3 Explain and relate the code of ethics to social experimentation and real world scenarios. (K2)

4 Describe risk and safety measures in various engineering fields. (K2)

5 Explain the impact of engineering solutions in a global/societal / professional context. (K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	3	3	3	3	3	1	3
CO2	2	3	2	2	2	3	3	3	3	3	2	3
CO3	3	2	3	2	2	3	3	3	3	3	1	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	2	2	2	2	2	3	3	3	3	3	1	3

Imagine the Future and

Make it happen!

Together let's build a better world where there is NO POVERTY and ZERO HUNGER.

We have GOOD HEALTH AND WELL BEING QUALITY EDUCATION and full GENDER EQUALITY everywhere.

There is CLEAN WATER AND SANITATION for everyone. AFFORDABLE AND CLEAN ENERGY

which will help to create DECENT WORK AND ECONOMIC GROWTH. Our prosperity shall be fuelled

by investments in INDUSTRY, INNOVATION AND INFRASTRUCTURE that will help us to

REDUCE INEQUALITIES by all means. We will live in SUSTAINABLE CITIES AND COMMUNITIES.

RESPONSIBLE CONSUMPTION AND PRODUCTION will help in healing our planet.

CLIMATE ACTION will reduce global warming and we will have abundant,

flourishing LIFE BELOW WATER, rich and diverse LIFE ON LAND.

We will enjoy PEACE AND JUSTICE through STRONG INSTITUTIONS

and will build long term PARTNERSHIPS FOR THE GOALS.

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College Campus
Sai Leo Nagar, West Tambaram,
Chennai - 600 044. Ph : 044-2251 2222

Administrative Office
"Sai Bhavan", 31B, Madley Road, T.Nagar,
Chennai - 600 017. Ph : 044-4226 7777

e-mail : sairam@sairamgroup.in

www.sairamgroup.in