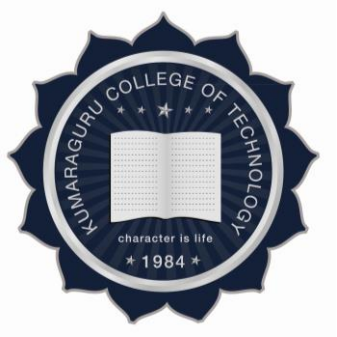
KUMARAGURU COLLEGE OF TECHNOLOGY, COIMBATORE – 641 049

Department of Electronics and Instrumentation Engineering

REGULATIONS 2017

CURRICULUM



III to VI Semesters

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Department of Electronics and Instrumentation Engineering

VISION

The Department of Electronics and Instrumentation Engineering (EIE) envisions a holistic education that transforms the learners into responsible engineers which shall enable them to identify significant problems both in industry and society to arrive at creative and sustainable solutions through collaborative team efforts.

MISSION

The Department of Electronics and Instrumentation Engineering (EIE) aims to

- Implement modern andragogical approach in academics, innovative research initiatives and collaborative projects that shall ethically address the societal needs.
- Develop knowledge and skills required to excel in manufacturing, automation and allied industries on a global platform.
- Expand the knowledge for higher studies and get inspired for lifelong learning.

Program Educational Objectives (PEOs)

Graduates of B.E (Electronics and Instrumentation Engineering) will

PEO 1	Excel in technical and professional career with core competence in automation.
PEO 2	Possess the passion for professional development by continuous learning in allied Engineering and Management fields.
PEO 3	Engage in resolving industrial and social issues using contemporary tools.
PEO 4	Exhibit professionalism and ethical attitude towards resolving automation issues to society at large.

Program Outcomes (POs)

Graduates of B.E (Electronics and Instrumentation Engineering) will be able to:		
PO 1	***Engineering Knowledge***	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to solve complex engineering problems.
PO 2	***Problem Analysis***	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	***Design / Development of Solutions***	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	***Conduct Investigations of Complex Problems***	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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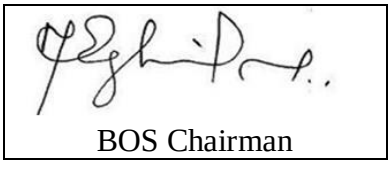
PO 5	***Modern Tool Usage***	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	***The Engineer and Society***	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	***Environment and Sustainability***	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	***Ethics***	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	***Individual and Team Work***	Function competently as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	***Communication***	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make decisive presentations, and give and receive impeccable instructions.
PO 11	***Project Management and Finance***	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	***Life-long Learning***	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological transformation.

Program Specific Outcomes (PSOs)

Graduates of B.E (Electronics and Instrumentation Engineering) will be able to:	
PSO 1	Develop, analyse and calibrate Instruments and electronic systems for various real world applications adhering to ISA ethical codes.
PSO 2	Integrate programmable logic controllers (PLC), distributed control systems (DCS) for manufacturing and processing systems and also gain proficiency in relevant software tools.



CURRICULUM

SEMESTER I										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U17MAI1202	Matrices and Differential Equations	Embedded – Theory and Practical	BS	3	0	2	0	4	--
2	U17PHT1007	Physics for Instrumentation Engineering	Theory	BS	3	0	0	0	3	--
3	U17CHT1004	Chemistry for Circuit Engineering	Theory	BS	3	0	0	0	3	--
4	U17CSI1211	Structured Programming using C	Embedded– Theory and Practical	ES	3	0	2	0	4	--
5	U17EII1201	Basic Electronics	Embedded– Theory and Practical	PC	3	0	2	0	4	--
6	U17ENI1201	English for Cognizance	Embedded– Theory and Practical	HS	1	0	2	0	2	--
7	U17CHP1501	Chemistry Laboratory	Lab	BS	0	0	2	0	1	--
8	U17VEP1501	Personal values	Lab	HS	0	0	2	0	1	--
								Total Credits	**22**	
								Total Contact Hours/week	**28**	

SEMESTER II										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U17MAT2102	Advanced Calculus and Laplace Transforms	Theory & Tutorial	BS	3	1	0	0	4	--
2	U17PHT2005	Material Science for Instrumentation Engineering	Theory	BS	3	0	0	0	3	--
3	U17EII2201	Electric Circuits	Embedded– Theory and Practical	PC	3	0	2	0	4	--
4	U17MET2101	Engineering Graphics	Theory & Tutorial	ES	2	1	0	0	3	--
5	U17PHP2501	Physics Laboratory	Lab	BS	0	0	2	0	1	--
6	U17MEP2501	Engineering Practices Laboratory	Lab	ES	0	0	2	0	1	--
7		Language Elective	Lab	HS	0	0	4	0	2	--
8	U17ISP2701	Social Immersion Project	Project	ES	0	0	0	4	2	--
9	U17VEP2502	Inter-Personal values	Lab	HS	0	0	2	0	1	
								Total Credits	**21**	
								Total Contact Hours/week	**29**	

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SEMESTER III										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U17EII3201	Analog Electronics	Embedded – Theory and Practical	PC	3	0	2	0	4	--
2	U17EII3202	Sensors and Measurements	Embedded – Theory and Practical	PC	3	0	2	0	4	--
3	U17BTT3006	Biology for Engineers	Theory	BS	3	0	0	0	3	--
4	U17MAT3102	Numerical methods and Probability	Theory & Tutorial	BS	3	1	0	0	4	--
5	U17MET3007	Mechanics and Thermodynamics	Theory	ES	3	0	0	0	3	--
6	U17INI3600	Engineering Clinics I	Embedded– Practical and Project	ES	0	0	4	2	3	--
								Total Credits	**21**	
								Total Contact Hours/week	**26**	

SEMESTER IV										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U17EII4201	Electronic Signal Conditioning	Embedded– Theory and Practical	PC	3	0	2	0	4	U17EII3201
2	U17EII4202	Digital Fundamentals and Microprocessor	Embedded – Theory and Practical	PC	3	0	2	0	4	--
3	U17EII4203	Modelling and Analysis of Dynamic Systems	Embedded– Theory and Practical	PC	3	0	2	0	4	--
4	U17EIT4004	MEMS and Sensor Design	Theory	PC	3	0	0	0	3	U17EII3202
5	U17EIT4005	Ancillary Support System	Theory	PC	3	0	0	0	3	--
6	U17INI4600	Engineering Clinics II	Embedded– Practical and Project	ES	0	0	4	2	3	--
								Total Credits	**21**	
								Total Contact Hours/week	**27**	

SEMESTER V										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U17EII5201	Process Dynamics and Control	Embedded– Theory and Practical	PC	3	0	2	0	4	U17EII4203
2	U17EII5202	Embedded Microcontrollers	Embedded– Theory and Practical	PC	3	0	2	0	4	U17EII4202

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3	U17EII5203	Field Instrumentation	Embedded–Theory and Practical	PC	3	0	2	0	4	U17EII3202
4	U17EIT5004	Industrial Communication and Networking	Theory	PC	3	0	0	0	3	--
5	U17EIE00- -	Professional Elective I	Theory	PE	3	0	0	0	3	--
6	U17- - - - - - -	Open Elective I	Theory	OE	3	0	0	0	3	--
7	U17INI5600	Engineering Clinics III	Embedded–Practical and Project	ES	0	0	4	2	3	--
Total Credits									**24**	
Total Contact Hours/week									**30**	

SEMESTER VI										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U17EII6201	Industrial Automation	Embedded–Theory and Practical	PC	3	0	2	0	4	U17EII5201 U17EII5203
2	U17EII6202	Digital Signal Processing & Deep learning	Embedded–Theory and Practical	PC	3	0	2	0	4	U17EII4203
3	U17EIE00- -	Professional Elective II	Theory	PE	3	0	0	0	3	--
4	U17- - - - - - -	Open Elective II	Theory	OE	3	0	0	0	3	--
5	U17EIT6003	Comprehensive Studies	Theory	PC	2	0	0	0	2	U17EII3201, U17EII3202, U17EII4202 U17EII5201, U17EII5203
6	U17EIE00- -	Professional Elective III	Theory	PE	3	0	0	0	3	--
7	U17INI6600	Engineering Clinics IV	Embedded–Practical and Project	ES	0	0	4	2	3	--
Total Credits									**22**	
Total Contact Hours/week									**26**	

SEMESTER VII										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U17EIT7001	Analytical Instrumentation	Theory	PC	3	0	0	0	3	U17EII3202
2	U17EII7202	Advanced Control system	Embedded–Theory and Practical	PC	3	0	2	0	4	U17EII5201

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3	U17EIE00- -	Professional Elective IV	Theory	PE	3	0	0	0	3	--
4	U17MBT7000	Engineering Economics and Financial Management	Theory	HS	3	0	0	0	3	--
5	U17EIP7703	Design project	Project Only Course	PW	0	0	0	6	3	--
Total Credits									**16**	
Total Contact Hours/week									**20**	

SEMESTER VIII										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U17EIP8701	Capstone Project	Project Only Course	PW	0	0	0	24	12	U17EIP7703
Total Credits									**12**	
Total Contact Hours/week									**24**	

List of Professional Electives

Electronic Automation										
S. No	**Course code**	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**	**Periods**	**CT**
1	U17EIE0001	Flexible and Wearable Electronics	Theory	3	0	0	0	3	3	PE
2	U17EIE0002	Lab on a Chip	Theory	3	0	0	0	3	3	PE
3	U17EIE0003	VLSI Design	Theory	3	0	0	0	3	3	PE
4	U17EIE0004	Robotics and Flexible Automation	Theory	3	0	0	0	3	3	PE
Advanced Instrumentation										
S. No	**Course code**	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**	**Periods**	**CT**
1	U17EIE0005	Wireless Sensor Measurement Systems	Theory	3	0	0	0	3	3	PE
2	U17EIE0006	Bio sensors and Medical Instrumentation	Theory	3	0	0	0	3	3	PE
3	U17EIE0007	Sensor and Data Fusion	Theory	3	0	0	0	3	3	PE
4	U17EIE0008	Machine Vision	Theory	3	0	0	0	3	3	PE

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Process Automation										
S. No	**Course code**	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**	**Periods**	**CT**
1	U17EIE0009	Fault Detection and Diagnosis	Theory	3	0	0	0	3	3	PE
2	U17EIE0010	Advanced Intelligent Controllers	Theory	3	0	0	0	3	3	PE
3	U17EIE0011	Industry 4.0	Theory	3	0	0	0	3	3	PE
4	U17EIE0012	System Identification, Modelling and Simulation	Theory	3	0	0	0	3	3	PE

General										
S. No	**Course code**	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**	**Periods**	**CT**
1	U17EIE0013	Artificial Intelligence and Machine learning	Theory	3	0	0	0	3	3	PE
2	U17EIE0014	Big Data Analytics	Theory	3	0	0	0	3	3	PE
3	U17EIE0015	Cloud Computing	Theory	3	0	0	0	3	3	PE
4	U17EIE0016	Augmented reality and Virtual Reality	Theory	3	0	0	0	3	3	PE
5	U17EIE0017	Industrial electronic Drives	Theory	3	0	0	0	3	3	PE

Mandatory Non credit courses					
S.No	**Couse Code**	**Course Title**	**Course Mode**	**CT**	**Sem**
1	U17VEP3503	Family Values	Lab	HS	3
2	U17CHT3000	Environmental Science and Engineering	Theory	MC	3
3	U17VEP4504	Professional Values	Lab	HS	4
4	U17INT4000	Constitution of India	Theory	MC	4
5	U17VEP5505	Social Values	Lab	HS	5
6	U17VEP6506	National Values	Lab	HS	6
7	U17VEP7507	Global Values	Lab	HS	7

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SEMESTER I

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U17MAI1202	Matrices and Differential Equations (For EIE)	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify eigen values and eigen vectors of matrices and examine the consistency of system of linear equations.

CO2: Apply orthogonal diagonalisation to convert quadratic form to canonical form.

CO3: Solve first order ordinary differential equations and apply them to certain physical situations.

CO4: Solve higher order ordinary differential equations and apply them to electrical circuits.

CO5: Evaluate the total derivative of a function,expand the given function as series and locate the maximum and minimum for multivariate function.

CO6: Determine Rank, Inverse, Eigen Values, Eigen vetors of the given matrix, Maxima-Minima of the function and Solve Differential equations using MATLAB

Pre-requisite : Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S			M				M	M		M
CO2	S	S			M				M	M		M
CO3	S	S			M				M	M		M
CO4	S	S			M				M	M		M
CO5	S	S			M				M	M		M
CO6	S	S			M				M	M		M

Course Assessment methods

Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) (Theory component)
3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component)
4. Model examination (lab component)
5. End Semester Examination (Theory and lab component)

Indirect

1. Course-end survey

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Theory Component contents

MATRICES 6 Hours

Rank of a matrix – Consistency of a system of linear equations - Rouche's theorem - Solution of a system of linear equations - Linearly dependent and independent vectors – Eigen values and Eigen vectors of a real matrix – Properties of eigen values and eigenvectors – Cayley Hamilton theorem (excluding proof).

DIAGONALISATION OF A REAL SYMMETRIC MATRIX 6 Hours

Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 11Hours

Leibnitz's equation – Bernoulli's equation – Equations of first order and higher degree - Clairauts form – Applications: Orthogonal trajectories and simple Electric circuit problems.

HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS 11Hours

Linear equations of second and higher order with constant coefficients – Euler's and Legendre's linear equations – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients - Application - Electrical circuit. (Differential equations and associated conditions need to be given).

FUNCTIONS OF VARIABLES 11Hours

Total derivative – Taylor's series expansion – Maxima and minima of functions of two variables – Constrained maxima and minima: Lagrange's multiplier method with single constraints – Jacobians.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45Hours

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition.
2. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
3. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics", S. Chand & Co., New Delhi, (Reprint) 2008.
4. Kreyzig E., "Advanced Engineering Mathematics", Eighth Edition, John Wiley and sons, 2010.
5. Arunachalam, T., Engineering Mathematics I, Sri Vignesh Publications, Coimbatore. (Revised) 2009.
6. Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai,2003.

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7. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).

Lab component:

List of Experiments **30 Hours**

1. Introduction to Matlab
2. Matrix Operations - Addition, Multiplication, Transpose, Inverse
3. Rank of a matrix and solution of a system of linear equations
4. Characteristic equation of a Matrix and Cayley-Hamilton Theorem.
5. Eigen Values and Eigen Vectors of Higher Order Matrices
6. Curve tracing
7. Solving first order ordinary differential equations.
8. Solving second order ordinary differential equations.
9. Determining Maxima and Minima of a function of one variable.
10. Determining Maxima and Minima of a function of two variables.

Theory: 0	Tutorial: 0	Practical: 30	Project: 0	Total: 30Hours

REFERENCES

1. E books and online course materials
2. Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, CengageLearning India Pvt. Ltd.
3. Advanced Engineering Mathematics, Dennis Zill Warren S Wright Michael R. Cullen,4th edition, 2011, Jones & Bartlett Learning.
4. www.arifsari.net/downloads/MATLAB.pdf

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U17PHT1007 **Physics for Instrumentation Engineering**

L	T	P	J	C
3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Analyze and identify the crystal structure and types in materials.
CO2: Explore the knowledge on the properties, production, and application of ultrasound.
CO3: Acquire the basic knowledge in quantum mechanics.
CO4: Imbibe the concept of optics, laser and their applications in engineering.
CO5: Categorize the optical fiber and apply it for various fields.
CO6: Understanding the basic principles of display technology.

Pre-requisites : NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										M
CO2	S	M			S							M
CO3	S	M			S							M
CO4	S	M			S							M
CO5	S	M			S							M
CO6	S	M					M					M

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Group Presentation, Project report, Poster preparation, End Semester Examination
Indirect
1. Course-end survey

9 Hours

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CRYSTAL PHYSICS

Space lattice – unit cell – lattice planes – Bravais space lattices – Miller indices – calculation of interplanar distances – Atomic radius – co- ordination number – Packing factor for SC, BCC, FCC and HCP structures-Natural crystal-Synthetic crystal-Piezoelectric crystal- X-cut, Y-cut, Z-cut crystals- crystal imperfections – point defects – line defects – surface defects – volume defects – effect of crystal imperfections.

ULTRASONICS **9 Hours**

Introduction – production methods of ultrasonics – magnetostriction generator – piezo electric generator – properties – detection – cavitation effect –acoustical grating – velocity measurement – applications: SONAR –velocity of blood flow – Ultrasonic flaw detector – A scan, B scan, C scan.

QUANTUM PHYSICS **9 Hours**

Planck's quantum theory of black body radiation (derivation) - photo electric effect (qualitative description only) - Compton effect (derivation) and experimental verification of Compton effect - De-Broglie's concept - Schrodinger wave equation - time independent and time dependent equations (derivations) - physical significance of wave function - particle in a box (one dimensional case).

APPIED OPTICS **9 Hours**

Air wedge and its applications - Lasers – spontaneous and stimulated emissions – Einstein's coefficients – Types of laser – Nd : YAG, CO_2 and semiconductor laser – Homo junction (qualitative description) – applications – Holography (Qualitative only)
Optical fiber: Principle and propagation of light in optical fibers – numerical aperture and acceptance angle – types of optical fibers – Fabrication of optical fiber - Double crucible technique-Splicing-Losses in optical fiber – communication system.

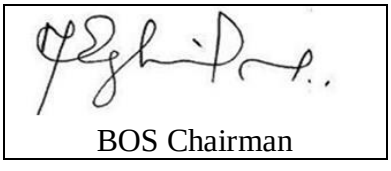
OPTICAL MATERIALS **9 Hours**

Optical properties of semiconductors – Excitons- Traps – colourcentre – Types of colourcenters– luminescence – fluorescence and phosphorescence - liquid crystal display – Dynamics scattering display – Twisted Nematic crystal display – Non- linear materials – second harmonic generation – optical mixing – optical phase conjugation.

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

REFERENCES

1. Calister, "Material Science and Engineering: An Introduction", 7th Edition, John Wiley and Sons, 2006.
2. Avadhanulu M.N. and Kshirsagar P.G., A textbook of Engineering Physics, S.Chand& Company Ltd, New Delhi,2005.
3. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2003.
4. Palanisamy P.K., Engineering Physics I, Scitech Publications, Chennai, 2011.
5. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.



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6. RajendranV, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
7. Gopal S., Engineering Physics, Inder Publications, Coimbatore, 2006.
8. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015. 2

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U17CHT1004 Chemistry for Circuit Engineering

L	T	P	J	C
3	0	0	0	3

(Common to Electronics and Communication Engineering and Electronics and Instrumentation Engineering)

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Discuss Basic concepts of electrochemistry involved in corrosion (K3)
CO2: Apply the principle of electrochemistry and assemble a battery (K3)
CO3: Outline the principles of electrode assembly in biomedical instrumentation (K2)
CO4: Discuss the thermodynamic concepts and predict the feasibility of chemical reaction (K2)
CO5: Outline about PCB and discuss the process of PCB fabrication(K2)
CO6: Apply the concepts of etching and plating in developing printed circuit boards (K3)

Pre-requisites : NIL

CO/PO Mapping
(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M					M						
CO2	M											
CO3	W	M				M						
CO4	S		M			M						
CO5	S											
CO6	M											

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation,Prototype or Product Demonstrationetc (as applicable) 3. End Semester Examination
Indirect
1. Course-end survey

ELECTROCHEMISTRY 9 Hours

Introduction - Electrode potential - Nernst equation and problems - Electrochemical series - Application of EMF measurements and problems - Kohlrausch law of independent migration

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of ions and its application

Electrodes: Standard and Reference electrode (Hydrogen and Calomel) - Types of electrodes (Metal - Metal ion; Metal - Metal insoluble salt, Redox electrode) - Ion selective (glass electrode) - Classification of electrochemical cell.

BIOELECTRODES 12 Hours

Introduction -Tissue interface - Determination of pH, pO_2, pCO_2 using electrodes - Electrodes for ECG - Electrodes for EEG - Dry electrodes: Dry contact and non-contact electrodes (overview)

Electrical conductivity of Electrode Jellies and Creams: Introduction -Microelectrodes: Glass micro capillary electrodes and Metal micro electrodes.

ENERGY STORING DEVICES 12 Hours

Batteries: Factors for selection of batteries - Rating calculation using datasheet.

Primary Battery (Alkaline battery) - Secondary Battery (Lead acid storage battery, Nickel - Cadmium battery, Lithium ion battery and Lithium polymer battery) - Nuclear battery-Nano battery.

Flow battery: Introduction - Construction of types of fuel cell

Solar Cells: Silicon Solar cells - Hybrid Solar cells - Dye sensitized Solar cells - Tandem Solar cells.

THERMODYNAMICS 3 Hours

Introduction - Thermodynamic process (isothermic, isobaric, isochoric and adiabatic processes) - Internal energy -First law of thermodynamics (Mathematical derivation and limitation) - Second law of thermodynamics - Third law and Zeroeth law of thermodynamics -Work function -Ficks law of diffusion.

BASICS OF PRINTED CIRCUIT BOARDS 9 Hours

Introduction - Components and Types of PCB – Advantages and Disadvantages - Flexible printed circuit boards (an overview)

Chemistry of Laminates in PCB: Properties and Types

Fabrication Process involved in PCB : Subtractive process – Additive process

Etching Techniques: Etching solutions - Electrochemical etching of Cu from PCB

Plating Techniques: Plating - Need for plating - Electroforming - Electropolishing - Electrochemical machining - Electrophoretic painting

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours

REFERENCES

1. Glasstone S., An introduction to Electrochemistry, 10th Edition, Affiliated to East West Press Private Limited, 2007.
2. Derek Pletcher and Frank C Walsh, Industrial Electrochemistry, Blackie Academic and Professional, London.
3. David Linden, Thomas B. Reddy, Handbook of batteries, 3rd edition, McGraw-Hill Companies, Inc. 2001
4. Revankar S.T., Majumdar P, "Fuel Cell: Principles, Design and Analysis", CRC Press, 2014.
5. Bahl B.S., Tuli G.D. and ArunBahl., Essential of Physical Chemistry, S.Chand& Co. Ltd., New Delhi.
6. Syed Shabudeen, P.S. and Shoba U.S., Engineering Chemistry, Inder Publishers,

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Coimbatore. 2014
7. Jain P.C. and Monika Jain, Engineering Chemistry, Dhanpatrai Pub. Co. (P) Ltd., New Delhi, 2015
8. R.S.Khandpur, Printed Circuit Boards Design, Fabrication and Assembly, McGraw-Hill Electronic Engineering, New Delhi.
9. R.S.Khandpur., Handbook of Biomedical Instrumentation.,Tata McGraw-Hill Publishing Company Limited., New Delhi.

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U17CSI1211 **Structured Programming using C**

L	T	P	J	C
3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Explain the basics of problem solving techniques

CO2: Select appropriate data types and control structures for solving a given problem

CO3: Illustrate the representation of arrays, strings and usage of string operations

CO4: Illustrate the importance of pointers and functions

CO5: Explain the fundamentals of structures and unions

CO6: Explain the fundamentals of file handling

Pre-requisite: Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										
CO2	S	M										
CO3	S	L			L				L	L		
CO4	M	L			L				L	L		M
CO5	M	L			L				L	L		M
CO6	L	L										

Course Assessment methods:

Direct
1. Continuous Assessment Test I, II (Theory Component)
2. Assignment (Theory Component)
3. Group Presentation (Theory Component)
4. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component)
5. Model examination (lab component)
6. End Semester Examination (Theory and lab component)
Indirect
1. Course-end survey

Theory Component contents

FUNDAMENTALS OF PROBLEM SOLVING **9 Hours**

Programs and Programming – Classification of Programming Languages based on Generations –

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Structured Programming Concept – Algorithm – Flowchart – Pseudo code

STRUCTURED PROGRAMMING **9 Hours**

Introduction to C Programming – Operators and Expressions – Data Input and Output – Control Statements

ARRAYS AND STRINGS **9 Hours**

Defining an array – Processing an array – Passing arrays to functions –Multidimensional Arrays Defining a string – NULL character – Initialization of Strings – Reading and Writing Strings – Processing Strings – Character Arithmetic – Searching and Sorting of Strings – Library functions for strings

FUNCTIONS, STORAGE CLASSES AND POINTERS **9 Hours**

Defining a function – Accessing a function – Function prototypes – Passing arguments to a function – Recursion – Storage classes – Pointer Fundamentals – Pointer Declaration – Passing Pointers to a Function – Pointers and one dimensional arrays – operations on pointers – Dynamic memory allocation

STRUCTURES, UNIONS AND FILES **9 Hours**

Structures and Unions: Defining a Structure – Processing a Structure – User defined data types (Typedef) – Unions

Files: Opening and Closing a Data File – Reading and writing a data file – Processing a data file – Unformatted data files – Concept of binary files – Accessing a file randomly using fseek

Theory: 45 hours **Tutorial:0 hours** **Practical:0 hours** **Total Hours: 45 hours**

REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. PradipDey and ManasGhosh, "Programming in C", Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.

Lab Component

List of Experiments **30 Hours**

1. Writing algorithms, flowcharts and pseudo codes for simple problems.
2. Programs on expressions and conversions
3. Programs using if, if-else, switch and nested if statements
4. Programs using while, do-while, for loops
5. Programs on one dimensional arrays, passing arrays to functions and array operations
6. Programs using two dimensional arrays, passing 2D arrays to functions
7. Programs using String functions
8. Programs using function calls, recursion, call by value
9. Programs on pointer operators, call by reference, pointers with arrays
10. Programs using structures and unions.
11. Programs on file operations and modes.
12. Working with text files, random files and binary files.

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Theory: 0	Tutorial: 0	Practical: 30	Project: 0	Total: 30 Hours

REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. PradipDey and ManasGhosh, "Programming in C", Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.

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U17EII1201 Basic Electronics

L	T	P	J	C
3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the physical model of basic electronic components like PN Junction Diode, BJT, FET and UJT.

CO2: Comprehend the VI characteristics of electronic devices like PN Junction Diode, BJT, FET and UJT.

CO3: Explore the operation and applications of Opto- electronic devices.

CO4: Explain the characteristics of devices like SCR,TRIAC,PUT,tunneldiode and many other devices used in electronic system.

CO5: Evaluate the characteristics of electronic devices with circuit simulation software and laboratory bench experiments.

CO6: Acquire hands on laboratory experience.

Pre-requisites : Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M		M			W		W			S
CO2	S	S		M	S						W	S
CO3												
CO4	S	S	W	M	S					W	W	S
CO5		S			S	M	W		S	M		S
CO6		S	M		S		W	M	S			S

Course Assessment methods

Direct
1. Continuous Assessment Test I, II (Theory Component)
2. Assignment (Theory Component)
3. Group Presentation (Theory Component)
4. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component)
5. Model examination (lab component)
6. End Semester Examination (Theory and lab component)
Indirect
1. Course-end survey

Theory Component contents

SEMICONDUCTOR DIODE **9 Hours**

Theory of p-n junction – p-n junction as diode – Volt-amp characteristics – Diode resistance – Temperature effect of p-n junction – Transition and diffusion capacitance

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of p-n diode – Diode switching times.

BI-POLAR TRANSISTOR **9 Hours**

Junction transistor – Transistor construction – Input and output characteristics of CE, CB and CC configurations – Transistor hybrid model for CE configuration – Transistor switching times – DC load line-AC load line and Q point.

FIELD EFFECT TRANSISTORS **9 Hours**

Junction field effect transistor – Pinch off voltage – JFET volt-ampere characteristics – JFET small signal model – MOSFETS and their characteristics – FET as a variable resistor – Unijunction transistor.

OPTO ELECTRONIC DEVICES **9 Hours**

Photo emissivity and photo electric theory – Theory, construction and characteristics: light emitting diodes, liquid crystal cell, seven segment display, photo conductive cell, photodiode, solar cell, photo transistor, opto couplers and laser diode.

OTHER DEVICES **9 Hours**

Theory, characteristics and application: SCR, TRIAC, PUT, tunnel diode, thermistors, piezo electric devices, zener diode, charge coupled devices, varactor diode and LDR.

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

REFERENCES

1. Jacob Millman, Christos C. Halkias, Electronic Devices and Circuits, Tata McGraw Hill Publishing Ltd., New Delhi, 2003.
2. Salivahanan S. and Suresh Kumar N., Electronic Devices and circuits, Tata McGraw Hill Publishing Ltd., New Delhi, 2003.
3. Godse A.P. and Bakshi U.A., Electronic Devices and Circuits, Technical Pub., 2010.
4. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India (P) Ltd., New Delhi, 2003.

Lab Component

List of Experiments **30 Hours**

1. Identification of the suitable electronic component as per application requirements.
2. Characteristics of semiconductor and Zener diode.
3. Characteristics of transistor under CE configuration and Determination of h parameters.
4. Characteristics of transistor under CB configuration and Determination of h parameters.
5. Characteristics of JFET.
6. Characteristics of UJT.
7. Characteristics of SCR.
8. Characteristics of Triac.
9. Characteristics of MOSFET.
10. Characteristics of photo diode.

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11. Simulate the characteristics of basic electronic devices.

Theory: 0	Tutorial: 0	Practical: 30	Project: 0	Total: 30 Hours

REFERENCES

1. Jacob Millman, Christos C. Halkias, Electronic Devices and Circuits, Tata McGraw Hill Publishing Ltd., New Delhi, 2003.
2.Salivahanan S. and Suresh Kumar N., Electronic Devices and circuits, Tata McGraw Hill Publishing Ltd., New Delhi, 2003.
3.Godse A.P. and Bakshi U.A., Electronic Devices and Circuits, Technical Pub., 2010.
4.David A. Bell, Electronic Devices and Circuits, Prentice Hall of India (P) Ltd., New Delhi, 2003.

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U17ENI1201 ENGLISH FOR COGNIZANCE

L	T	P	J	C
1	0	2	0	2

(Common to all branches of Engineering and Technology)

COURSE OUTCOMES

After the course the Student will be able to:

CO1: Understand and appreciate vocabulary and syntax with accuracy and clarity.

CO2: Communicate effectively by using appropriate grammar and technical parlance in a range of academic scenarios.

CO3: Interpret and critically evaluate discourses related to functional English.

CO4: Comprehend critical text leading to academic articulation.

CO5: Disseminate professional information through appropriatemeans of communication.

CO6: Demonstrate an understanding for innovative language learning strategies and write texts applying registers formats and language appropriate to the context.

CO/PO Mapping
(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	W	M				W			M	S		M		
CO2		W	M		W	S		W	M	S		S		
CO3	W	S				W	W			S		M		
CO4		M								S		M		
CO5		S				W			M	S		S		
CO6		W				W			W	S		S		

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Direct
1. Continuous Assessment Test I 2. Open book test 3. Assignment 4. End Semester Examination
Indirect
1. Course-end survey

Course Assessment methods

INTRODUCTION TO LITERARY SKILLS **9 Hours**

Parts of Speech – Word Formation – Homonyms - Homophones and Homographs, One Word Substitutes, Acronyms and Abbreviations, Reading Aloud, Quick Reading, Sequencing of jumbled sentences, Reading to Predict.

TECHNICAL NUANCES **9 Hours**

Tense, Voice, Kinds of Syntax, Gerund and Infinitives, Cause and effect expressions, Purpose and functional expressions, Conditional clauses, Reported speech, Diary Writing, Editing (Grammar – Concord, Articles, Parts of Speech, Modifiers – Dangling participles, Misplaced, Squinting and Punctuation).

COMPREHENSION AND ANALYSIS **9 Hours**

Sub Skills of Reading, Reading Comprehension, Text Visualization, Peer Reading, Cloze Test, Inferring Technical Texts, Reading a Travelogue, Reading for Interrogation, Reading to Respond, Note making – Linear and Non-linear.

PRACTISING LITERARY SKILLS **9 Hours**

Instructions and Recommendations, Discourse markers – Process description, Writing a Paragraph – Descriptive, Narrative, Compare and Contrast, Persuasive, Creative Writing, Critical Reading, Twirl Reading, Google Reading.

TECHNICAL CORRESPONDENCE **9 Hours**

Technical Discourse, Modules of a letter, Professional Letters, Industrial Visit/ In-plant Training, Basics of E-Mail writing and E-mail etiquette, Writing Notices, Circulars, Memo and Notes, Report writing.

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Theory: 15	Tutorial: 0	Practical: 30	Project: 0	Total: 45 Hours

Reference Books:

1. English for Engineers—Regional Institute of English, South India, Bangalore, published by Foundation Books, Chennai.

2. Effective Technical Communication—A Guide for Scientists and Engineers—BarunK.Mitra—Oxford University Press, New Delhi.

3. Interchange, Fourth Edition—Jack.C.Richards et.al,--Cambridge University Press, Sri Maitrey Print Tech., Noida.

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U17CHP1501 **Chemistry Laboratory (COMMON TO ECE, E&I, EEE, FT & ME)**

L	T	P	J	C
0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Prepare standard solutions (S1)

CO2: Analyse the properties of water by applying the chemical concepts (S2)

CO3: Analyse the solutions by electrochemical techniques and apply it in real life situations like corrosion, soil, water testing etc (S2)

CO4: Analyse the solutions by spectroscopic techniques and apply it in real life situations like corrosion, soil, water testing etc (S2)

Pre-requisites :

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2	M											
CO3	M					M						
CO4	M					M						

Course Assessment methods

Direct
1. Post-experiment Test/Viva; Experimental Report for each experiment; Model Examination 2. End Semester Examination
Indirect
1. Course-end survey

List of Experiments **30 hours**

1. Preparation of normal solutions of the following substances - Sodium carbonate, Hydrochloricacid and Buffer solution

WATER TESTING

2. Determination of total, temporary and permanent hardness by EDTA method.
3. Estimation of DO by Winkler'smethod
4. Estimation of alkalinity by Indicatormethod.
5. Estimation of chloride by Argentometricmethod.

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ELECTRO CHEMICAL ANALYSIS

6. Estimation of hydrochloric acid by pHmetry.
7. Conductometric estimation of mixture of acids and strongbase
8. Estimation of corrosion of Iron byPotentiometry

PHOTOMETRY

9. Estimation of the extent of dissolution of Copper / Ferrous ions by Spectrophotmetry.
10. Estimation of sodium and potassium in water by Flamephotometry.

DEMONSTRATION

11. Determination of Fire point and Flash point
12. Determination of Cloud and Pour point
13. Microscopic usage in Metallurgy.
14. Determination of Molecular weight by Viscometer

Theory: 0	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 30 Hours**

REFERENCES

1. Jeffery G.H., Bassett J., Mendham J. and Denny R.C., Vogel's Text Book of Quantitative Chemical Analysis, Oxford, ELBS, London,2012.
2. Shoemaker D.P. and C.W. Garland., Experiments in Physical Chemistry, Tata McGraw-Hill Pub. Co., Ltd., London,2003.
3. Shoba U.S., Sivahari R. and Mayildurai R., Practical Chemistry, Inder Publications, Coimbatore, 2011.

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U17VEP1501 **PERSONAL VALUES**

L	T	P	J	C
0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Become an individual in knowing the self

CO 2 : Acquire and express Gratitude, Truthfulness, Punctuality, Cleanliness & fitness.

CO 3: Practice simple physical exercise and breathing techniques

CO 4: Practice Yoga asana which will enhance the quality of life.

CO 5: Practice Meditation and get benefited.

CO 6: Procure Self Healing techniques for propagating healthy society

Pre-requisites : NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												M
CO2										S		
CO3						M						
CO4						S			M			
CO5										M		
CO6								W				S

Course Assessment methods

Direct
1. Group Activity / Individual performance and assignment 2. Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

30 hours

Values through Practical activities:

1.Knowing the self : Introduction to value education - Need & importance of Value education – Knowing the self – realization of human life – animal instinct vs sixth sense.

2. Mental Health : Evolution of senses – functioning steps of human mind – Body and Mind coordination - Analysis of thoughts – moralization of desires– autosuggestions – power of positive affirmations. – Meditation and its benefits.

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3.Physical Health: Physical body constitution– Types of food - effects of food on body and mind – healthy eating habits – food as medicine– self healing techniques.

4.Core value : Self love&Self care Gratitude - Happiness - Optimistic –Enthusiasm – Simplicity – Punctual - Self Control - Cleanliness & personal hygiene - Freedom from belief systems.

5.Fitness: Simplified physical exercises – Sun salutation - Lung strengthening practices: Naadisuddhi pranayama – Silent sitting and listening to nature – Meditation.

Theory: 0	Tutorial: 0	Practical: 30	Project: 0	Total: 30 hours

REFERENCES

1. KNOW YOURSELF — SOCRATES – PDF format at www.au.af.mil/au/awc/awcgate/army/rotc_self-aware.pdf

2. STEPS TO KNOWLEDGE: The Book of Inner Knowing – PDF format at www.newmessage.org/wp-content/uploads/pdfs/books/STK_NKL_v1.5.pdf

3. PROMOTING MENTAL HEALTH - World Health Organization – PDF format at www.who.int/mental_health/evidence/MH_Promotion_Book.pdf

4. LEARNING TO BE: A HOLISTIC AND INTEGRATED APPROACH TO VALUES – UNESCO PDF format at www.unesdoc.unesco.org/images/0012/001279/127914e.pdf

5. PERSONALITY DEVELOPMENT By SWAMI VIVEKANANDA www.estudantedavedanta.net/Personality-Development.pdf

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SEMESTER II


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U17MAT2102 **Advanced Calculus and Laplace Transforms (Common to EEE,EIE)**

L	T	P	J	C
3	1	0	0	4

Course Outcomes

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

CO1 : Evaluate multiple integrals and apply them to find area, moment of inertia, centre of mass and volume K3

CO2 : Apply various vector differential operators and integral theorems for solving engineering problems involving cubes and rectangular parallelepipeds. K4

CO3 : Construct analytic functions of complex variables and transform functions from Z - plane and w-plane and vice-versa, using conformal mappings K4

CO4 : Use the fundamentals of residues, complex integration to evaluate real integrals K3

CO5 : Transform functions in time domain to frequency domain using Laplace transform K4

CO6 Convert ordinary differential equations into algebraic equations using Laplace transform and solve them using inverse Laplace transform K4

Pre-requisites : Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S							M	M		M
CO2	S	S							M	M		M
CO3	S	S							M	M		M
CO4	S	S							M	M		M
CO5	S	S							M	M		M
CO6	S	S							M	M		M

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination
Indirect
1. Course-end survey

MULTIPLE INTEGRALS **9 + 3 Hours**

Double integration – Cartesian and polar coordinates – Change of order of integration – Change of variables between cartesian and polar coordinates - Triple integration in cartesian coordinates – Application: Area as double integral – Volume as triple integral-Total charge in a plate

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VECTOR CALCULUS **9 + 3 Hours**

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

ANALYTIC FUNCTION **9 + 3 Hours**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy-Riemann equations in Cartesian coordinates and sufficient conditions (excluding proofs) – Properties of analytic function – Construction of analytic function by Milne Thomson method – Conformal mapping : $w = z + c$, cz , $1/z$ and bilinear transformation.

COMPLEX INTEGRATION **9 + 3 Hours**

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proofs) – Taylor's and Laurent's series expansions – Singularities – Residues – Cauchy's residue theorem (excluding proof) – Application of residue theorem to evaluate real integrals - Unit circle and semi-circular contours (excluding poles on real axis).

LAPLACE TRANSFORM **5 +2 Hours**

Definition of the Laplace Transform; Properties of the Laplace Transform – Superposition, Shift in t or Time Delay, Shift in s, Time Derivatives, Time Integral - Initial Value Theorem - Final Value Theorem; Transform of periodic functions

INVERSE LAPLACE TRANSFORM **4 +1 Hours**

Inverse transforms - Convolution theorem – Application to solution of linear ordinary differential equations of second order with constant coefficients - Solution of integral equations.

Theory: 45	**Tutorial: 15**	**Practical: 0**	**Project: 0**	**Total : 60 Hours**

REFERENCES

1. Veerarajan T., "Engineering Mathematics" (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
2. Kreyzig E., "Advanced Engineering Mathematics", John Wiley & Sons (Asia) Pvt, Ltd., Singapore, 10th Edition, 2011.
3. Philip D. Cha, James J. Rosenberg, Clive L. Dym, "Fundamentals of Modeling and Analyzing Engineering Systems" Published by the Press Syndicate Of The University Of Cambridge, The Pitt Building, Trumpington Street, Cambridge, United Kingdom. (Unit – 5)
4. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, Delhi, 39th Edition, 2005.
5. Venkataraman M.K., "Engineering Mathematics", Volume - II, The National Pub. Co., Chennai, 3rd edition, 2007.
6. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics", S. Chand & Co., New Delhi, (Re print) 2008.
7. Arunachalam, T., Engineering Mathematics II, Sri Vignesh Publications, Coimbatore. (Revised) 2009.
8. C. Ray Wylie and Louis C Barret, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2003.

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9. Simmons G.F., Differential Equations with Applications and Historical Notes, Tata McGraw Hill Edition 2003, Eighteenth reprint 2010.

E books and online learning materials

1. Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage
2. Learning India Pvt. Ltd.
3. Advanced Engineering Mathematics, Dennis Zill Warren S Wright Michael R. Cullen,
4. 4th edition, 2011, Jones & Bartlett Learning.

Online Courses :

http://nptel.ac.in/course.php?disciplineId=111

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U17PHT2005 Material Science for Instrumentation Engineering

L	T	P	J	C
3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the core concepts of conductors.

CO2: Explain the behavior of semiconductors and its applications

CO3: Differentiate the structure and physical properties of magnetic materials.

CO4: Explain the basics of superconductors and its applications

CO5: Understand the mechanism of dielectrics and its applications

CO6: Study of nano materials & new engineering materials and their properties with applications.

Pre-requisites : NIL

CO/PO Mapping
(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										M
CO2	S	M			M							M
CO3	S	M										M
CO4	S	M										M
CO5	S	M										M
CO6	S	M			M							M

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Cooperative learning report, Assignment; Group Presentation, Project report, Poster preparation 3. End Semester Examination.
Indirect
1. Course-end survey

CONDUCTING MATERIALS **9 Hours**

Classical free electron theory of metals-Electrical conductivity –Thermal conductivity - expression – Wiedemann Franz law (derivation) – Lorentz number – drawbacks of classical theory – Fermi distribution function – density of energy states – effect of temperature on Fermi energy.

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SEMICONDUCTING MATERIALS **9 Hours**

Origin of band gap in solids (Qualitative treatment only) - carrier concentration in an intrinsic semi conductor (derivation) – Fermi level – variation of Fermi level with temperature - Electrical conductivity – band gap semiconductor — Extrinsic semiconductor(Qualitative only)- Variation of Fermi level with temperature and impurity concentration – Hall effect – Determination of Hall coefficient – experimental set up – Applications.

MAGNETIC AND SUPERCONDUCTING MATERIALS **9 Hours**

Magnetic materials: Properties of dia, para, ferro, anti ferro and ferri magnetic materials - Domain theory of ferromagnetism - hysteresis – soft and hard magnetic materials – Ferrites – Applications - magnetic storage devices- Tapes, magnetic disc drives – Bubble memory.

Superconducting materials: Superconducting phenomena – properties of superconductors – Meissner effect, Isotope effect, Type I &Type II superconductors – High Tc superconductors - Applications – cryotron, magnetic levitation and squids.

DIELECTRIC MATERIALS **9 Hours**

Electronic, ionic, orientation and space charge polarization - Frequencyand temperature dependence of polarization –Internal field –Clausiusmossotte equation- Dielectric loss – Dielectric breakdown – different types of break down mechanism - Ferro electric materials - properties and applications.

NEW ENGINEERING MATERIALS AND NANOTECHNOLOGY **9 Hours**

New Engineering Materials: Metallic glasses – preparation, properties and applications – Shape memory alloys (SMA) – characteristics, properties of NiTi alloy applications - advantages and disadvantages of SMA.

Nano Materials: synthesis - Chemical vapour deposition – sol-gel - Electro deposition – ball milling – properties of nano particles and applications. – Carbon nano tubes – fabrication - pulsed laser deposition - structure, properties & applications.

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

REFERENCES

1. Halliday D., Resnick R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Calister, "Material Science and Engineering: An Introduction", 7th Edition, John Wiley and Sons, 2006.
3. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2003.
4. Palanisamy P.K., Materials Science, 2nd edition, Scitech Pub. India, (P) Ltd., Chennai, 2003.
5. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
6. Rajendran V, Materials science, 5th edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
7. Avadhanulu M.N. and Kshirsagar P.G., A textbook of Engineering Physics, S.Chand& Company Ltd, New Delhi,2005.
8. Gopal S., Engineering Physics, Inder Publications, Coimbatore, 2006.

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U17EII2201 ELECTRIC CIRCUITS

L	T	P	J	C
3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Evaluate the fundamental laws to solve electric circuits theoretically, practically and verify it with simulation tools

CO2: Apply electrical circuit analysis techniques to DC & AC circuits.

CO3: To analyze the electrical network using electrical circuit analysis techniques by applying network theorems.

CO4: To apply the concepts of AC circuit power analysis to solve electric circuits.

CO5: Understand the transient response of simple RL, RC & RLC circuits and predict the frequency response of resonance circuits.

CO6: Evaluate and troubleshoot any practical situation and demonstrate the converged solution.

Pre-requisite: Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO 12
CO1	S	W	W	W	S	W						
CO2	W	M	S	W			W	W				
CO3	S			W								
CO4	S	W			W							
CO5		W	W	W								
CO6				S					W	W	W	W

Course Assessment methods:

Direct
1. Continuous Assessment Test I, II (Theory Component) 2. Assignment (Theory Component) 3. Group Presentation (Theory Component) 4. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component) 5. Model examination (lab component) 6. End Semester Examination (Theory and lab component)
Indirect
1. Course-end survey

Theory Component contents

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DC CIRCUITS ANALYSIS **11 Hours**

Basic Definitions: Charge, Current, Voltage and Power, Element types, Circuit elements characteristics: Resistors, Inductors, capacitors - Voltage and Current Sources - Ohm's Law, Kirchhoff's Current Law, Kirchhoff's Voltage Law, Circuit elements in Series and Parallel, Voltage and Current Division, Source Transformation, Delta-Star and Star- Delta transformation, Mesh Analysis, super mesh, Nodal analysis, Super node.

NETWORK THEOREMS **7 Hours**

Superposition Theorem, Thevenin's Theorem and Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Verification of Theorems, Introduction to Simulation tools.

SINUSOIDAL STEADY STATE ANALYSIS **9 Hours**

Sinusoids, Phasors, Phasor representation of R, L and C, Phasor Diagrams, Impedance, Admittance, Susceptance, Conductance and Reactance.

AC Circuit Power Analysis-Instantaneous Power, Average Power, RMS Power, Apparent Power and Power Factor, Complex Power, Mesh Analysis & Nodal Analysis, Verification of Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.

FIRST ORDER AND SECOND ORDER CIRCUITS **9 Hours**

Basic RL and RC Circuits: The Source-Free RL Circuit, the Source-Free RC Circuit, The Unit-Step Function, Driven RL Circuits, Driven RC Circuits- Source free series and parallel RLC circuits.

RESONANCE AND COUPLED CIRCUITS **9Hours**

Frequency Response of Parallel and Series Resonance circuits-determination of Resonant Frequency, Q – Factor and Bandwidth. Magnetically Coupled Circuits - Self Inductance, Mutual Inductance, Coefficient of Coupling, Energy in a coupled circuit, Linear Transformer, Ideal Transformer, Duality, Two port networks – Z parameters and H parameters.

Theory: 45 hours	**Tutorial:0 hours**	**Practical:0 hours**	**Total Hours: 45 hours**

REFERENCES

1. Charles K. Alexander and Mathew N.O. Sadiku, Fundamentals of Electric Circuits, 5th edition, McGraw-Hill, 2013.
2. David E. Johnson, Johny R. Johnson and John L. Hilburn, Electric Circuit Analysis, 3rd edition, Prentice-Hall Int.
3. Murthy K.V.V., Kamath M.S., Basic Circuit Analysis, Jaico Publishing House, 1999.
4. Norman Balaba nian, Electric Circuits, Int. Edition, McGraw-Hill, 1994.
5. Decarlo R.A. and Lin P.M., Linear circuit analysis - The time domain, Phasor and Laplace transform approach, Oxford press, 2nd edition, 2003.
6. William H. Hayt, Jr Jack E. Kemmerly and Steven M. Durbin, Engineering Circuit Analysis, 8th edition, MC GrawHill, 2013.
7. Joseph Edministor and Nahvi (Mohmood), Theory & Problems of Electric Circuits, 6th

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edition, MC Graw Hill, 2014.
8. Ravish R. Singh, Network Analysis and Synthesis, 1st edition, MC Graw Hill, 2013.

Lab Component

List of Experiments **30 Hours**

1. Demonstration of the characteristics of basic circuit elements .
2. Verifications of Ohm's Laws & Kirchhoff's Laws.
3. Verification of Star to Delta and Delta to Star Conversion using simulation tools.
4. Verification of network theorem.
5. Phasor relationships in RL & RC circuits.
6. Frequency response RL & RC Circuits.
7. Frequency response of series resonance circuit.
8. Frequency response of parallel resonance circuit.

Theory: 0	Tutorial: 0	Practical: 30	Project: 0	Total: 30 Hours

REFERENCES

1. Charles K. Alexander and Mathew N.O. Sadiku, Fundamentals of Electric Circuits, 5th edition, McGraw-Hill, 2013.
2. David E. Johnson, Johny R. Johnson and John L. Hilburn, Electric Circuit Analysis, 3rd edition, Prentice-Hall Int.
3. Murthy K.V.V., Kamath M.S., Basic Circuit Analysis, Jaico Publishing House, 1999.
4. Norman Balaba nian, Electric Circuits, Int. Edition, McGraw-Hill, 1994.
5. Decarlo R.A. and Lin P.M., Linear circuit analysis - The time domain, Phasor and Laplace transform approach, Oxford press, 2nd edition, 2003.
6. William H. Hayt, Jr Jack E. Kemmerly and Steven M. Durbin, Engineering Circuit Analysis, 8th edition, MC GrawHill, 2013.
7. Joseph Edministor and Nahvi (Mohmood), Theory & Problems of Electric Circuits, 6th edition, MC Graw Hill, 2014.
8. Ravish R. Singh, Network Analysis and Synthesis, 1st edition, MC Graw Hill, 2013.

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U17MET2101 ENGINEERING GRAPHICS

L	T	P	J	C
2	1	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Construct various plane curves.

C02: Construct projection of points and projection of lines.

CO3: Develop projection of surfaces and solids.

CO4: Solve problems in sections of solids and development of surfaces.

CO5: Apply the concepts of isometric, and perspective projections

CO6: Apply free hand sketching in engineering practice.

Pre-requisites : Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										
CO2	S	S									W	
CO3	S	S									M	
CO4	S	S										
CO5	S											
CO6	S											

Course Assessment methods

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) (Theory component) 3. End Semester Examination (Theory Component)
Indirect
1. Course-end survey

PLANE CURVES, PROJECTION OF POINTS AND LINES 6+3 Hours

Importance of graphics in design process, visualization, communication, documentation and drafting tools, Construction of curves - ellipse, parabola, and hyperbola by eccentricity method only. Orthographic projection of points.

Projections of straight lines located in first quadrant - determination of true

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length and true inclinations.

PROJECTIONS OF SURFACES AND SOLIDS
6+3 Hours

Projections of plane surfaces - polygonal lamina and circular lamina, located in first quadrant and inclined to one reference plane. Projection of simple solids - prism, pyramid, cylinder and cone. Drawing views when the axis of the solid is inclined to one reference plane.

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES
6+3 Hours

Sectioning of simple solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane.
Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.

PICTORIAL PROJECTIONS
6+3 Hours

Isometric projection, Isometric scale, Isometric views of simple solids, truncated prisms, pyramids, cylinders and cones.

Perspective projection of prisms and pyramids when its base resting on the ground by vanishing point method.

FREE-HAND SKETCHING
6+3 Hours

Free hand sketching techniques, sketching of orthographic views from given pictorial views of objects, including free-hand dimensioning.
Sketching pictorial views from given orthographic views.

Theory: 30	Tutorial: 15	Practical: 0	Project: 0	Total: 45Hours

REFERENCES

1. Bhatt ND, Engineering Drawing, Charotar Publishing house, 54th edition, 2014.
2. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, New Delhi, 2016.
3. Nataraajan K.V., Engineering Drawing and Graphics, Dhanalakshmi Publisher, Chennai, 2006.
4. Basant Agrawal and Agrawal C.M, Engineering Drawing and Graphics,McGraw Hill Edition(India), 2013.
5. Gopalkrishna K.R., Engineering Drawing (Vol. I & II), Subhas Publications, 2014.

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U17PHP2501 PHYSICS LABORATORY (COMMON TO EC, EE, EI, FT, ME)

L	T	P	J	C
0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Determine different physical properties of a material like thermal conductivity, thickness of the material.

CO2: Perform experiments involving the physical phenomena like interference and diffraction

CO3: Apply physical theories in real life situations by also taking into account its limitation.

Pre-requisites : NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S											
CO2		M	S									
CO3		S		M								

Course Assessment methods

Direct
1. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment; Model Examination 2. End Semester Examination
Indirect
1. Course-end survey

List of Experiments **30 Hours**

1. Determine thermal conductivity of the given cardboard by Lee's disc method.
2. Determine the thickness of a thin sheet by air wedge method.
3. Determine the co-efficient of viscosity of the given liquid by Poiseuille's flow method.
4. Determine the value of acceleration due to gravity by compound pendulum.
5. Calculate the solar panel efficiency by using lux meter.
6. Determine the wavelengths of the violet, blue, green and yellow in mercury spectrum using spectrometer grating method (the green spectral line for which the


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wavelength is 5461 A^0).

7. Determine Young's modulus of the given bar using non-uniform bending method.
8. Calculate the frequency of the given tuning fork by longitudinal and transverse mode of vibrational methods.
9. Determine the velocity of ultrasonic sound and compressibility of the given liquid by using ultrasonic interferometer.
10. By using semiconductor laser determine:
    i) Wavelength of LASER using grating.
    ii) Acceptance angle & numerical aperture of optical fiber (grating element: N=5,00,000 lines/meter).

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

REFERENCES

1. Laboratory Manual of Engineering Physics by Dr. Y. Aparna & Dr. K. Venkateswara Rao (V.G.S Publishers)
2. "Practical Physics", G.L. Squires, Cambridge University Press, Cambridge, 1985. 11. 12.
3. "Great Experiments in Physics", M.H. Shamos, Holt, Rinehart and Winston Inc., 1959.
4. "Experiments in Modern Physics", A.C. Melissinos, Academic Press, N.Y., 1966. Gupta S.C, and Kapur, J.N.

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U17MEP2501 **ENGINEERING PRACTICES LABORATORY**

L	T	P	J	C
0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Select the various tools and equipment's used in the fabrication workshop.
CO2: Develop various models in carpentry and fitting
CO3: Make components using sheet metal work.
CO4: Select the various tools and joints for different applications in plumbing.
CO5: Demonstrate and evaluate the parameters of basic electronic components (wires, resistors, capacitors, diodes etc.) and test the components.
CO6: Estimate DC and AC Voltage and currents using appropriate measuring instruments.

Pre-requisites : Nil

	CO-PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											
COs	**Programme Outcomes(POS)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S											
CO2					M							
CO3			M									
CO4						W						
CO5	M											
CO6	M											

Course Assessment methods

Direct
1. Pre-or Post-Experiment Test/Viva; Experimental Report for each experiment; Comprehensive report / Model Examination 2. End Semester Examination
Indirect
1. Course-end survey

List of Experiments **30 Hours**

GROUP – I

A. CIVIL ENGINEERING

1. Carpentry

- Study of carpentry tools
- Preparation of T joint
- Preparation of dovetail joint

2. Plumbing

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- Study of pipeline joints

B. MECHANICAL ENGINEERING

1. Fitting

- Study of fitting tools
- Preparation of L joint
- Preparation of square joint

2. Sheet Metal Working

- Study of sheet metal working tools
- Preparation of cone
- Preparation of tray

GROUP - II (ELECTRICAL & ELECTRONICS ENGINEERING)

C. 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.

D. ELECTRONIC ENGINEERING PRACTICE

1. Testing of Electronic components and Measurements using a digital multimeter.
2. Study of CRO and Function generator.
3. PCB Design and Fabrication.
4. Soldering simple electronic circuits and checking continuity

Theory: 0	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 30Hours**

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U17ISP2701 SOCIAL IMMERSION PROJECT

L	T	P	J	C
0	0	0	4	2

(Common to all branches of Engineering and Technology)

COURSE OUTCOMES

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

CO1 : Achieve the desirable awareness regarding significant social problems and identify the needs to provide a possible and innovative solution.

CO2 : Acquire and demonstrate effective professional and technical skills to deal with social issues through innovative leadership and sustainable services / approaches.

CO3 : Provide students with a rich practical and socially oriented team work approach.

CO4 : Explain how to make leadership decisions concerning organizational structure and the role of project resources on a project's team.

CO5 : Enhance technical knowledge in addressing the needs of a community problem.

CO6 : Identify tools and techniques for planning and working on a project.

Course Assessment methods

Direct	Indirect

CO/PO Mapping
(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1			S			S	S					
CO2			M	S		S	M	M	M			
CO3			S	W		S	S		S			M
CO4			S			S	S		W		M	
CO5	S		M			S	M					
CO6			S			S	S					

Direct	Indirect
1. Project Review 2. General report preparation 3. Team Presentation	1. Impact study 2. Field Visit & Observation Skill 3. Course end survey

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SOCIAL BONDING AND ENGINEERING

Society and its impact on the individual – Responsibility of individuals towards community building – Essential requirement of the society – Role of an engineering graduate in approaching the requirements - Developing social consciousness.

ENGINEERING PREREQUISITE FOR ENHANCED SOCIAL LIVING

Theoretical reading (Based on the project / general – Books to be identified by the team) - Inculcating Social immersion and Leadership- Study on the society and identifying problems - Social immersion and Engineering implementation - Analysis of problems on issue based - Identification of causes and effects of the social issue identified.

ESSENTIAL ENGINEERING INNOVATION

Essential Engineering Concepts - Multiple approaches towards the problem &Selection for addressing- Addressing a theoretical social problem -Providing multiple solutions for the problem

PROJECT PLANNING AND APPROACHES

Knowledge on budgeting and fund raising - Approaching agencies related to problems. Partnering with agencies- Presentation Skills - Report preparation

BROAD AREA OF PROJECTS

(Students can also identify their own social issue)

Water / Sanitation and Hygiene - Waste Management -Women Empowerment- Community health - Child health/ Poverty/Education/others - Energy management -Environment Management - Adult Education - -Youth Empowerment - Green Industry - Given above are the broad areas of projects recommended. Projects may vary to individuals/ groups/ class/ branch.

TOTAL : 60 Hours

References:

1. Nicholls Alex and Murdock Alex, Social Innovation Blurring Boundaries to reconfigure markets, Palgrave Macmillan., New York, 2012. :
2. Osburg Thomas and Schmidpeter Rene`, Social Innovation Solutions for sustainable Future.Springer, Germany 2013.
3. Adedeji B. Badiru, STEP Project Management: Guide for Science, Technology, and Engineering Projects. Taylor and Francis Group., Florida 2009.

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U17VEP2502 INTERPERSONAL VALUES

L	T	P	J	C
0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Develop a healthy relationship & harmony with others
CO 2: Practice respecting every human being
CO 3: Practice to eradicate negative temperaments
CO 4: Acquire Respect, Honesty, Empathy, Forgiveness and Equality
CO 5: Practice Exercises and Meditation to lead a healthy life
CO 6: Manage the cognitive abilities of an Individual

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										S		
CO2									S			
CO3											M	S
CO4						M						
CO5												M
CO6											M	

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities: **30 hours**

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1. **Introduction**: Introduction to interpersonal values – Developing harmony with others – Healthy relationship – Need & importance of interpersonal values for dealing with others and team - Effective communication with others.

2. **Maneuvering the temperaments:** From Greed To Contentment - Anger To Tolerance - Miserliness To Charity – Ego To Equality - Vengeance To Forgiveness.

3. **Core value** : **Truthfulness -**Honesty –Helping–Friendship – Brotherhood – Tolerance – Caring & Sharing – Forgiveness – Charity –Sympathy — Generosity – Brotherhood - Adaptability.

4.Pathway to Blissful life :

Signs of anger – Root cause – Chain reaction – Evil effects on Body and Mind – Analyzing roots of worries – Techniques to eradicate worries.

5.Therapeutic measures: Spine strengthening exercises - Nero muscular breathing exercises - Laughing therapy - Mindfulness meditation.

Theory: 0	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 30 hours**

REFERENCES

1. INTERPERSONAL SKILLS Tutorial (PDF Version) - TutorialsPoint www.tutorialspoint.com/interpersonal_skills/interpersonal_skills_tutorial.pdf
2. INTERPERSONAL RELATIONSHIPS AT WORK - KI Open Archive - Karolinska www. publications.ki.se/xmlui/bitstream/handle/10616/39545/thesis.pdf?sequence=1
3. VALUES EDUCATION FOR PEACE, HUMAN RIGHTS, DEMOCRACY – UNESCO www.unesdoc.unesco.org/images/0011/001143/114357eo.pdf
4. MANEUVERING OF SIX TEMPERAMENTS - Vethathiri Maharishi www.ijhssi.org/papers/v5(5)/F0505034036.pdf
5. THE BLISS OF INNER FIRE: HEART PRACTICE OF THE SIX ... - Wisdom Publications - www.wisdompubs.org/sites/.../Bliss%20of%20Inner%20Fire%20Book%20Preview.pd...

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ENGLISH ELECTIVE


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U17ENP2501 – ENGLISH FOR PLACEMENT PURPOSES
(Common to all branches of Engineering and Technology)

L	T	P	J	C
0	0	4	0	2

COURSE OBJECTIVES

1. To enhance the logical, analytical and critical thinking skills of the students leading to effective corporate communication.
2. To develop relevant employability skills to cater to the communicative demands of the industry.
3. To adopt relevant job related oral and written communication skills to competently perform in campus recruitments.
4. To train students in presentation skills, persuasive skills and career skills.

COURSE OUTCOMES

After the course the student will be able to:

CO1: Enhance the logical, analytical and critical thinking skills of the students leading to effective corporate communication.
CO2: Develop relevant employability skills to cater to the communicative demands of the industry.
CO3: Adopt relevant job related oral and written communication skills to competently perform in campus recruitments.

Assessment Methods

CO/PO Mapping
(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	W	M				W			M	S		M		
CO2		W	M		W	S		W	M	S		S		
CO3	W	S				W	W			S		M		

Direct
1. Continuous Assessment of Skills 2. Placement Paper Test 3. End Semester Examination
Indirect
1. Course-end survey

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No	Topic	Hours
UNIT -1 – Verbal Ability – 12Hrs		
1.1	Introduction to corporate culture	**1**
1.2	Verbal and Analytical Reasoning	**2**
1.3	Transcoding Graphics	**2**
1.4	Picture Perception & Video Sensitization	**3**
1.5	Placement Test Papers	**4**
UNIT -2 – Presentation Skills – 12Hrs		
2.1	Thematic Oral Presentation	**2**
2.2	Extempore	**4**
2.3	Effective PowerPoint Presentation	**2**
2.4	Email Writing and Resume Writing	**2**
2.5	Copy Editing	**2**
UNIT -3 – Interactive Employability Skills – 12Hrs		
3.1	Introduction to Employability Skills	**1**
3.2	Corporate Interaction	**1**
3.3	Interview Process &Kinds of Interviews	**1**
3.4	Self-Introduction	**4**
3.5	Mock Interview & Stress Interview Practice	**5**
UNIT -4 – Oral Discussion – 12Hrs		
4.1	Introduction to Structure of GD	**1**
4.2	Types of GD	**1**
4.3	GD Practice	**4**
4.4	Introduction to Role-play	**1**
4.5	Role-play Practice	**5**
UNIT -5 – Corporate Skills – 12Hrs		
5.1	Receptive skills	**2**
5.2	Polite English, Placement Behaviour	**2**
5.3	Negotiation Skills	**3**
5.4	Rapid interpretation	**2**
5.5	Business Writing	**3**
Total		**60**

Reference:

1. A Modern Approach to Non Verbal Reasoning (English, Paperback, Dr. R S Aggarwal)
2. Aptitude Guru : Tricks & Tips - Android Apps on Google Play
3. Word Power Made Easy: The Complete Handbook for Building a Superior Vocabulary (By Norman Lewis)
4. Effective Technical Communication Tata Mc Graw Hills Publications (Ashraf Rizvi)
5. English and Soft skills Orient Black Swan Publishers (S. P. Dhanavel)

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U17ENP2502 - ENGLISH FOR RESEARCH PURPOSES

L	T	P	J	C
0	0	4	0	2

COURSE OBJECTIVES

The students will be facilitated to:

1. Recognize and understand fundamental concepts of research and its methodology.
2. Use the resources to read, interpret and critically evaluate the information.
3. Employ and organize the components of writing skills for research.
4. Craft a research paper in a particular discipline.
5. Present and defend the hypothesis of their research proposal.

COURSE OUTCOMES:

After the course the student will be able to:

- Apply some basic concepts of research and its methodologies.
- Identify appropriate research topics and define research problem.
- Demonstrate knowledge of data analysis and interpretation in relation to the research process.
- Draft a review article/ paper effectively using the components of research writing.
- Participate and present professionally in a research forum.

CO/PO Mapping
(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1				M	M				W	M		S		
CO2				M	M				W	M		S		
CO3				S	M				W	M		S		
CO4									M			S		
CO5									M		S	S		

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UNIT-1	INTRODUCTION TO RESEARCH	8 Periods
1.1	Research – Objectives, benefits and types	1
1.2	Choice of topic	1
1.3	Looking for resources	2
1.4	Reading literature review	2
1.5	Citing sources and formation of preliminary bibliography	2
UNIT-2	**FORMATION OF RESEARCH**	**10 Periods**
2.1	Preparing a working outline of research	3
2.2	Formation of hypothesis	2
2.3	Plagiarism	1
2.4	Taking notes and strategies for organizing notes	2
2.5	Planning and organizing the review of literature	2
UNIT-3	**OPERATION OF RESEARCH**	**16 Periods**
3.1	Different types of surveys	2
3.2	Exploring research idea and constructing the research	4
3.3	Finding background information and gathering more information on the chosen area	4
3.4	Locating current research on the topic chosen	2
3.5	Interpreting data and graphics	4
UNIT-4	**MANUSCRIPTION OF RESEARCH**	**13 Periods**
4.1	Writing the first draft	3
4.2	Quality and Style of writing	3
4.3	Editing and proof reading	3
4.4	Writing the introduction and conclusion	3
4.5	Summarizing the research paper and preparing title page	1

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UNIT-5	PRESENTATION AND PUBLICATION OF RESEARCH	13 Periods
5.1	Final revision and proof reading	3
5.2	Final presentation	3
5.3	Benefits of publishing an article	1
5.4	How to publish an article	4
5.5	Funding agencies	2

Reference Books:

1. How to write and publish a research paper. Robert A Day, 4th edition, Cambridge University Press, 1995.
2. The Craft of Research. Wayne C Booth, Gregory G. Colomb, Joseph M Williams, The University of Chicago Press, 2008.
3. Engineering Research Methodology, Krishnan Nallaperumal, 2013.
4. How to write a Paper, ed George M Hall, BMJ Publishing Group, 2003.

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U17ENP2503 – English for Competitive Exams

(Common to all branches of Engineering and Technology)

L	T	P	J	C
0	0	4	0	2

Course Objectives:

1. To impart specific training for various Competitive Examinations like IELTS and TOEFL, DEFENCE EXAMS, BANK & LIC EXAMS, CAT etc.
2. To familiarize the learners with online examinations.
3. To improve the writing skills of students through combination of theory and practice for various competitive exams.
4. To create awareness of job prospects in government and defense service.

Course Outcomes:

By the end of the course the students will be able to:

1. Comprehend the necessity of English competitive exams in the current scenario.
2. Acquire awareness of English content in Government service and defense service Jobs.
3. Accomplish the prediction skills and interpretative excellence required for Competitive Exams.
4. Gain ideas on various Competitive exams and mark out their own capability.
5. Develop the credibility of competitive spirit.

CO/PO Mapping
(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1				M	M				W	M		S		
CO2				M	M				W	M		S		
CO3				S	M				W	M		S		
CO4									M			S		
CO5									M			S		

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No	Topic	Hours
UNIT -1 – Various Competitive Exams – An over view – 5 Hrs		
1.1	General over view of various competitive exams	**1**
1.2	Requirements and eligibility for various competitive exams.	**1**
1.3	Introduction to specialized English exams for work or study abroad	**1**
1.4	Scope for engineering graduates in defence service.	**1**
1.5	Pattern and weightage for English in different competitive exams	**1**
UNIT -2 – English Requirement for Higher Education and Work Abroad– 10 Hrs		
2.1	Conversation social / general context – brief presentation	**2**
2.2	Interpretation of data into text	**2**
2.3	Inferring details from conversation / announcements/ information	**2**
2.4	Understanding specific information- Reading long and short passages	**2**
2.5	Formal and informal Email communication	**2**
UNIT -3 – Verbal Aptitude to Compete – Part I– 10 Hrs		
3.1	Analogy, Cloze test	**2**
3.2	Spot the Error	**2**
3.3	Ordering of Sentences	**2**
3.4	Reading Comprehension	**2**
3.5	Synonyms and Antonyms– One Word Substitutes, Miscellaneous Vocabulary and Spellings	**2**
UNIT -4 – Verbal Aptitude to Compete – Part II– 10 Hrs		
4.1	Verbal Puzzle	**1**
4.2	Idioms and Phrases	**2**
4.3	Essay and Letter	**3**
4.4	Sentence Improvement	**2**
4.5	Fill in the Blanks, Sentence Completion	**2**
UNIT -5 – Training for Competency – 15Hrs		
5.1	Practice Test - I (TOEFL/ IELTS)	**3**
5.2	Practice Test -II (CAT)	**3**
5.3	Practice Test - III (BANK EXAMS)	**3**
5.4	Practice Test - IV(DEFENCE EXAMS / BANK EXAMS)	**3**
5.5	Group Discussion	**3**
Total		**60**

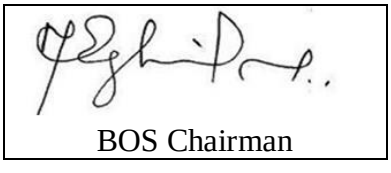
Reference Books:

Cambridge BEC Preliminary Book 4, Cambridge University Press, March,2009.

Complete IELTs, Guy brook- Hart &VanessaJakeman, Cambridge University Press, March,2009

A modern approach to verbal & non-verbal reasoning,Dr.R.SAgarwal, S Chand publications

McGraw-Hill Education TOEFL iBT with 3 Practice Tests and DVD-ROM



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SEMESTER III

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U17EII3201 **ANALOG ELECTRONICS**

L	T	P	J	C
3	0	2	0	4

Course Outcomes (CO):

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

CO1: Apply simple models of bipolar junction transistors, field effect transistors and operational amplifiers, to predict the behavior of amplifier circuits

CO2: Explain the fundamental concepts and operating characteristics of operational amplifiers.

CO3: Utilize operational amplifiers for building linear and non-linear applications

CO4: Design a precision amplifier using Op-amp with required specifications and a low noise amplifier using bipolar and field effect transistors.

CO5: Design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis

CO6: Design and implement high precision circuit for sensor interface and bipolar transistor and JFET with low noise

Pre-requisite: --

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	L	L	M							M	S	
CO2	M	L											M	
CO3	S	M	L	L	M					M		M	S	
CO4	S	S	M	M								M	M	
CO5	S	S	M	M	S				S	M	M		S	
CO6	S	S	M	M	S				S				S	

Course Assessment Methods:

Direct	Indirect
• Model Lab Exam • End Semester Practical Exam • End Semester Exam • Assignments	• Course Exit Survey

Course Content:

ANALYSIS OF BIPOLAR AND UNIPOLAR TRANSISTOR BASED AMPLIFIERS **12 Hours**

Introduction-Load line- Biasing a BJT-Transistor modelling-Small signal practical CE amplifier under h parameter model-Amplifier frequency response-half power gain-CE amplifier at low frequency-CE amplifier at high frequency-Total frequency response-CE amplifier in cascade-overall gain of amplifier in cascade- frequency response.

Introduction- Biasing a JFET-Field effect transistor as amplifier. Feedback configurations. Power amplifier operating classes – Class A, B, AB, c, D, S-power efficiency and analysis.

OPERATIONAL AMPLIFIER **7 Hours**

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Small signal analysis of Differential amplifier- DC and AC characteristics of Op-amp, open loop and closed loop operation of OP-amp. -OPamp frequency response.

APPLICATIONS OF OPERATIONAL AMPLIFIER 9 Hours

Inverting amplifier- non inverting amplifier- Voltage follower -differential amplifier- Instrumentation amplifier, isolation amplifier, chopper amplifier

Differentiator, integrator, clipper, clamper, Sample and hold circuit, V-I converter, I-V converter. Multivibrator, comparator- Filter-Low pass response – high pass response- band pass response-fourth order response- Filter design using standard tables.

OSCILLATORS AND TIMERS 7 Hours

Waveform generator-sine, square and Ramp wave - IC 555 timer – functional block-operation under Astable- Monostable mode. Applications of IC555 timer.

PRECISION OPAMP DESIGN AND LOW NOISE TECHNIQUE 10 Hours

Precision opamp design techniques- high speed Opamp technique-choosing precision opamp-design of precision amplifier

Noise -low noise design with bipolar transistor and JFET-Noise in differential and feedback amplifiers-Noise in operational amplifier.

List of Experiments:

1 Introduction to MyDAQ and Reading data sheets of various Transistors.
2. Study of trouble shooting strategies.(open/short circuit, series/parallel circuits, Transistor/Op-amp circuits)
3. Design, simulation and implementation of small signal amplifier using BJT and FET.
4. Design, simulation and implementation of power amplifier and calculating the power efficiency.
5 Project- Audio Amplifier
6 Practical Verifications of characteristics of Op-amp.
7 Interfacing a sensor to the Instrumentation/chopper amplifier and find the gain.
8 Design and implementation of wave shaping circuits.
9 Design and Build a temperature controlled system using Op-amp as a ON/ OFF controller
10 Design and build a function generator capable of generating square, sine and ramp wave.
11 Design and build the humidity detector using IC555 timer
12 Design and implementation of input protection and conditioning circuit in precision Op-Amp
13 Design and implementation of high precision circuit for sensor interface.
14 Design of bipolar transistor and JFET with low noise
15 Project – Design a signal conditioning unit for a sensor.

Theory Hours : 45	**Practical Hours : 30**	**Total Hours : 75**

Reference books:

1. Herando Lautaro Fernandez-canque, ”Analog Electronics Applications-Fundamentals of Design and Analysis”, CRC press,2017.

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2. Horowitz and Hill, "The art of Electronics"3rd Edition, Cambridge university press.
3. Walt Jung, Editor Emeritus,"Op-Amp Applications Handbook", Elsevier 2015
4. Robert L.Boylestad, Louis Nashelsky,"Electronic Devices and Circuit Theory",11th Edition,Pearson,2013
5. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press Third Edition,2013.

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U17EII3202 SENSORS AND MEASUREMENTS

L	T	P	J	C
3	0	2	0	4

Course Outcomes (CO):

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

CO1: Describe the characteristics and construction details of different sensors.

CO2: Analyze suitable signal conditioning circuits for resistive, reactance and self generating sensors.

CO3: Explain the fundamental concepts and working principle of analog and digital meters.

CO4: Analyze the specification details for the given sensor/Instrument

CO5: Demonstrate the Calibration of temperature sensors and electrical meters like voltmeter and ammeter.

CO6: Evaluate a measurement system using sensor and signal conditioning circuits for an application.

Pre-requisite: --

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W										S	W	
CO2	S	S	M	M									S	
CO3	M	W				W						S		
CO4	S	S	M	M	M									
CO5	S	M	W	W						M			S	
CO6	S	S	M	M			W		M		M			

Course Assessment Methods:	
Direct	**Indirect**
• Continuous assessment test • Model Lab Exam • End Semester Exam • Assignments	• Course Exit Survey

Course Content:

INTRODUCTION TO SENSOR BASED MEASUREMENT SYSTEM: 4 Hours

General concepts and terminology, Sensor classifications, Primary Sensors, Materials for Sensors, Microsensor Technology, and Specification details of sensors/ Instruments –static and dynamic.

RESISTIVE SENSORS AND SIGNAL CONDITIONING: 10 Hours

Potentiometers, Strain gauges, FSR, Resistive bendy sensors, RTDs, Thermistors, Magnetoresistors, LDRs, Resistive Hygrometers, Resistive Gas Sensors, Liquid Conductivity Sensors. Measurement of Resistance: Voltage Dividers, Wheatstone Bridge -Balance Measurements, Deflection Measurements.

REACTANCE VARIATION SENSORS AND SIGNAL CONDITIONING: 9 Hours

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Capacitive Sensors - variable and differential. Inductive Sensors-Variable reluctance and eddy current sensors –LVDTs - Synchros, resolvers, and Inductosyn - Magnetoelastic and magnetostrictive sensor - Wiegand and pulse-wire sensors - Saturation-core (flux-gate) sensors – SQUIDs. AC Bridges - Signal Conditioner for LVDT - Specific Signal Conditioners for Capacitive Sensors - Resolver-to-Digital and Digital-to-Resolver Converters.

SELF-GENERATING SENSORS AND SIGNAL CONDITIONING: 7 Hours

Thermoelectric Sensors: Thermocouples, Piezoelectric Sensors, Pyroelectric Sensors, Photovoltaic Sensors, Electrochemical Sensors.

DIGITAL, INTELLIGENT AND OTHER SENSORS: 6 Hours

Position Encoders, Resonant Sensors, Variable Oscillators, Conversion to Frequency, Period, or Time Duration. Smart sensors. Sensors Based on Semiconductor Junctions, Sensors Based on MOSFET Transistors, Charge-Coupled and CMOS Image Sensors, Fiber-Optic Sensors, Ultrasonic-Based Sensors, Biosensors.

ANALOG AND DIGITAL METERS: 9 Hours

Moving iron- permanent magnet moving coil instruments, Measurement of DC, AC voltage and current, Hall effect clamp meter, power meter, Q-meter, Digital voltmeter, Digital multimeter, Timer/counter, time, phase and frequency measurements, oscilloscope and data loggers.

LIST OF EXPERIMENTS:

1 Introduction to simulation tools : Matlab and LabView
2. Reading data sheets of various sensors.
3. Practical verification of Strain gauge sensor specifications with the signal conditioning circuits.
4. Practical verification of RTD and Thermistor sensor specifications with the signal conditioning circuits.
5 Practical verification of Capacitive Sensors specifications with the signal conditioning circuits.
6 Practical verification of Hall efffect Sensors specifications with the signal conditioning circuits.
7 Practical verification of LVDT Sensors specifications with the signal conditioning circuits.
8 Practical verification of Magnetostrictive Sensors specifications with the signal conditioning circuits.
9 Practical verification of Thermocouple Sensors specifications with the signal conditioning circuits.
10 Practical verification of Piezoelectric Sensors specifications with the signal conditioning circuits.
11 Practical verification of Photovoltaic Sensors specifications with the signal conditioning circuits.
12 Study of Fiber-Optic Sensors, Position Encoders and Ultrasonic-Based Sensors
13 Calibrate voltmeter and an ammeter using Electrical calibration Test Bench
14 Calibrate RTD and Thermistor using Temperature Calibration Test Bench
15 Project – Design and testing of a measurement system.

Theory Hours : 45	**Practical Hours : 30**	**Total Hours : 75**

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REFERENCE BOOKS:

1. Ramon Pallas-Areny, John G. Webster ,"Sensors and Signal Conditioning" , John Wiley and Sons, 2nd Edition, 2001.
2. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press, Third Edition,2013.
3. Kalantar-zadeh, Kourosh "SENSORS An introductory course", Springer, 2013
4. Herman K.P. Neubert, "Instrument Transducers-An introduction to their performance and design", Oxford University Press, second Edition, 2011
5. E.A. Doebelin, 'Measurement Systems – Applications and Design', Tata Mc Graw Hill, sixth edition,2012.

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U17BTT3006	Biology for Engineers (Common to all departments)	L	T	P	PJ	C
		3	0	0	0	3

Course Objectives:

The objective of the course to give students an overall idea about the origin of life, biological system and the engineering problems associated with it.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Understand the basics of evolution.

CO2 Learn the composition of cells and information storage and transfer in cells.

CO3: Obtaining an overview on the various biological systemS and engineering problems

CO/PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S											S		
CO2	S				M							S		
CO3	S	S	M		M	S						S	S	

Course Assessment methods:

	Direct		Indirect
1	Continuous Assessment Tests	1	Course end survey
2	Assignments		
3	End Semester Examination		

BASIS OF LIFE: **4 Hours**

Origin of life –theory of evolution, Uniqueness of life on earth; Characteristics of living organisms, Tree of life classification –archaea, prokaryotes, eukaryotes, Viruses and life in extremophiles

COMPOSITION OF CELLS **9 Hours**

Biomolecules and their functions; Types of cells; organelles and tissues. Organs and physiological systems, Methods to study cellular function (enzymatic reactions, specific Ag-Ab reactions, separation –chromatography, centrifugation, radioisotopes).

Case Study: Analytical Methods in Biological Sample Analysis – Blood, Urine

INFORMATION STORAGE AND TRANSFER **11 Hours**

Heredity and DNA; organization of DNA in cells; Genes and chromosomes; Central dogma of information transfer; transcription and Protein synthesis; Cell division and cell cycle. Mutation and cancer.

Case Study: Personalized Medicine

SYSTEMS TO CARRY OUT BIOLOGICAL WORK: **9 Hours**

Molecular systems- Protein –workhorses of cells : Hemoglobin (O2 transport); Insulin (metabolic control); Antibodies (immunity); Collagen (structural); Na, K, ATPase (Membrane potential, transport); ATP synthase (ATP synthesis); Physiological systems: Circulatory system and heart; Nervous system; Muscular system.

Case Study: Wearable Electronics

ENGINEERING BIOLOGICAL SYSTEMS: **7 Hours**

Cell culture (biologics production; Hydroponics/ Aeroponics); Stem cell therapy; RNAi; Monoclonal antibodies.

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TECHNOLOGY –BIOLOGY INTERFACE: **5 Hours**
Biosensors (Glucose biosensor construction); Tissue engineering (scaffolding); Lab-on-chips. Case Study: biomaterials (metallic and ceramic implants)

Theory: 45 Hours **Tutorial: 0 Hours** **Practical: 0 Hours** **Total : 45 Hours**

Reference books:

1. William, T. (2009). Introduction to biotechnology. Pearson Education India.
2. Campbell, N. A., Mitchell, L. G., Reece, J. B., & Taylor, M. R. (2000). Biology: concepts & connections (No. QH308. 2 C35 1996). Benjamin/Cummings.
3. Fumento, M. (2003). Bioevolution: how biotechnology is changing our world.
4. Kumar, H. D. (1998). Textbook on Biotechnology. Indian Journal of Pharmacology, 30(4), 275.
5. Taylor, D. J., Green, N. P., Stout, G. W., & Soper, R. (1997). Biological science (Vol. 983). Cambridge, United Kingdom: Cambridge University Press.

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U17MAT3102 **NUMERICAL METHODS AND PROBABILITY(EIE)**

L	T	P	J	C
3	1	0	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1: Apply the concepts of various numerical techniques for solving non-linear equations and systems of linear equations.

CO2: Analyze and apply the knowledge of interpolation and determine the integration and differentiation of the functions by using the numerical data.

CO3: Predict the dynamic behaviour of the system through solution of ordinary differential equations by using numerical methods.

CO4: Apply the concepts of probability, conditional probability and total probability.

CO5: Analyze random or unpredictable experiments and investigate important features of random experiments.

CO6: Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.

Pre-requisite:

System of equations, Frequency distribution, mean, median, mode.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										
CO2	S	S										
CO3	S	S							M			
CO4	S	S										
CO5	S	S							M			
CO6	S	S										

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination
Indirect
1. Course-end survey

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SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9+3 Hours

Linear interpolation method – Iteration method – Newton's method – Solution of linear system by Gaussian elimination and Gauss-Jordan methods - Iterative methods: Gauss Jacobi and Gauss - Seidel methods – Inverse of matrix by Gauss – Jordan method – Eigenvalues of a matrix by Power method.

INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3 Hours

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's rules.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3 Hours

Single step methods: Taylor's series method – Euler and Improved Euler methods for solving a first order equations – Fourth order Runge – Kutta method for solving first and second order equations – Multistep method: Milne's predictor and corrector method.

PROBABILITY 3+1 Hours

Axioms of probability - Conditional probability – Total probability – Bayes' theorem

RANDOM VARIABLES 6+2 Hours

Random variable – Distribution function – properties – Probability mass function-
Probability density function – moments and moment generating function – properties.

STANDARD DISTRIBUTIONS 9+3 Hours

Binomial, Poisson and Normal distributions – Moments, Moment Generating functions and properties for the above distributions - Fitting of Binomial and Poisson distributions.

Theory: 45 Hours	**Tutorials: 15 Hours**	**Total: 60 Hours**

Reference books:

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 7th Edition, Pearson Education Asia, New Delhi, 2007.
3. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 7th Edition, Tata McGraw-Hill, New Delhi, 2016.
4. R.A. Johnson and C.B. Gupta, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
5. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th edition, 2017.

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U17MET3007 **MECHANICS AND THERMODYNAMICS**

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Explain the concepts of thermodynamics and mechanisms of heat transfer.

CO2: Discuss the working of turbines and boilers.

CO3: Apply the fundamental concepts in determining the effect of forces on a particle.

CO4: Apply the concept of Euler and Bernoulli's equation for solving fluid flow problems.

CO5: Analyze the performance of various fluid machines.

Pre-requisite: Nil

COs	PO											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2	S											
CO3	M											
CO4		M										
CO5		M										

Course Assessment Methods:	
Direct	**Indirect**
• Internal tests • Assignments • End Semester Exam	• Course Exit Survey

Course Content:

BASIC OF THERMODYNAMICS AND HEAT TRANSFER **9 Hours**

Thermodynamic systems – Types, Properties, State - process - Cycle – Equilibrium – Work and heat transfer – First law of thermodynamics for non-flow process (closed system) – First law applied to Flow process (open system) - SFEE (Steady flow energy equation) – Second law of thermodynamics – Heat engines – Refrigerators and heat pumps (Descriptive only). Modes of Heat transfer- One dimensional Conduction heat transfer (Steady state) – composite walls, Convection heat transfer – Free and Forced convection- Cooling of electronic components: Thermoelectric cooling – Chip cooling (Descriptive only).

STEAM BOILERS AND TURBINES **9 Hours**

Formation of steam – properties of steam –working principle – Types of boilers-Mounting and accessories (Descriptive only). Steam power cycle (Rankine), Steam turbines: Impulse and reaction principle (Descriptive only).

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SOLID MECHANICS **9 Hours**

Introduction - Laws of Mechanics, Parallelogram and triangular Laws of forces – Coplanar Forces - Resolution and Composition of forces – Free body diagram - Equilibrium of a particle - Centre of gravity, Centre of mass and Centroid – Moment of Inertia of simple areas – Transfer formula – Radius of gyration – Polar moment of inertia – Product of inertia - Mass moment of Inertia of simple solids. Kinetics – Newton's law – D'Alembert's Principle – Work Energy method – Principle of Impulse momentum – Impact of elastic bodies.

FLUID PROPERTIES AND FLOW KINEMATICS **9 Hours**

Fluid properties – Viscosity – Surface Tension – Capillarity – Fluid Pressure and Pressure Head – Types of Fluid Flow – Flow Lines – Continuity Equation. Euler's equations – Bernoulli's Equation and Applications – Venturi meter, orifice meter and pitot tube.

FLUID MACHINES **9 Hours**

Pumps - definition and classifications - Centrifugal pump - Working Principle - performance curves, Reciprocating pump- Working principle. Turbines: Definition and classifications - Pelton turbine - Francis turbine - Kaplan turbine - working principles.

Theory Hours : 45	**Practical Hours:0**	**Total Hours : 45**

REFERENCES:

1. R. K. Bansal, Fluid Mechanics & Hydraulic Machines – Lakshmi PublicationsPvt., Ltd. 2011
2. S. Domkundwar, C. P. Kotandaraman & A. V. Domkundwar, Thermal Engineering, Dhanpat Rai & Co, 2012
3. P. K. Nag, 'Engineering Thermodynamics Tata McGraw Hill, New Delhi, 2013.
4. R. S. Khumi & J. K. Gupta, Thermal Engineering, S Chand & Co Ltd. 2009.
5. K. L. Kumar, Engineerng Fluid Mechanics, S. Chand & Company Ltd., 2008.
6. Beer F P and Johnson E R, "Vector Mechanics for Engineers, Statics and Dynamics", Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2006
7. P. N. Modi & S. M. Seth, "Hydraulic & Fluid Mechanics including Hydraulic Machines, Standard Book 2010.

8. Rajasekaran S and Sankarasubramanian G, "Engineering Mechanics-Statics and Dynamics", Vikas Publishing House Pvt. Ltd., New Delhi, 2006

9. Rajput, B. K. Sankaar, "Thermal Engineering", S. Chand & Co. Ltd., 2007.

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U17INI3600 **ENGINEERING CLINICS - I**

L	T	P	J	C
0	0	4	2	3

Course objectives

•To help the students look into the functioning of simple to complex devices and systems
•To enable the students to design and build simple systems on their own
•To help experiment with innovative ideas in design and team work
•To create an engaging and challenging environment in the engineering lab

Course Outcomes (CO):

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

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite: Nil

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S		
CO2											S		S	
CO3										S				

Course Assessment Methods:	
Direct	**Indirect**
1.Project reviews 50% 2.Workbook report 10% 3.Demonstration& Viva-voce 40%	1. Course Exit Survey

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.
In the III semester, students will focus primarily on IOT with C programming using Audino.

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.

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5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.

The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

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U17VEP3503 **FAMILY VALUES**
(Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Develop skills in maintaining the harmony in the family.
CO 2: Create impulsive activities for healthy family
CO 3: Be receptive to troubled Individuals
CO 4: Gain healthy life by practicing Kundalini Yoga & Kayakalpa
CO 5: Possess Empathy among family members.
CO 6: Reason the life and its significance

Pre-requisites :
1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									S			
CO2							M					
CO3										M		
CO4												S
CO5						S						
CO6								M				

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

1. Family system: Introduction to Family Values – elements of family values - Adjustment, Tolerance, Sacrifice - Family structure in different society – work life balance.
2. Peace in Family : Family members and their responsibility - Roles of parents, children, grant parents -. Respectable women hood
3. Core value:Empathy: Unconditional love - Respect - Compassion - sacrifice–Care &share - helping – emotional support- hospitality – cleanliness
4. Blessing: Blessing - methods - Vibration effect - Benefits - Reason for misunderstanding in

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the Family and resolution through blessings.

5. Healthy Family: Good relationship with neighbors - Counseling - Simplified Kundalini Yoga - Kaya Kalpa Yoga

Workshop mode

REFERENCES

1. FAMILY - www.download.nos.org/331courseE/L-13%20FAMILY.pdf

2. FRAMEWORK FOR ACTION ON VALUES EDUCATION IN EARLY CHILDHOOD – UNESCO – PDF –www.unesdoc.unesco.org/images/0012/001287/128712e.pdf

3. TRUE FAMILY VALUES Third Edition - Tparents Home www.tparents.org/Library/Unification/Books/TFV3/_TFV3.pdf

4. FAMILY VALUES IN A HISTORICAL PERSPECTIVE - The Tanner Lectures on www.tannerlectures.utah.edu/_documents/a-to-z/s/Stone95.pdf

5. PROBLEMS OF INDIA'S CHANGING FAMILY AND STATE ... - the United Nations - www.un.org/esa/socdev/family/docs/egm09/Singh.pdf

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U17CHT3000	Environmental Science and Engineering (Common to All branches)	L	T	P	J	C
		3	0	0	0	0

Course Outcomes

After successful completion of this course, the students would be able to

CO 1: Analyze the impact of engineering solutions in a global and societal context.

CO 2: Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems.

CO 3: Highlight the importance of ecosystem and biodiversity.

CO 4: Consider issues of environment and sustainable development in his/her personal and professional undertakings.

CO 5: Paraphrase the importance of conservation of resources.

CO 6: Play an important role in transferring a healthy environment for future generations.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1		M					S		M			
CO 2						M				M		
CO 3							M					
CO 4						M	S					
CO 5							S					
CO 6			W				S					M

Course Assessment methods

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation	Course end survey

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

14 Hours

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies – Timber extraction, mining, dams and their effects on forests and tribal people.

Water resources: Use and overutilization of surface and ground water, conflicts over water, dams – benefits and problems – Water conservation, rain water harvesting, watershed management.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, case studies.

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Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, case studies.
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources.

ECOSYSTEMS AND BIODIVERSITY

9 Hours

ECOSYSTEM: Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids – Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

BIODIVERSITY: Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION

8 Hours

Definition – Causes, effects and control measures of: (a) Air pollution – Organic and inorganic pollution – cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – Waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT

7 Hours

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies – Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Human Rights.

HUMAN POPULATION AND THE ENVIRONMENT

7 Hours

Population growth and explosion – Welfare Program – Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

Theory: 45 Hours	**Practical hours : 0**	**Total: 45 Hours**

REFERENCES

1. G. Tyler Miller and Scott Spoolman, 'Environmental Science', Fourteenth Edition, Brooks Cole, 2012.
2. Gilbert M. Masters and Wendell P. Ela, 'Introduction to Environmental Engineering and Science', Third Edition, Pearson Education, 2013.

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3. Bharucha Erach, 'The Biodiversity of India', Mapin Publishing Pvt. Ltd., Ahmedabad, 2002.
4. Trivedi R.K and P.K.Goel, 'Introduction to Air Pollution', Techno-Science Publications, 2003.
5. Trivedi R.K., 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media, 1996.
6. Cunningham, W.P.Cooper and T.H.Gorhani, 'Environmental Encyclopedia', Jaico Publication House, Mumbai, 2001.
7. Wager K.D., 'Environmental Management', W.B. Saunders Co., Philadelphia, USA, 1998.
8. Colin R. Townsend, Michael Begon and John L. Harper, 'Essentials of Ecology', Third Edition, Blackwell Publishing, 2008.

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SEMESTER IV

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U17EII4201 **ELECTRONIC SIGNAL CONDITIONING**

L	T	P	J	C
3	0	2	0	4

Course Outcomes (CO):

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

CO1: Elucidate and design the linear and non-linear applications of an op-amp.

CO2: Analyze the characteristics of various analog filters.

CO3: Classify and comprehend the working principle of data converters.

CO4: Illustrate the function of Voltage regulators, Oscillators, Relays and PLL for various applications.

CO5: Design and simulate various analog circuits of op-amp application, filters, converters, oscillators, relays and PLL.

CO6: Design, construct, and experimentally validate various analog circuits of op-amp application, filters, converters, oscillators, relays and PLL .

Pre-requisite: U17EII3201 - Analog Electronics

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	L	L	M							M	S	M
CO2	S	M	L	L	M					M		M	S	M
CO3	M	L											M	L
CO4	S	M	L	L	M							M	S	M
CO5	S	S	M	M	S				S	M	M		S	S
CO6	S	S	M	M	S				S				S	S

Course Assessment Methods:	
Direct	**Indirect**
• Continuous assessment test • Model Lab Exam • End Semester theory and Practical Exam • Assignments	• Course Exit Survey

Course Content:

LINEAR AND NON-LINEAR APPLICATIONS OF OP-AMP **9 Hours**

Basic linear scaling circuits -Voltage amplification and impedance conversion - Voltage summation-Voltage subtraction- current amplification-AC Amplifiers-Non-linear circuits-specific non-linear amplification-synthesized nonlinear response-logarithmic response using nonlinear component-practical logarithmic amplifier. Integrator applications- differentiator applications.

ANALOGUE SIGNAL FILTERS **8 Hours**

Passive filter-LPF-HPF-BPF-BSF, Active filter, Active filter using operational amplifier, choosing frequency response of the low pass filter and high pass filter, sallen-key second order active filter.

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ANALOGUE AND DIGITAL CONVERSION **7 Hours**

General conversion principles and terminology, Digital to analogue conversion-weighted resistor method-R-2R ladder method, Analogue to Digital conversion-Flash ADC-Successive Approximation ADC-counter ramp ADC-dual slope ADC-delta sigma charge balance ADC.

RECTIFIER AND SWITCHING REGULATOR **8 Hours**

Rectifier- half wave- full wave- bridge rectifier- filter-ripple reduction techniques -Precision rectifier

Linear regulators-protection circuit- characteristics of linear regulators-Applications of linear regulator. Switching regulator –step down buck- types of switching regulator-PWM controllers.

OSCILLATORS AND RELAYS **8 Hours**

RC Oscillators- RC phase shift- Wien bridge, LC oscillators- Hartley-Colpitts – crystal oscillator.

Relays-basic principles of relays-types of relays-Applications of relays.

PHASE LOCKED LOOP **5 Hours**

Basic principle-phase detector –VCO-Low pass filter-Monolithic phase locked loop-PLL applications.

List of Experiments:

1 Design, simulation and implementation of Op-amp linear application - Voltage summer, voltage subtractor, AC amplifier

2 Design, simulation and implementation of Op-amp nonlinear applications - Sample and Hold circuit, Log and Antilog Amplifier, Multiplier.

3 Design, simulation and implementation of Electronic P, PI and PID controllers using Op-amp.

4 Design and analysis of the Frequency response of second order Butterworth low pass filter and high pass filter.

5 Design and analysis of the Frequency response of second order Universal active filter.

6. Design, simulation and analysis of successive approximation type analog to digital converter.

7. Design, simulation and analysis of R-2R ladder network n type analog to digital converter.

8. Design, simulation and implementation of Half wave, Full wave and Precision rectifiers.

9. Design, simulation and implementation of rectifier with filters.

10. Design, simulation and implementation of DC power supply using LM314 and LM723.

11. Design, simulation and implementation of RC phase shift and Wien bridge oscillator.

12. Design, simulation and implementation of Relay switch circuit.

13. Design, simulation and Analyze the characteristics and application of PLL.

14 Design, simulation and implementation of buck boost PWM controller.

15. Mini project in PCB

Theory Hours : 45	Practical Hours :30	Total Hours :75

Reference Books:

1. Electronic Signal Conditioning Ist Edition, Bruce Newby, imprint by Butterworth Heinemann Ltd, Reed Elsevier Plc Group.

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2. Linear integrated circuits, Joseph Carr and Joe Carr, imprint by Newnes Ltd, Elseveir.
3. Op-amps and Linear integrated circuits by Ramakant K Gayakwad, Perason Publications
4. Linear integrated circuits by D Roy Choudhury and Shail B Jain, New age international Publications, 4 th edition.

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U17EII4202 **DIGITAL FUNDAMENTALS AND MICROPROCESSORS**

L	T	P	J	C
3	0	2	0	4

Course Outcomes (CO):

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

CO1:.Summarize the fundamental concepts of number systems and logic gates.

CO2:.Explain the elements of digital system abstractions such as digital representations of information,
digital logic, Boolean algebra, state elements and finite state machine (FSMs).

CO3:.Apply the appropriate truth table from a description of a combinational and sequential logic
function.

CO4:.Outline the evolution of Microprocessors and Microcontrollers.

CO5:. Design and simulate the various combinational and sequential circuit operation.

CO6:.Design, construct and develop theoretical device/circuit operation can be implemented in properly
constructed digital circuits.

Pre-requisite: --

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1K2	M		L									M	S	
CO2K3	S	M	L										M	
CO3K3	S	M		L						M		M	S	
CO4K2	M		L							M		M	M	
CO5K5	S	S	S	S	M				S				S	
CO6K6	S	S	S	S	S				S				S	

Course Assessment Methods:	
Direct	**Indirect**
• Continuous assessment test • Model Lab Exam • End Semester Exam • Assignments	• Course Exit Survey

Course Content:

NUMBER SYSTEMS AND CODES **6 Hours**

Number systems – Decimal, binary, octal, hexa-decimal, BCD – number conversions – binary arithmetic – 1s and 2s complement representations and arithmetic – weighted and un-weighted codes – ASCII, Gray and 8421 codes

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DIGITAL LOGIC AND LAWS **12 Hours**

Basic gates – AND, OR, NOT – Universal gates – NAND and NOR – special gates – EX-OR and EX-NOR – Boolean algebra – DeMorgan's Laws – Simplification using Boolean algebra – Truth Table representation of logic - Converting Truth-Table into Boolean expressions – Sum-of –Products and Product of Sums forms - - Karnaugh Map – Min terms and Max terms – Logic simplification using Karnaugh maps for 3 and 4 variable functions – Use of don't cares.

COMBINATIONAL LOGIC CIRCUITS **9 Hours**

Adders – half-adder, full-adder, serial adder, parallel (carry look ahead) , BCD adders – Encoders and decoders – multiplexors and de-multiplexors – parity generators and checkers – magnitude comparator, 7-segment display drivers and decoders

SEQUENTIAL LOGIC CIRCUITS **9 Hours**

Latches and flip-flops – Level and edge triggering - SR, clocked SR, data latches – JK, T and D flip-flops – Excitation table and characteristic equations – asynchronous and synchronous logic – shift registers – universal shift registers – asynchronous, synchronous and modulo counters – Finite state machines – Moore and Mealey models – Introduction to state table, state diagrams and state reduction – Counter design using FSM approach – Sequence detection using Moore and Mealey models.

INTRODUCTION TO MICROPROCESSORS AND MICROCONTROLLERS **9 Hours**

Evolution of microprocessors, 4-bit, 8-bit, 16-bit, 32-bit and 64-bit – Von Neumann Architecture – Harvard Architecture – Evolution of microcontrollers – 4-bit, 8-bit, 16-bit and 32-bit - Central processing unit – Memory – RAM and ROM – Interfacing – Serial I/O, Parallel I/O, interrupt I/O and Direct memory access – Need for peripherals – Architectures of 8085 and 8051– Block diagram of 8255 PPI

List of Experiments:

1. Simplification and implementation of Combinational circuits (use of K-map)
2. Arithmetic circuits – Half-adders, full-adders, Carry look-ahead adders, BCD adders, magnitude comparators
3. Sequential circuits – Verification of excitation tables of SR, JK, T and D flip-flops
4. Sequential circuits – Universal shift registers, asynchronous counters, synchronous counters, modulo counters, BCD counters
5. FSM based design – Counters, sequence detectors

Theory Hours :45	**Practical Hours :30**	**Total Hours :75**

Reference books:

1. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc., New Delhi, 2009.
2. A.P. Malvino, D. Leach, G. Saha, "Digital Principles and Applications", 6th Edition, Tata McGraw Hill Co. Ltd., New Delhi
3. S. Gaonkar, "Microprocessor, Architecture and Programming", 5th Edition, Penram International Publications Pvt. Ltd.
4. M. A. Mazidi, J. G. Mazidi, "8051 Microcontroller and embedded systems", 5th Edition, Pearson Education Inc.

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U17EII4203 **MODELLING AND ANALYSIS OF DYNAMIC SYSTEMS**

L	T	P	J	C
3	0	2	0	4

Course Outcomes (CO):

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

CO1: Model any given 1st and 2nd order physical system and analyse the dynamic response.

CO2: Apply the block diagram reduction technique, Signal flow Graph, Bond graph and State space modelling for the given physical system.

CO3: Analyse the time response for the given system and the steady state error.

CO4: Analyse the stability of the given system using Bode plot, polar plot and Nyquist plot and also analyse the stability in digital domain.

CO5: Examine the given physical model using simulation tools.

CO6: Inference the model in Time and Frequency domain and experiment validation for the same.

Pre-requisite --

COs	PO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	S	M	W	W	M								S		
CO2	S	M	W	W					M	S			S		
CO3	M	S	M	M								M	M		
CO4	M	S	M	M	M				M				M		
CO5	M	S	M	M	S						M		W		
CO6	M	S	M	M	S		S						M		

Course Assessment Methods:	
Direct	**Indirect**
• Continuous assessment test • Model Lab Exam • End Semester Exam • Assignments	• Course Exit Survey

Course Content:

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INTRODUCTION TO PROCESS DYNAMICS AND MATHEMATICAL MODELS 12 Hours

Introduction to Control Systems – Classifications - Review of 1st and 2nd order linear differential equations – Modelling of Mechanical, Thermal, Pneumatic, Hydraulic, Electrical and Electromechanical systems in frequency Domain – State space Modelling - Introduction to z-transform - discrete time system representation using difference equations.

PROCESS SIMPLIFICATION 6 Hours

Bond Graph – Block Diagram Reduction - Signal Flow graph.

TIME DOMAIN ANALYSIS 9 Hours

Introduction – Test Signals – First and Second Order Systems – Time Domain Specifications - Representation of process dynamics by 1^{st} and 2^{nd} order transfer functions – Static and Generalised Error Co-efficients – Steady state error analysis - Stability criteria for feedback control – Routh-Hurwitz criterion - Root locus diagrams.

FREQUENCY DOMAIN ANALYSIS AND COMPENSATOR DESIGN 9 Hours

Frequency Domain Specifications - Frequency response plots – Stability Analysis - Bode Plot, Polar Plot, Nyquist Plot – Correlation between time and frequency domain specifications - Lag, Lead, Lag-Lead Compensator Design.

STABILITY ANALYSIS IN DIGITAL DOMAIN 9 Hours

Bilinear transformation – Jury's stability test - stability analysis using root locus –Z domain Nyquist stability.

List of Experiments:

1 Introduction to MatLab Simulink, Control System tool box, Simscape.
2 Simulation of thermometer, RL / RC, Gear Train, Single tank system using Simscape.
3 State space modelling using simulation.
4 Modelling a system in digital domain.
5 Simulation study of process simplifications.
6 Modelling of Manometer using simulation tool and experimental validation of second order step response.
7 Simulation and experimental validation of Servo motors.
8 Time domain analysis and experimental validation of Gear train / Whirling of Shaft models.
9 Frequency domain analysis and experimental validation Static and Dynamic Balancing Machine models.
10 Frequency domain analysis and experimental validation of Governor Apparatus / Gear Models.
11 Compensator design.
12 Case Study: Inverted pendulum.
13 Case Study: Robotic System
14 Case Study: Syncros

Theory Hours: 45	**Practical Hours :30**	**Total Hours :75**

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Reference books:

1. Chi-Tsong Chen, Analog and Digital Control Systems Design, Saunders College Publishing, Harcourt Brace Jovanovich college Publishers.
2. Norman S. Nise, Control Systems Engineering, John Wiley & Sons; 7th Edition edition, ISBN-10: 1118170512 ISBN-13: 978-1118170519.
3. Barraclough, B, Dutton, K, Thompson, S 1997, The Art of Control Engineering, Prentice Hall ISBN-13: 978-0201175455.
4. Knovel library: https://app.knovel.com

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U17EIT4004 MEMS AND SENSOR DESIGN

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Comprehend the Fundamentals of the fabrication techniques behind the successful MEMS devices.

CO2: Appreciate the importance of micro fabrication.

CO3: Comprehend the principles of nano fabrication techniques and typical clean room.

CO4: Apply the principal mechanisms of thin film deposition, lithography, arching and other techniques.

Pre-requisite: U17EII3202 – Sensors and Measurements

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		S							S		S		
CO2	S			M				W		S			M	
CO3	S		M							S		M		
CO4	S		M						M	S		M		

Course Assessment Methods:	
Direct	**Indirect**
• Continuous assessment test • End Semester Exam • Assignments	• Course Exit Survey

Course Content:

INTRODUCTION 9 Hours

MEMS, Microsystems, Smart systems and nano sensors – smart sensors and actuators -Evolution of MEMS –Approaches to MEMS Design – Successful MEMS Products – Applications - MEMS devices in smart phones - Capacitive Accelerometer, Microphones, BAW resonator and Bimorph actuator.

MICROSYSTEM FABRICATION 9 Hours

Diffusion, Oxidation, Deposition and Etching - Basic Principles of CVD process – PCVD, metal-organic CVD and Atomic layer CVD (ALD) – Special CVD processes – PVD process – Thermal evaporation and sputtering – Other PVD methods.

MICROSYSTEM MANUFACTURING 9 Hours

Lithography – UV and Electron beam lithography – Dry Etching – Etching anisotropy – Deep Dry Etching – Ion beam etching – Wet etching – isotropic and anisotropic wet etching – Bulk and surface micromachining – etch stop techniques – super drying.

DESIGN AND TESTING OF CAPACITIVE ACCELEROMETER 9 Hours

Quasi-Static Accelerometers - Position Measurement - Circuits -Demodulation - Chopper-Amplifiers – Sampling - Signal-to-Noise Issues - Sensor Design and Modeling - Fabrication and Packaging - Noise and Accuracy – Simulation and parametric testing using CAD tool.

DESIGN AND TESTING OF PIEZORESISTIVE PRESSURE SENSOR 9 Hours

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Hydraulic System: Basics – Hydraulic Fluid Power – Symbols – Electrical Elements – Hydraulic Piezoresistive materials - Longitudinal and Transverse Piezoresistance - Stress and Doping- Fabrication Process Flow - Diaphragm and Piezoresistor dimensions - Stress Analysis
Signal - Conditioning and Calibration - Device Noise - Simulation and parametric testing using CAD tool.

Theory Hours: 45	**Practical Hours: 0**	**Total Hours : 45**

Reference Books:

1. Senturia, Stephen D. Microsystem Design, New York Springer, 2004
2.Micro and Nanofabrication (MEMS) edX Mass Online Open Course : https://courses.edx.org/courses/course-v1:EPFLx+memsX+3T2017/course/
3. Madou, Marc. Fundamentals of Microfabrication. Boca Raton, FL: CRC Press, 1998.
4. "Introduction to Microfabrication, Second Edition", Sami Franssila, John Wiley,2010.

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U17EIT4005 ANCILLARY SUPPORT SYSTEMS

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Evaluate the basic principles of EMI/EMC problem identification, design, and prevention, earthing and shielding principles, procedures and practices.

CO2: Evaluate the principles of power distribution systems and system components.

CO3: Develop a wiring diagram for a control panel.

CO4: Illustrate the operation of hydraulic and pneumatic systems.

Pre-requisite: Nil

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		S							S		S		
CO2	S			M				W		S			M	
CO3	S		M							S		M		
CO4	S		M						M	S		M		

Course Assessment Methods:	
Direct	**Indirect**
• Continuous assessment test • End Semester Exam • Assignments	• Course Exit Survey

Course Content:

PRACTICAL SHIELDING, EARTHING AND CIRCUIT BOARD LAYOUT OF ELECTRONIC SYSTEMS 9 Hours

Fundamentals of EMI, coupling modes, sources of transients, Fourier representation of EMI - Earthing and shielding principles and practices - LF magnetic shielding, gaskets and sealing, PCB shielding, safety and signal grounds - Cables, connectors and circuits - noise, cable parameters, routing, screening and connectors, stray capacitance and lead inductance.

PROTECTION AND SWITCHGEAR 9 Hours

Power distribution fundamentals - equipment, voltage improvement - Short circuits (common faults, calculations - Switchgear – medium voltage - parameters and operating characteristics, isolators/connectors, circuit breakers, insulation types - Power cables - types, losses, voltage drops, installation, faults.

CONTROL PANEL WIRING 9 Hours

Wiring drawings of control panels - Electrical safety - tools and equipments - Wiring a control panel - Identifying faulty components – Profession skills – Coordination and Communication skills - work place health and safety.

MOTOR PROTECTION AND CONTROL 9 Hours

Three phase induction motor – motor technology and construction, energy losses and efficiency – Control and protection - DOL starters – Star/Delta starters – AC variable speed drives - Types of VFD - Soft Starters – DC Servo motors – Speed control for DC motors –Drives for Stepper

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motor and Servo motor.

HYDRAULICS AND PNEUMATIC SYSTEMS **9 Hours**

Hydraulic System: Basics – Hydraulic Fluid Power – Symbols – Electrical Elements – Hydraulic pumps – Motors and Actuators – Hydraulic valves and System accessories – Hydraulic circuit design.

Pneumatic system: Fundamentals, Construction – Power Transition – FRL units – Actuator – Control Valves – Pneumatic circuits - Electrical elements used in pneumatic circuits.

Theory Hours : 45	**Practical Hours: 0**	**Total Hours : 45**

Reference Books:

1.IDC Technologies, Practical Electrical Wiring Standards (AS 3000:2007), IDC Technologies, Perth.

2.IDC Technologies, Safe Operation & Maintenance of Circuit Breakers and Switchgear, IDC Technologies, Perth.

3.IDC Technologies, Troubleshooting, Maintenance & Protection of AC Electrical Motors and Drives, IDC Technologies, Perth.

4.Electrical System Design – M.K. Giridharan – Amazon.com

5.Advanced Industrial Control Technology – Peng Zhang

6.Cyber security for industrial control SCADA, DCS, PLC, HMI – Tyson Macaulay Bryan L. Singer

7. Electrical motors and Drives – Austin Hughes

8.Hydraulics and Pneumatics a Technician's and Engineer's – Andrew Parr

9.Engineering Application of Pneumatic and Hydraulics – Eurlng lan C. Thrner

10.Hydraulics Basic Level – FESTO

11.Hydraulics Professional – FESTO

12.A Text Book of Electrical Technology Vol 1 & 2 – B.L. Theraja

13.https://app.knovel.com

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U17INI4600 **ENGINEERING CLINICS - II**

L	T	P	J	C
0	0	4	2	3

Course objectives

•To help the students look into the functioning of simple to complex devices and systems
•To enable the students to design and build simple systems on their own
•To help experiment with innovative ideas in design and team work
•To create an engaging and challenging environment in the engineering lab

Course Outcomes (CO):

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

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite: Nil

COs	PO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S		
CO2											S		S	
CO3										S				

Course Assessment Methods:

Direct	Indirect
1.Project reviews 50%	1. Course Exit Survey
2.Workbook report 10%	
3.Demonstration& Viva-voce 40%	

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.
In the IV semester, students will focus primarily on Raspberry pi based controllers with Python programming.

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.

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5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.

The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

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U17VEP4504 **PROFESSIONAL VALUES**
(Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to
CO 1: Develop the ethical values in both professional and personal life
CO 2: Develop ability to take decision to reinforce professional life
CO 3: Rational in professional skills required for diverse society
CO 4: Excel in ingenious attitude to congregate professional life
CO 5: Research into the professional stand
CO 6: Spruce an Individual with decorum to achieve professional life

Pre-requisites :
1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3.U17VEP3503 / FAMILY VALUES

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								S				
CO2				M								
CO3			S									
CO4												S
CO5								M				
CO6										M		

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:
1.Professional skills With Values: Positive Attitude, Adaptability, Responsibility, Honesty and Integrity, Self Esteem, & Self Confidence
2.Building Innovative work cultures: Creative thinking, Critical thinking, Conflict Resolution, Problem Solving, & Decision making
3.Professional Work Ethics: Types of Ethics, Etiquette, personality Grooming, Emotional quotient, Human Dignity, Safety & Role of Professional in Social Responsibility
4.Engineering Ethics: Engineering Council of India - Objectives - Code of Ethics - Social responsibility -Professional Quality - Ethical issues - Effects - Strategy – Corruption, Consequences, Cures
5.Case studies in engineering ethics: Discussion of case studies relating to Public safety, health,

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welfare, Quality of product, Improper conduct by management, Product responsibility, Intellectual property

Workshop mode

REFERENCES

1. LEARNING TO DO SOURCEBOOK 3 - UNESCO-UNEVOC -PDF
www.unevoc.unesco.org/fileadmin/user_upload/pubs/LearningToDo.pdf

2. DECLARATION OF PROFESSIONAL VALUES AND ETHICAL STANDARDS
www.garda.ie/Documents/User/declarationvalues.pdf

3. KARMA YOGA - SWAMI VIVEKANANDA
www.vivekananda.net/PDFBooks/KarmaYoga.pdf

4. PROFESSIONAL ETHICS IN ENGINEERING - Sasurie College of Engineering
www.sasurieengg.com/.../GE2025%20Professional%20Ethics%20in%20Engineering.

5. ENGINEERING ETHICS CASE STUDY; Challenger
www.ucc.ie/en/processeng/staff/academic/ebyrne/.../PE1006PptNotesLect7.pdf

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U17INT4000

CONSTITUTION OF INDIA

(Mandatory course)

L	T	P	J	C
2	0	0	0	0

Course Outcomes:

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

CO 1: Gain Knowledge about the Constitutional Law of India
CO 2: Understand the Fundamental Rights and Duties of a citizen
CO 3: Apply the concept of Federal structure of Indian Government
CO 4: Analyze the Amendments and Emergency provisions in the Constitution
CO 5: Develop a holistic approach in their life as a Citizen of India

Pre-requisites :NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M			W			S
CO2						S		S				M
CO3									M	S		W
CO4								W	M			M
CO5						M		M				S
CO6												

Course Assessment methods

Direct
3. Group Activity / Quiz/ Debate / Case studies 4. Class test / Assignment
Indirect
Surveys

THEORY COMPONENT:

Module.1: Introduction to Indian Constitution **4 hours**

Meaning of the constitution law and constitutionalism - Historical perspective of the Constitutic and characteristics of the Constitution of India.

Module.2:Fundamental Rights **8 hours**

Scheme of the fundamental rights - Right to Equality - Fundamental Right under Article 19 - Scope of the Right to Life and Liberty - Fundamental Duties and its legal status - Directive Principles of State Policy – Its importance and implementation

Module.3:Federal Structure **8 hours**

Federal structure and distribution of legislative and financial powers between the Union and

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the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India

Module.4:Amendment to Constitution **6 hours**

Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India.

Module.5:Emergency Provisions **4 hours**

National Emergency, President Rule, Financial Emergency Local Self Government – Constitutional Scheme in India.

Theory: 30	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 30 hours**

REFERENCES

1.Constitution of India - Ministry of Law & Justice – PDF format
awmin.nic.in/coi/coiason29july08.pdf

2. Introduction to the Constitution of India by Durgadas Basu

5. The Constitution of India – Google free material -
www.constitution.org/cons/india/const.html

4. Parliament of India – PDF format
download.nos.org/srsec317newE/317EL11.pdf

5. The Role of the President of India – By Prof.Balkrishna

6. Local Government in India – E Book - Pradeep Sachdeva
https://books.google.com/books/.../Local_Government_in_In...

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SEMESTER V


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U17EII5201 **PROCESS DYNAMICS AND CONTROL**

L	T	P	J	C
3	0	2	0	4

Course Outcomes (CO):

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

CO1: Identify the basic principles & importance of process control in industrial process plants. (K3)

CO2: Develop the mathematical model of the process to design the control. (K3)

CO3: Design and tune process (PID) controllers(K3)

CO4: Distinguish the characteristics of different types of Control Strategies. (K3)

CO5: Use appropriate software tools for the modelling of plant dynamics and the design of control loops.(K3)

CO6: Understand the experimental implementation of process control schemes and the methods for process monitoring and diagnosis (K2)

Pre-requisite: U17EII4203 - Modelling and Analysis of Dynamic Systems.

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	W					M		M			M	
CO2	S	M	W	W										M
CO3	S	M	W	W										
CO4	S	M	W											
CO5	S	M			M									
CO6	M	W												M

Course Assessment Methods:

Direct

- Internal Tests
- Assignment
- Model Lab Exam
- End Semester Theory & Practical Exam

Indirect

- Course Exit Survey

Course Content:

INTRODUCTION **(6 hours)**

Introduction to Process control– Hardware elements of a process control system – Degrees of freedom – Process control implementation – Process control documentation – sample control strategies.

Control Objectives & Benefits – Safety – Environmental protection – Equipment protection – Smooth operation – production rate – product quality – Monitoring & Diagnosis.

MODELLING PROCESS DYNAMICS **(8 hours)**

Review of Modeling - Introduction –Input-Output Models And Transfer Functions -

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examples - Stirred-tank heat exchanger - CSTR - On/off room aircon system.
Dynamic Behavior of Typical Process Systems - Basic System Elements - Self-Regulation - Series Structures Of Simple Systems – Non - interacting Series - Interacting Series - Multiple Input-Multiple Output Systems.Empirical Model Identification - An Empirical Model Building Procedure

FEEDBACK CONTROL(12 hours)
The Feedback Loop - PID Algorithm - PID Controller Tuning for Dynamic Performance - Stability Analysis and Controller Tuning –Digital Implementation of Process control - Practical Application of Feedback Control - Performance of Feedback Control Systems.

SINGLE-LOOP & MULTI-LOOP (14 hours)
Cascade Control – Feed forward Control - Inferential Control - Level and Inventory Control- Single variable model predictive control – Multiloop control – Interaction and Performance analysis.

PROCESS CONTROL DESIGN (4 hours)
Process Control Design:Definition and Decisions - Managing the Design Procedure**.**

List of Experiments:

1 Process Flow Diagram and P&I Diagram for the laboratory process models
2. Safety and Protection setups application for the laboratory process models
3. Modeling and Analysis of STR
4. Dynamic Modeling, Analysis using simulation and real time implementation of Temperature Process controller
5 Dynamic Modeling, Analysis using simulation and real time implementation of Level Process controller
6 Dynamic Modeling, Analysis using simulation and real time implementation of Flow Process controller
7 Characteristics of Process hardware elements: Control valve with and without positioner
8 Tuning of controllers for any process using open loop methods
9 Tuning of controllers for any process using closed loop methods
10 Design and testing of Feed Forward control system
11 Design and testing of Ratio control system for a given application
12 Design and testing of Split range control system
13 Design and testing of Cascade control system
14 Design and testing of Multi-loop control system
15 Configuring and testing of DCS operated Conical tank system

Theory Hours: 45	**Practical Hours: 30**	**Total Hours: 75**

References:

1. Marlin, T. E., " Process Control - Designing Processes and Control Systems for Dynamic Performance", 2nd Edition, McGraw Hill, New York, 2000

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2. http://www.pc-education.mcmaster.ca/SampleCourse.html
3. W. Bequette, Process Control: Modelling, Design, and Simulation, Prentice Hall International Series, 2002.
4. Stephanopoulos, G., “Chemical Process Control“, Prentice Hall Of India, 2003.
5. Coughnowr, D., “Process Systems Analysis and Control “, 3rd Edition. McGraw Hill, New York, 2008.
6. Process Dynamics and Control by Dale E. Seborg, John Wiley & Sons.

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U17EII5202 EMBEDDED MICROCONTROLLERS

L	T	P	J	C
3	0	2	0	4

Course Outcomes (CO):

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

CO1: Relate microcontroller architecture to embedded development.
CO2: Develop algorithms for embedded system design.
CO3: Practice serial protocol programming with microcontrollers.
CO4: Specify appropriate protocol for given application.
CO5: Demonstrate real-time communication interface.
CO6: Apply protocols for device driver requirements.
Pre-requisite: U17EII4202 - Digital fundamentals and microprocessors.

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W												
CO2	S	M	W	W						W			M	
CO3	S	S	M	M										
CO4	M	W								M			M	
CO5	S	M	W											
CO6	S	S	S	S	M					S	W	M	S	

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • Model Lab Exam • End Semester Theory & Practical Exam	• Course Exit Survey

Course Content:

INTRODUCTION TO ARM ARCHITECTURE AND MCU (9 hours)

Overview of ARM architecture and design - Embedded Code Debugging Tools n Tips - MCU Memory Map - MCU Bus Interfaces- MCU Clocks and Details - MCU Peripheral Clock Control- MCU Vector table- MCU interrupt Design - NVIC - Interrupt handling - MCU Specific Header file- Importance of "Volatile" Keyword

GPIO REGISTERS AND CODE DRIVER (9 hours)

GPIO- GPIO Programming structure and Registers- GPIO Driver Development - Driver header file - GPIO Driver Development- Implementing Init API - GPIO Driver Development. Implementing Read/Write APIs - GPIO driver Code testing. Writing Sample APP- GPIO Interrupt Handling

UART FUNCTIONAL BLOCK, INTERRUPT HANDLING AND CODE DRIVER (9 hours)

UART Essentials, UART functional block and Peripheral Clock - Communication - Interrupts –

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Registers - Driver Development: Getting Started. UART Driver Development: Driver Header File - Writing init Function - Writing TX/RX function - Interrupt Handling, UART sample application: Getting ready, UART sample application: Implementation

I2C PROTOCOL FUNCTIONAL BLOCK, INTERRUPTS AND LOGIC ANALYZER(9hours)

I2C Essentials, protocol Operating Modes- Addressing mode, Functional block diagram and Clocks - Interrupts – Peripheral - Registers -Master/Slave Communication.

I2C Driver Development: Getting started-Driver Development: Driver header file - Init Function- Writing TX/RX API - Event Interrupt handling for master, Event Interrupt handling for slave - Error Interrupt Handling - Writing I2C sample application: Getting ready, Writing I2C sample Application: Master Code Testing and Protocol Decoding using logic analyzer.

SPI PROTOCOL FUNCTIONAL BLOCK AND DRIVERS (9 hours)

SPI Essentials - phase, polarity and SPI modes. SPI: Functional Block and Clock, SPI Important Registers. SPI Driver Development - Writing Driver header file. SPI Driver Development: Implementing init API - SPI Master/Slave Communication - SPI Driver Development: Implementing TX/RX API.

List of experiments

1 To Blink an LED using RPi.
2 a) ADC Interfacing using RPi.
   b) Potentiometer Interfacing using RPi.
3 Pulse width modulation using RPi.
4 Serial Communication using RPi.
5 Data Monitoring systems in website using RPi.
6 Data Monitoring systems in mobile app using RPi.
7 GPIO Driver Development and Implementing Read/Write in APIs using STM Controller.
8 Serial Communication interfacing the TX/RX function in UART using STMController.
9 Serial Communication interfacing Interrupt Handling in UART using STM Controller
10 ADC interfacing with UART communication using STMController.
11 Event Interrupt handling for master and slave communication in I2C using STMController.
12 SPI Driver Development: Implementing TX/RX API using STMController.
13 Serial Communication Timer interfacing using EEPROM and implement in STM Controller
14 Mini project.

Theory Hours: 45	**Practical Hours: 30**	**Total Hours:75**

REFERENCES

1. Geoffrey Brown “Discovering the STM32 Microcontroller”.
2. microcontroller peripheral devices and examples of typical by QIU SHI KE JI BIAN ZHU
3. Steve Furber, “ARM System on Chip Architecture” Addison- Wesley Professional Second Edition, Aug 2000.
4. Device Driver Programming by Concurrent Computer Corporation
5. Jason Andrews “Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)” Newnes, BK and CD-ROM (Aug 2004).
6. P. Rashinkar, Paterson and L.Singh, “System on a Chip Verification – Methodologies and Techniques”, Kluwer Academic Publishers, 2001.

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7. David Seal “ARM Architecture reference Manual”, Addison-Wesley Professional;2nd Edition,2001
8. Alan Clement, “The Principle of computer Hardware”, 3rd Edition, Oxford University Press.

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U17EII5203 **FIELD INSTRUMENTATION**

L	T	P	J	C
3	0	2	0	4

Course Outcomes (CO):

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

CO1: Identify the measurement technique of various physical parameters for process industry.K3

CO2: Solve engineering problems of Field Instruments and analyze their safety/redundancy K4

CO3. Develop PI diagram for a given unit operation and design transmitters.K3

CO4: Evaluate the procedure to Calibrate and Mount of the measuring devices.K5

CO5: Identify appropriate measuring devices for industrial applications and conduct experiments.K3

CO6: Acquire and Analyzethe performances of Field Instruments using appropriate tools.K4

Pre-requisite: U17EII3202 -Sensors and Transducers

COs	**PO**												**PSO**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
	K3	K4	K5	K5	K3	K3	K3	K3	K3	K3	K3	K3	K4	K4
CO1-K3	S	M	W	W									M	
CO2-K4	S	S	W	W				M					S	
CO3-K3	S	M	W	W	M					M			S	
CO4-K5	W	M	S	S									S	
CO5-K3	S	M	W	W									M	
CO6-K4	S	S	M	M	M								S	

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • Model Lab Exam • End Semester Theory & Practical Exam	• Course Exit Survey

Course Content:

LEVEL MEASUREMENT **10 Hours**

Introduction level measurement technologies in the process control industry- Categorizing Level Measurement Technologies: Contact and Non-Contact type-Type of Material Measured (liquids, granular solids, slurries, and interfaces)- Contact Sensors : Level Sight Gauge, Float, Displacer, Bubble Tube, RF Capacitance, Resistance Tape, Contacting Ultrasonic; Non-Contact Sensors: Radar, NC Ultrasonic, Load Cells, Nuclear- Mounting techniques- Level sensor accessories in process/instrument, - Analysis stability &safety/redundancy.

Case Study: Boiler drum, Oil separator, Ballast tanks, Gas separators, ***

FLOW MEASUREMENT **10 Hours**

Introduction to flowmeters for process control industry - Differential Pressure Flowmeters, Positive Displacement Flowmeters, Turbine Flowmeters, Coriolis Flowmeters,Ultrasonic Flowmeters, Vortex Flowmeters, Thermal Flowmeters, Mounting techniques- flow sensor accessories in process/instrument-Analysis of stability &safety/redundancy. Calibration techniques-Case Study: steam flow, oil flow, air flow, water flow, ***

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TEMPERATURE MEASUREMENT **10 Hours**

Introduction to Industrial Temperature Measurement Devices- Resistance Temperature Detectors (RTDs), RTD sensor connections, Self-heating error, Thermocouples, Dissimilar metal junctions, Thermocouple types, Manually interpreting thermocouple voltages, Reference junction compensation, Law of Intermediate Metals, Software compensation, Extension wire, Side-effects of reference junction compensation, Burnout detection, Connector and Tips for Selecting a Thermowell for your Process Application. Non-contact temperature sensors, Concentrating pyrometers, Distance considerations, Emissivity, Thermal imaging, Temperature sensor accessories in process/instrument- Analysis of stability &safety/redundancy.- Case Study: – steam temperature- pulp temperature, CSTR, ***

PRESSURE MEASUREMENT **7 Hours**

Introduction to Industrial Pressure measurement- Mechanical types – Electrical types –Elastic types – Vacuum pressure gauges – DPT –Electronic pressure measurement types- Mounting techniques- Calibration techniques - Pressure sensor accessories in process/instrument- Analysis of stability &safety/redundancy-Case Study: steam pressure, CSTR, ***

FIELD INSTRUMENTS AND DESIGN OF TRANSMITTER'S **8 Hours**

Miscellaneous field instruments and Design of Transmitter's:- Vibration – pH- Density – Conductivity – viscosity-humidity –Design of Two-wire, Three-wire& Four-wire transmitter circuits (Chip Based), Calibration techniques - Instrumentation data sheets- Process Instrumentation diagram (one unit operation case study, ***).

Note:

***** Approach to all the application with PI diagram**

List of Experiments:

1. Dynamic response analysis of Capacitance type level meter
2. Experimental validation of d/p transmitter specifications
3. Experimental validation of mass flow meters.
4. Specification validation of Restriction type flow meters.
5. Design ofcold junction compensation for thermocouple.
6. Design and Analyse the performance of Thermocouple & RTD for a specific Application.
7. Design and Analyse the performance of Piezo resistive pressure Transmitter.
8. Calibration of Pressure gauges as per NABL standards
9. Calibration of Temperature sensor as per NABL standards
10. pH meter standardization and measurement of pH values of solutions with & without Temperature compensation.
11. Measurements of conductivity of test solutions
12. Measurement of absorbance and Transmittance of a given sample using UV spectrophotometer.

Theory Hours: 45	Practical Hours: 30	Total Hours:75

Text Books:

1. "Doebelin E.O. and Manik D.N.", Measurement Systems Application and Design, Special Indian Edition,
Tata McGraw Hill Education, 2007.
2. "Patranabis",D. Principles of Industrial Instrumentation, 3rdEdition, Tata McGraw Hill, New Delhi, 2010.
3. "Bela G. Liptak", Instrument Engineers' Handbook Fourth Edition, Process Measurement and

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Analysis Volume I, CRC Press, 2003.
4. “Eckman, D.P.”, “Industrial Instrumentation”, Wiley Eastern Limited.
5.“Tony R. Kuphaldt”, Lessons in Industrial Instrumentation,
6. “R.P Benedict” Fundamentals of Pressure and Flow Measurements, John Wiley & sons.
7. “David W. Spitzer”, Industrial Flow Measurement; ISA The Instrumentation, Systems, and Automation Society,01/Jan/2005.
8. Instrumentation for automation and process control http://www.idc-online.com
9. Instrumentation tools.com symbols & standards.

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U17EII5004 **INDUSTRIAL COMMUNICATION AND NETWORKING**

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Analyze the fundamentals of communications (K4).

CO2: Examine the principles of selecting and installing telecommunications systems(K4).

CO3: Make use of "best practice" decisions on the best and most cost-effective access options for an industrial network (K4).

CO4: Identify, prevent and troubleshoot industrial communications problems(K3).

CO5: Test the installation and the configuration of a simple Ethernet network(K3).

CO6: Interpret a protocol through simple implementation (K2).

Pre-requisite: -

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02
	K3	K4	K5	K5	K3	K3	K3	K3	K3	K3	K3	K3	K4	K4
CO1(K4)		S												
CO2(K4)		S	M										M	
CO3(K3)	S			S							M	M		
CO4(K4)	M			S						M				
CO5(K3)	S				M		W							S
CO6 (K2)						M								M

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment/Projects/Reports • End semester exams	• Course Exit Survey

Course Content:

BASICS OF COMMUNICATION SYSTEM **2 Hours.**

Communication, Communication systems, Modulation, Bandwidth Requirement. Channel Capacity, Baud Rate, Data Rate.

MODULATION TECHNIQUES **10 Hours**

Theory of Amplitude Modulation- Frequency spectrum of AM wave- Representation of AM- Power Relation in the AM wave-Theory of Frequency Modulation- Mathematical Representation of FM- Frequency spectrum of FM wave-Theory of Phase Modulation- Comparison of different modulations-Modulation for Digital signal: Introduction- modulation circuit- demodulation circuit- ASK- FSK- PSK- PWM- PAM- PPM

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FUNDAMENTALS OF DATA COMMUNICATIONS **6 Hours**

Bit- Bytes and Characters- Communication principle- Communication modes- Synchronous and asynchronous system- Error detection- Transmission Characteristics- Data coding- UART- Functional Layered Models - OSI reference model- System engineering approach- Input / Output Structures- Control Unit Structure- Protocols- Basics of Network Topology

INDUSTRIAL COMMUNICATIONS STANDARDS AND PROTOCOLS **8 Hours**

Serial Communication Standards: Serial data communication interface standards- Balanced and unbalanced transmission lines- RS 232-422-485 standards. Troubleshooting serial data communication circuits- Test equipment- RS 422 Standard- RS 485 Standard- Troubleshooting and testing with RS 485- 20 mA Current loop- GPIB- USB.Controller Area Networks (CAN) protocol

Industrial Protocols: XON/OFF Signaling- Binary Synchronous Protocol (BSC)- HDLC/SDLC protocol- CSMA/CD- CA protocol- OSI implementation for Industrial communications- Industrial control applications: ASCCII-based protocol – ANSI –X 3.28 -2.5.

HART COMMUNICATION PROTOCOL **9 Hours**

Architecture - physical- data link- application layer- communication technique- normal and burst mode of communication- benefits of HART. Introduction to Wireless HART

OPEN INDUSTRIAL FIELDBUS AND DEVICENET SYSTEMS **10 Hours**

Industrial Ethernet: 10Mbps- 100Mbps Ethernet- Gigabit Ethernet- Industrial Ethernet. **Foundation fieldbus:** Fieldbus requirement- features- advantages- fieldbus components- types- architecture–physical- data link- application layer- system and network management- wiring- segment functionality checking- function block application process.

Profibus: Architecture- OSI-model- PROFIBUS types – PA- DP & FMS and their comparison- Designing PROFIBUS- Network design- Advantages and Applications of PROFIBUS in industries**.**

Theory Hours: 45	**Practical Hours: 0**	**Total Hours: 465**

References Books:

1. Kennedy and Devis- Electronic Communication Systems
2. John Park, Steve Mackay, Edwin Wright, Practical Data Communications for Instrumentations and Control, 1 st Edition ELSEVIER, 2003.
3. Deon Reynders, Steve Mackay, Edwin Wright, Practical Industrial Data Communications, 1 st Edition ELSEVIER, 2005.
4. Behrouz A. Forouzan, Data Communications and Networking, 2nd Edition, Mc Grow – Hill, 2001
5. Lawrence M. Thompson and Tim Shaw, Industrial Data Communications 5thEdition ,ISA

List of Open Source Software/learning website:

Learning website: -

- http://nptel.iitm.ac.in/courses.php
- http://ocw.mit.edu
- http://www.electrical-engineering-portal.com
- http://en.wikipedia.org
- https://www.anlog.com
- https://www.protocols.com
- https://www.cse.wustl.edu/~lu/cse521s/Slides/wirelesshart.pdf

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U17INI5600 **ENGINEERING CLINICS - III**

L	T	P	J	C
0	0	4	2	3

Course objectives

•To help the students look into the functioning of simple to complex devices and systems
•To enable the students to design and build simple systems on their own
•To help experiment with innovative ideas in design and team work
•To create an engaging and challenging environment in the engineering lab

Course Outcomes (CO):

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

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite: Nil

COs	PO												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S		
CO2											S		S	
CO3										S				

Course Assessment Methods:

Direct	Indirect
1.Project reviews 50%	1. Course Exit Survey
2.Workbook report 10%	
3.Demonstration& Viva-voce 40%	

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.
In the V semester, students will focus primarily on Design project combining concepts learnt

in Engineering clinics I and II

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.

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The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

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U17VEP5505 **SOCIAL VALUES**
(Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Understand the transformation from self to society

CO 2: Acquire knowledge about disparity among Human Beings

CO 3: Realize the new ethics in creating a more sustainable Society

CO 4: Develop skills to manage challenges in social issues

CO 5: Acquire the skills for Management of Social work & HolisticSociety

CO 6: Validate the social liabilities at dissimilar situations

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3.U17VEP3503 / FAMILY VALUES
4.U17VEP4504 / PROFESSIONAL VALUES

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						S						
CO2							S					
CO3								M				
CO4											S	
CO5												S
CO6									M			

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1. Self and Society: Relation between self and society – Different forms of society - Elements of Social structures – Realization of Duties and Responsibilities of Individual in the Society

2. Social Values: Tolerance – Responsibility – Sacrifice – Sympathy - Service – peace-nonviolence - right conduct- Unity – forgive – dedication – Honest

3. Social issues : Disparity among Human beings- Poverty-Sanitation -corruption- un

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employment-superstition – religious intolerance & castes – terrorism.

4. Emerging Ethics for Sustainable Society: Unison of Men in Society - Positive Social Ethics - Cause and Effect - Ensuring an Equitable Society- Effect of Social Media in society - development of Education and Science in the Society

5. Social Welfare:Social welfare Organization - Programme by Government and NGO's - Benefits of Social Service - Balancing the Family and Social Life – Development of Holistic Society

Workshop mode

REFERENCES

1. SOCIAL PROBLEMS IN INDIA - ForumIAS.com – PDF discuss.forumias.com/uploads/File upload/.../711b18f321d406be9c79980b179932.pd...

2. INVESTING IN CULTURAL DIVERSITY AND INTERCULTURAL DIALOGUE: UNESCO ...

www.un.org/en/events/culturaldiversityday/pdf/Investing_in_cultural_diversity.pdf

3. INDIAN SOCIETY AND SOCIAL CHANGE - University of Calicut

www.universityofcalicut.info/SDE/BA_sociology_indian_society.pdf

4. CULTURE, SOCIETY AND THE MEDIA - E-classwww.eclass.uoa.gr/.../MEDIA164/.../%5BTony_Bennett,_James_Curran,_Michael_G

5. SOCIAL WELFARE ADMINISTRATION - IGNOU

www.ignou.ac.in/upload/Bswe-003%20Block-2-UNIT-6-small%20size.pdf

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SEMESTER VI

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U17EII6201 **INDUSTRIAL AUTOMATION**

L	T	P	J	C
3	0	2	0	4

Course Outcomes (CO):
After Successful completion of this course, the students will be able to :

CO1:Apply the design aspects of industrial automation. K3
CO2: Build PLC program and logic controllers with case study. K3
CO3: Develop PLC diagram &implement the Automation technique used in Industry.K3
C04: Solve engineering problems for Field Automation and analyse their safety/redundancy. K4

CO5: Distinguish appropriate Input/output devices & schemes for industrial automation applications and conduct experiments & analyse their performances. K4

CO6: Develop communication protocol for a typical Field Automation networkArchitecture. K3

Pre-requisite: U17EII5201Process Dynamics and Control
U17EII5203Field Instrumentation

COs	**PO**												**PSO**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
	K3	K4	K5	K5	K3	K3	K3	K3	K3	K3	K3	K3	K4	K4
CO1-K3	S	M	W	W										
CO2- K3	S	M	W	W	S				M	M			M	
CO3-K3	S	M	W	W	S			W					S	S
CO4-K4	M	S	M	M	S								S	S
CO5-K4	M	S	M	M					S	S			S	S
CO6-K3	S	M	W	W									S	S

Course Assessment Methods:

Direct	Indirect
• Internal Tests • Assignment • Model Lab Exam • End Semester Theory & Practical Exam	• Course Exit Survey

Course Content:

DESIGN ASPECTS OF INDUSTRIAL AUTOMATION **9 Hours**

Detailed study of process sequences – preparation of input and output list –Preparation of Schemes (open loop, closed loop, hardwire control, interface) – Input / output signal ranges (Voltage, Current, Pulse) - hardware Selection procedure.

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PROGRAMMABLE LOGIC CONTROLLERS **9Hours**

Overview, Functions & Features, - Typical areas of application – Relay & Relay Logics- PLC vs dedicated controllers – PLC Architecture & Hardware – System Configuration – Power requirement calculation– Redundancy in power supply system – choice of circuit breakers – control panel & common wiring practices.

PLC PROGRAMMING (FUNDAMENTALS) **9 Hours**

PLC Programming Languages – System bits & words – Logic functions – Latch and Memory concepts – Timers & Counter concepts – Basic programming using concepts

PLC PROGRAMMING (FUNCTIONS) **9 Hours**

Arithmetic functions – compare functions – converter functions – Data transfer instructions – Function blocks – PID Function Blocks - Different types of programming sequences (Manual, Auto & Alarm) – Operator Level Interfacing unit (HMI) – HMI Programming.

Applications:

Binder-Processing Machine, Crystal Measurement, Smart Bench, Sagger Load Station, Tray Handlers & Cotton Classing System

INTRODUCTION TO SCADA **9 Hours**

Introduction to SCADA – SCADA Architecture – Concept of DCS – DCS Architecture – DCS Configuration and Programming – Communication Protocol – Typical Network architecture – Plant network design – Network field instruments-(with case study-using SCADA & Centum VP DCS)

List of Experiments:

1. 1 Study of basic control function in PLC
2. Implementation of logic gates and Boolean functions.
3. Implementation of PLC timer functions.
4. Implementation of PLC counters functions
5. Emulation and Graphical Control.
6. Implementation of PID LOOPS using PLC.
7. Motor control using PLC.
8. Sequential lighting of bulbs.
9. Implementation Automatic Traffic control system.
10. Implementation of sequencer.
11. Develop communication Protocol for a typical Field Automation Network Architecture.

Theory Hours: 45	**Practical Hours: 30**	**Total Hours: 75**

References:

1. “Frank Lamb “, Industrial Automation Hands-On, 2013 by McGraw-Hill Education. ISBN: 978-0-07-181645-8.

2. “StamatiosManesis& George Nikolukopo”, Introduction to Industrial Automation, CRC press, Taylor &Fancis, 2018.

3.“Hugh Jack” Automatic Manufacturing Systems with PLCs, 2007; www.PAControl.com

4. “Frank D. Petruzella” Programming Logic Controllers.

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U17EII6202 **DIGITAL SIGNAL PROCESSING AND DEEP LEARNING**

L	T	P	J	C
3	0	2	0	4

Course Outcomes (CO):

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

CO 1: Understand the characteristics of discrete-time signals and discrete systems
CO 2: Analyze signal / system properties using mathematical tools
CO 3: Apply and develop algorithms for digital systems
CO 4: Illustrate efficient computation of DFT
CO 5: Discuss advanced features and architecture of generic P-DSP
CO 6: Design FIR and IIR filters

Pre-requisite: U17EII4203- Modelling and Analysis of Dynamic Systems.

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M													
CO2		S											S	
CO3			S											S
CO4	S													
CO5				S										
CO6	M													

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • Model Lab Exam • End Semester Theory & Practical Exam	• Course Exit Survey

Course Content:

DISCRETE TIME SIGNALS AND SYSTEMS **9 Hours**

Representation of a CT signal by samples – Sampling theorem – Reconstruction of a signal from its samples – Aliasing – DT Signals – Impulse, Step, Pulse, Sine, Exponential – Properties of DT signals - Transformation of independent variable – Shifting, scaling, folding - Discrete Time LTI systems – Properties – Impulse response – Convolution sum – Properties of Convolution

Z-TRANSFORM AND SYSTEM ANALYSIS **9 Hours**

DTFT – Properties - Z transform – Forward Transform - Inverse Transform using Partial Fractions - Properties – Pole-Zero plot – Difference Equations - Transfer function - Analysis of Discrete Time systems using DTFT and Z Transform.

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DISCRETE FOURIER TRANSFORM **9 Hours**

Introduction to DFT– Properties of DFT – Efficient computation of DFT – FFT algorithms – Introduction to Radix-n algorithms - Radix-2 FFT – Decimation-in-Time and Decimation–in-Frequency algorithms – Butterfly diagram.

DESIGN OF DIGITAL FILTERS **9 Hours**

FIR filter design: Linear phase characteristics - Windowing Technique –Rectangular, Hamming, Hanning, Blackmann windows – IIR filter design: Analog filter design - Butterworth and Chebyshev approximations – Impulse invariance and Bilinear transformations - FIR and IIR filter structures – Direct form I and II - cascade and parallel forms – Finite Precision effects.

ADVANCED TOPICS IN DSP AND MACHINE LEARNING **9 Hours**

Concepts of multi-rate signal processing – Decimation and interpolation by integer factor – Sampling rate conversion – Introduction to DSP architecture - Harvard, Modified Harvard architectures –Machine learning – AI revolution – Block chain – Using AI to augment human intelligence.

List of Experiments:

1 Matlab Primer – 1D and 2D array manipulations
2 Signal generation and sampling analysis
3 Audio signal – Frequency domain analysis
4 Audio capture and processing
5 Design of filters – FIR
6 Design of filters - IIR
7 Noise removal using filtering of audios
8 Implementation of simple neural networks
9 Implementation of neural networks with hidden layers
10 Simple regression applications.

Theory Hours: 45	**Practical Hours: 30**	**Total Hours: 75**

References:

1. Mrinal Mandel and Amir Asif, “Continuous and Discrete Time Signals and Systems”, Cambridge International Student Edition, Cambridge University Press, 2007.
2. Leonard Eddison, “Machine Learning – A technical approach to machine learning for beginners”, 2017
3. JohnG.ProakisandDimitrisG.Manolakis, “DigitalSignalProcessing,Principles AlgorithmsandApplications”,PHI, 3rdEdition.2000.
4. B. Venkataramani, M. Bhaskar, “Digital Signal Processors, Architecture, Programming and Applications”, Tata McGraw Hill, New Delhi, 2003. (Unit V)
5. JohnyR.Johnson,“IntroductiontoDigitalSignalProcessing”,PHI, 2009.
6. Won Y. Yang et. Al., “Signals and Systems with MATLAB”, Springer International Edition, 2009
7. Steven W. Smith, “The Scientists and Engineer’s Guide to Digital Signal Processing”, California Technical Publishing, 1997.
8. James H. McClellan, Ronald W. Schafer, Mark A. Yoder, “Signal Processing First”, 2nd Edition

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U17EIT6003 **COMPREHENSIVE STUDIES**

L	T	P	J	C
2	0	0	0	2

Course Outcomes (CO):

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

CO1: Solve problems in areas of engineering mathematics and electrical circuits.

CO2: Solve problems in areas of signals and systems, analog electronics and control systems.

CO3: Solve problems in areas of digital electronics, measurements, sensors and industrial instrumentation

CO4 : Solve problems in areas of communication and optical instrumentation.

Pre-requisite: U17EII3201, U17EII3202, U17EII4202 U17EII5201, U17EII5203

COs	**PO**												**PSO**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	S	M		S	M								M	
CO2	M	M		M									M	
CO3	W		M										M	
CO4	M	M		W										M

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • End Semester Theory Exam	• Course Exit Survey

Course Content:

SECTION 1: ENGINEERING MATHEMATICS

Linear Algebra: Matrix algebra, systems of linear equations, Eigen values and Eigen vectors.

Calculus: Mean value theorems, theorems of integral calculus, partial derivatives, maxima and minima, multiple integrals, Fourier series, vector identities, line, surface and volume integrals, Stokes, Gauss and Green's theorems.

Differential equations: First order equation (linear and nonlinear), higher order linear differential equations with constant coefficients, method of variation of parameters, Cauchy's and Euler's equations, initial and boundary value problems, solution of partial differential equations: variable separable method.

Analysis of complex variables: Analytic functions, Cauchy's integral theorem and integral formula, Taylor's and Laurent's series, residue theorem, solution of integrals.

Probability and Statistics: Sampling theorems, conditional probability, mean, median, mode and standard deviation, random variables, discrete and continuous distributions: normal, Poisson and binomial distributions.

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Numerical Methods: Matrix inversion, solutions of non-linear algebraic equations, iterative methods for solving differential equations, numerical integration, regression and correlation analysis.

Instrumentation Engineering

SECTION 2: ELECTRICAL CIRCUITS:

Voltage and current sources: independent, dependent, ideal and practical; v-i relationships of resistor, inductor, mutual inductor and capacitor; transient analysis of RLC circuits with dc excitation.

Kirchoff's laws, mesh and nodal analysis, superposition, Thevenin, Norton, maximum power transfer and reciprocity theorems.

Peak-, average- and rms values of ac quantities; apparent-, active- and reactive powers; phasor analysis, impedance and admittance; series and parallel resonance, locus diagrams, realization of basic filters with R, L and C elements.

One-port and two-port networks, driving point impedance and admittance, open-, and short circuit parameters.

SECTION 3: SIGNALS AND SYSTEMS

Periodic, aperiodic and impulse signals; Laplace, Fourier and z-transforms; transfer function, frequency response of first and second order linear time invariant systems, impulse response of systems; convolution, correlation. Discrete time system: impulse response, frequency response, pulse transfer function; DFT and FFT; basics of IIR and FIR filters.

SECTION 4: CONTROL SYSTEMS

Feedback principles, signal flow graphs, transient response, steady-state-errors, Bode plot, phase and gain margins, Routh and Nyquist criteria, root loci, design of lead, lag and lead-lag compensators, state-space representation of systems; time-delay systems; mechanical, hydraulic and pneumatic system components, synchro pair, servo and stepper motors, servo valves; on-off, P, P-I, P-I-D, cascade, feedforward, and ratio controllers.

SECTION 5: ANALOG ELECTRONICS

Characteristics and applications of diode, Zener diode, BJT and MOSFET; small signal analysis of transistor circuits, feedback amplifiers. Characteristics of operational amplifiers; applications of opamps: difference amplifier, adder, subtractor, integrator, differentiator, instrumentation amplifier, precision rectifier, active filters and other circuits. Oscillators, signal generators, voltage controlled oscillators and phase locked loop.

SECTION 6: DIGITAL ELECTRONICS

Combinational logic circuits, minimization of Boolean functions. IC families: TTL and CMOS. Arithmetic circuits, comparators, Schmitt trigger, multi-vibrators, sequential circuits, flip-flops, shift registers, timers and counters; sample-and-hold circuit, multiplexer, analog-to-digital (successive approximation, integrating, flash and sigma-delta) and digital-to-analog converters (weighted R, R-2R ladder and current steering logic). Characteristics of ADC and DAC (resolution, quantization, significant bits, conversion/settling time); basics of number systems, 8-bit microprocessor and microcontroller: applications, memory and input-output interfacing; basics of data acquisition systems.

SECTION 7: MEASUREMENTS

SI units, systematic and random errors in measurement, expression of uncertainty - accuracy and precision index, propagation of errors. PMMC, MI and dynamometer type instruments; dc potentiometer; bridges for measurement of R, L and C, Q-meter. Measurement of voltage, current and power in single and three phase circuits; ac and dc current probes; true rms meters, voltage and current scaling, instrument transformers, timer/counter, time, phase and frequency measurements, digital voltmeter, digital multimeter; oscilloscope, shielding and

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grounding.

SECTION 8: SENSORS AND INDUSTRIAL INSTRUMENTATION

Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors and associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (differential pressure, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor); liquid level, pH, conductivity and viscosity measurement.

SECTION 9: COMMUNICATION AND OPTICAL INSTRUMENTATION

Amplitude- and frequency modulation and demodulation; Shannon's sampling theorem, pulse code modulation; frequency and time division multiplexing, amplitude-, phase-, frequency-, pulse shift keying for digital modulation; optical sources and detectors: LED, laser, photo-diode, light dependent resistor and their characteristics; interferometer: applications in metrology; basics of fiber optic sensing.

Theory Hours: 45	**Practical Hours: 0**	**Total Hours: 45**

Refences :

1. GATE Solved Papers for Instrumentation (IN)
2. Guidebook for Gate Instrumentation Engineering.

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U17INI6600 **ENGINEERING CLINICS - IV**

L	T	P	J	C
0	0	4	2	3

Course objectives

•To help the students look into the functioning of simple to complex devices and systems
•To enable the students to design and build simple systems on their own
•To help experiment with innovative ideas in design and team work
•To create an engaging and challenging environment in the engineering lab

Course Outcomes (CO):

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

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite: Nil

COs	PO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S		
CO2											S		S	
CO3										S				

Course Assessment Methods:	
Direct	**Indirect**
1.Project reviews 50% 2.Workbook report 10% 3.Demonstration& Viva-voce 40%	1. Course Exit Survey

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.
In the VI semester, students will focus primarily on Reverse engineering project to improve performance of a product, Design and developing a prototype.

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.

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4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

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U17VEP6506 **NATIONAL VALUES**
(Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Acquire knowledge on the Essence of Indian Knowledge Tradition

CO 2: Know the great Indian personalities and follow their trail

CO 3: Understand the specialty of democracy

CO 4: Disseminate our Nation and its values to propagate peace

CO 5: Contribute with their energy and effort for a prosperous India

CO 6: Propagate the youth and the contribution for development of our Nation

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3.U17VEP3503 / FAMILY VALUES
4.U17VEP4504 / PROFESSIONAL VALUES
5.U17VEP5505 / SOCIAL VALUES

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						S						
CO2									M			
CO3							M					
CO4								S				
CO5											S	
CO6												M

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

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1. Essence of Indian Knowledge Tradition:
Basic structure of Indian Knowledge System - Modern Science and Indian Knowledge System - Yoga and Holistic Health care - Case studies - Philosophical Tradition -
Indian Linguistic Tradition - Indian Artistic Tradition.

2. Great Indian Leaders : Ancient rulers - Freedom fighters - Social reformers -Religious and Spiritual leaders - Noble laureates -Scientists – Statesman.

3. Largest Democracy : Socialist -Secular - Democratic and Republic – special features of Indian constitution – Three pillar of Indian democracy - Fundamental rights – Duties of a citizen – centre state relationship.

4. India's Contribution to World peace : Nonaligned Nation – Principle of Pancha Sheela – Mutual respect, non-aggression, non-interference, Equality and cooperation – Role of India in UNO -Yoga India's gift to the world.

5. Emerging India : World's largest young work force - Stable Economic development - Labor market & Achievement in space technology – Value based Social structure. Emerging economic superpower.

Workshop mode

REFERENCES

1. KNOWLEDGE TRADITIONS AND PRACTICES OF INDIA, *CBSE Publication*
   cbseacademic.nic.in/web_material/Circulars/2012/68_KTPI/Module_6_2.pdf

2. CULTURAL HERITAGE OF INDIA - SCERT Kerala
www.scert.kerala.gov.in/images/2014/HSC.../35_Gandhian_Studies_unit-01.pdf

3. LEARNING TO DO: VALUES FOR LEARNING AND WORKING TOGETHER - UNESCO
   www.unesdoc.unesco.org/images/0014/001480/148021e.pdf

4. INDIA AFTER GANDHI.pdf - Ramachandra Guha - University of Warwick
www2.warwick.ac.uk/fac/arts/history/students/modules/hi297/.../week1.pdf

5. INDIA'S CONTRIBUTION TO THE REST OF THE WORLD - YouSigma
   www.yousigma.com/interesting facts/indiasgifttotheworld.pdf

6. INDIA AS AN EMERGING POWER - International Studies Association
web.isanet.org/Web/Conferences/.../11353cac-9e9b-434f-a25b-a2b51dc4af78.pdf

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SEMESTER VII

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U17EIT7001	ANALYTICAL INSTRUMENTATION	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

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

CO1: Understand the interaction of electromagnetic radiations with matter and apply analytical techniques to accurately determine the elements present in the given sample. (K2)

CO2: Select an Instrument for a particular analysis with idea of its merits, demerits and Limitations (K3)

CO3: To familiarize the students with various instrumental methods of chemical analysis. (K3)

CO4: Analyze hazardous materials, environmental samples, inorganic, organic and biomaterials at trace and ultra-trace quantities (K4)

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1 (K2)	S	L												
CO2 (K3)	S	M	M		M								M	
CO3 (K3)	S	M	M		M				M	M	M		M	
CO4 (K4)	S	M	M		M								M	

S-Strong M-Medium L-Low

Course Assessment methods:

Direct	Indirect
Continuous assessment tests Assignments Lab exam End Semester Exam	Course exit survey

Course content

Introduction to analytical systems & Spectroscopy principles: 9 Hrs

Introduction to composition measurement and process analyzers. Importance of analytical instrumentation for continuous on-line measurement.

Electromagnetic spectrum. Sources and monochromators. UV/visible sources (Deuterium lamp, tungsten lamp), Infrared sources (Globar lamp, Nernst lamp), X rays sources (Coolidge tube), prism and gratings (Echelette grating), Detectors and transducers (Photodiode, photomultipliers, silicon diode, thermocouple, thermistor, Geiger-Muller tube, Ionization chamber).

UV, Visible spectroscopy & Infrared spectroscopy 9 Hrs

UV/visible spectrophotometer, Beer-Lambert law, Technical vocabulary, spectra, analysis, Instrumentation limits and deviation from the Beer-Lambert law. Examples of UV/visible spectra. Single beam and double beam (spatial, temporal) spectrophotometer.

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Infrared spectrometers (Dispersive and Fourier Transform Infrared (FTIR)), Samples preparation. Analysis and FTIR spectra.

Radiochemical and Magnetic resonance techniques 9 Hrs

Nuclear radiations – Detectors – GM counter – Proportional counter – Solid state detectors – Gamma cameras – X-ray spectroscopy – Detectors – Diffractometers – Absorption meters – Detectors. NMR – Basic principles – NMR spectrometer – Applications. Mass spectrometers – Different types – Applications.

Chromatography and Surface characterization by Spectroscopy & Microscopy 9 Hrs

Different techniques – Gas chromatography-basic and with multiple columns – Detectors-Applications in environmental analysis, – High-pressure liquid chromatographs – Applications, Introduction to the study of surfces, Electron Spectroscopy, Surface photon spectroscopic methods, Electron- Stimulated Microanalysis methods & Scanning Probe microscope.

Industrial gas analyzers and pollution monitoring instruments 9 Hrs

Types of gas analyzers – Oxygen-micro fuel cells, NO_2 and H_2S types, Luft detectors with flow sensor, filter cells, Continuous emission monitoring system (CEMS), thermal conductivity analyzers. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation – Dust and smoke measurements, pH measurement.

Theory: 45 Hrs. Total hrs. 45 hrs.

1. Douglas A. Skoog, F. James Holler, Timothy A. Nieman "Principles of Instrumental Analysis" , Cengage Learning; 6th Edition, 2006,
2. Francis Rouessac, Annick Rouessac, "Chemical Analysis", 2002
3. H.H.Willard, L.L.Merritt, J.A.Dean, F.A.Settle, 'Instrumental methods of analysis', CBS publishing & distribution, 1995.
4. R.S. Khandpur, 'Handbook of Analytical Instruments', Tata McGraw Hill publishing Co. Ltd., 2003
5. Douglas A. Skoog, D. M. West, F. J. Holler "Analytical Chemistry". 7th Edition, 1996.
6. Robinson, James W., "Undergraduate instrumental analysis", 1995

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U17EII7202	ADVANCED CONTROL SYSTEMS	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Acquire knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers. (K4)

CO2: Analyse non-linear system behaviour by phase plane and describing function methods. (K4)

CO3: Perform stability analysis of non-linear systems. (K4)

CO4: Evaluate performance measures for optimal control problem and design a robust control system. (K4)

CO5: Demonstrate the state space analysis of the given system using simulation tools. (K4)

CO6: Demonstrate non-linear system analysis. (K4)

Pre-requisite courses:

1. U17EII4203 - Modelling and Analysis of Dynamic Systems

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs) / Programme Specific Outcomes (PSOs)													
	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K6)	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1 (K4)	PSO2 (K4)
CO1 (K4)	M	S	M	M									M	
CO2 (K4)	M	S	M	M									M	
CO3 (K4)	M	S	M	M									M	
CO4 (K4)	M	S	M	M									M	
CO5 (K4)	M	S	M	M	S			M	M	M		W	M	
CO6 (K5)	W	M	S	S	S			M	M	M		W	M	

Course Assessment methods:

Direct	Indirect
Continuous assessment tests Assignments Lab exam End Semester Exam	Course exit survey

Course Content:

STATE SPACE ANALYSIS **12 Hrs**

State space analysis of continuous and discrete systems – solution of time invariant autonomous systems, forced system – state transition matrix – relationship between state equations and transfer function – properties of state transition matrix – computation of state transition matrix -

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controllability / observability criteria – controller / observer design by state feedback based on pole placement – design of state feedback control systems – full-order and reduced-order observer design.

PHASE PLANE ANALYSIS **12 Hrs**

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.

DESCRIBING FUNCTION ANALYSIS **12 Hrs**

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – conditions for stability – stability of oscillations.

STABILITY ANALYSIS **12 Hrs**

Introduction – Lyapunov's stability concept – Lyapunov's direct method – Lure's transformation – Aizerman's and Kalman's conjecture – Popov's criterion – circle criterion.

OPTIMAL AND ROBUST CONTROL SYSTEM DESIGN **12 Hrs**

Optimal control: Introduction- Performance measures for optimal control problem – Linear Quadratic Regulator – linear quadratic tracking problem – optimal estimation – Kalman filter.

Robust control: Introduction – norms of vectors and matrices – norms of systems – H_2 optimal controller – H_2 optimal estimation – H_∞ controller – H_∞ estimation.

Theory: 45 Hrs **Tutorial: 15 Hrs** **Total Hrs: 60**

List of Experiments

(Simulation Tools: MATLAB / LabVIEW)

1. Developing a state model for a second order system cascaded with active lead circuit and finding its step response and impulse response.
2. Determination of Eigen values of the state model and to convert the state model into transfer function.
3. Transformation of the state model to controllable canonical and diagonal forms.
4. Controllability and Observability Tests.
5. Design of state feedback controller and full state observer.
6. Plotting phase portraits of the system having stable / unstable nodes and focus.
7. Plotting phase portraits of the system having vortex and saddle points.
8. Demonstration of limit cycles for Vanderpol's equation.
9. Demonstration of effect of non-linearities.
10. Stability analysis using describing function method.
11. Liapunov's stability analysis.
12. Design of exact feedback linearizing controller for a non-linear system.
13. Design of a robust control system.
14. Design of an optimal control system.

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REFERENCES

1. Katsuhiko Ogata, 'Modern Control Engineering', Prentice Hall of India Pvt. Ltd., New Delhi, 5th Edition, 2010.
2. Franklin, G. F., David Powell, J, Emami-Naeini, A, 'Feedback Control of Dynamic Systems', Prentice Hall, 7th Edition, 2014.
3. Gopal M, 'Modern Control System Theory', New Age International, 3rd Edition 2014.
4. Dorf R. C, Bishop, R. H, 'Modern Control Systems', Prentice Hall, 13th Edition, 2016.
5. Brogan W. L, 'Modern Control Theory', Prentice Hall, 3rd Edition, 1990.
6. Rolan S. Burns, 'Advanced Control Engineering', Butterworth-Heinmann, A division of Reed Educational and Professional Publishing Limited, Oxford, 2001.
7. Norman S. Nise, 'Control Systems Engineering', John Wiley & Sons Private Limited, 2013.
8. Hassan K. Khalil, 'Nonlinear Systems', Prentice – Hall PTR, 2013.
9. Jean-Jacques Slotine and Weiping Li, 'Applied Nonlinear Control', Prentice Hall, 2005.
10. Sastry S, "Nonlinear Systems: Analysis, Stability, and Control", Springer 2013.
11. Nagrath J and Gopal M, 'Control System Engineering', New Age International Publishers, 6th Edition, 2018.
12. George J. Thaler, 'Automatic Control Systems', Jaico Publishing house, 1993.
13. Ronald R. Mohler, 'Non-linear Systems, Vol. – I, Dynamics & Control', Pearson Education, 1998.
14. Benjamin C. Kuo, 'Automatic Control Systems', Wiley India, 9th Edition, 2014.
15. Ganesh C, Shanmugasundaram R, Mayurappriyan P S, 'Principles of Control Systems', Yes Dee Publishing Limited, India, 2020.

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U17MBT7000	ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT	L	T	P	J	C
		3	0	0	0	3

Course outcomes

After successful of the course, the student would be able to:

CO1: Evaluate the economic theories, cost concepts and pricing policies

CO2: Analyze the market structures and integration concepts

CO3: Apply the concepts of national income and understand the functions of banks and concepts of globalization

CO4: Apply the concepts of financial management for project appraisal and working capital management

CO5: Understand accounting systems

CO6: Analyze financial statements using ratio analysis

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M				M					M			M
CO2				M		M					M			M
CO3						M					M			M
CO4				M							S			M
CO5											S			M
CO6		M		M							S			M

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4.Group Presentation 5. End semester exam	Course end survey

ECONOMICS, COST AND PRICING CONCEPTS **9 hours**

Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply – Actual Cost and opportunity Cost – Incremental Cost and sunk Cost – Fixed

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and variable Cost – Marginal Costing – Total Cost – Elements of Cost – Cost curves – Breakeven point and breakeven chart – Limitations of break-even chart – Interpretation of break-even chart – Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing policies – Pricing methods.

CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES 9 hours

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger – Horizontal integration.

NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT 9 hours

National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization

CONCEPTS OF FINANCIAL MANAGEMENT 9 hours

Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital

ACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS 9 hours

Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations

Theory :45 hours **Total: 45 hours**

References:

1. Prasanna Chandra, "Financial Management (Theory & Practice)", Tata Mcgraw Hill Publishing Co Ltd, 2016.
2. Weston & Brigham, "Essentials of Managerial Finance", The Dryden Press; Fifth Edition edition (1974)
3. Pandey, I. M., "Financial Management"
4. Fundamentals of Financial Management- James C. Van Horne.
5. Bhaskar S. "Engineering Economics and Financial Accounting", (2003) Anuradha Agencies, Chennai
6. Financial Management & Policy -James C. Van Horne
7. Management Accounting & Financial Management- M. Y. Khan & P. K. Jain
8. Management Accounting Principles & Practice -P. Saravanavel
9. Ramachandra Aryasri.A., and Ramana Murthy V.V.,"Engineering Economics & Financial Accounting"-Tata McGraw Hill, New Delhi, 2006.
10. Varshney R.L., and Maheswari K.L.,"Managerial Economics" – Sultan Chand & Sons, New Delhi, 2001
11. Samvelson and Nordhaus,"Economics"-Tata McGraw Hill, New Delhi, 2002

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U17EIP7703	DESIGN PROJECT	L	T	P	J	C
		0	0	0	6	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Apply current industry accepted process control / automation practices

CO2: Implement new and emerging technologies to analyze, design, maintain reliable, safe, and cost effective solution for industry problems.

CO3: Exhibit teamwork and effective communication skills.

CO4: Understand the standards and practices used in industry/ research organization/In-house research

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1 (K2)	S	S	S	M	S			S				S		S
CO2 (K3)			S	S	S	M	S	S				S	S	
CO3 (K3)								S	S	S	M	S	S	
CO4 (K4)			M	M	M	M		S		M	S	S		S

S-Strong M-Medium L-Low

Course Assessment methods:

Direct	Indirect
Project Reviews Viva Project Demo	Course exit survey

GUIDELINES

1. Selection of a topic or project title in consultation with a faculty member.
2. Develop a project planning strategy.
3. If it is an industry – sponsored project, a concurrent letter from industry is required.
4. A maximum of 3 students per group will do the project.
5. The project may be done in one of the labs under the supervision of a guide or in the selected industry.
6. Continuous assessment of the project will be done by the project review committee based on

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four reviews consisting of technical presentation.

7. At the end of the project, a report will be written and a technical presentation along with demonstration will be made by the students.

8.The report, project demonstration and technical presentations will be evaluated by the internal and external examiners.

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U17VEP7507 **GLOBAL VALUES**
(Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

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

CO 1: Aware of the concept of Universal Brotherhood and support the organizations which areworking for it

CO 2: Follow the path of Ahimsa in every aspect of their life

CO 3: Uphold the Universal declaration of Human Rights

CO 4: Understand the unequal distribution of wealth in the World and bestow their efforttowards inclusive growth

CO 5: Sensitize the environmental degradation and work for the sustainable development

CO 6: Amalgamate harmony through Non-violence and edify the nation headed for upholdingdevelopment

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES
5. U17VEP5505 / SOCIAL VALUES
6. U17VEP6506 / NATIONAL VALUES

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M					
CO2								S				
CO3									M			
CO4						S						
CO5											M	
CO6												S

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1. Universal Brotherhood : Meaning of Universal Brotherhood- Functioning of Various organization for Universal human beings -Red Cross, UN Office for Humanitarian Affairs – Case study on humanitarian problems and intervention - Active role of

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Students/Individual on Universal Brotherhood.

2. Global Peace, Harmony and Unity : Functions of UNO - Principal Organizations - Special organization – Case study relating to disturbance of world peace and role of UNO – Participatory role of Students/Individual in attaining the Global peace and Unity.

3. Non-Violence : Philosophy of nonviolence- Nonviolence practiced by Mahatma Gandhi – Global recognition for nonviolence - Forms of nonviolence - Case study on the success story of nonviolence– Practicing nonviolence in everyday life.

4. Humanity and Justice: Universal declaration of Human Rights - Broad classification - Relevant Constitutional Provisions– Judicial activism on human rights violation - Case study on Human rights violation– Adherence to human rights by Students/Individuals.

5. Inclusive growth and sustainable development : Goals to transform our World: No Poverty - Good Health - Education – Equality - Economic Growth - Reduced Inequality – Protection of environment – Case study on inequality and environmental degradation and remedial measures.

Workshop mode

REFERENCES

1. TEACHING ASIA-PACIFIC CORE VALUES OF PEACE AND HARMONY – UNICEF www.unicef.org/.../pdf/Teaching%20Asia-Pacific%20core%20values.pdf

2. THREE-DIMENSIONAL ACTION FOR WORLD PROSPERITY AND PEACE- IIM Indore - www.iimidr.ac.in/.../Three-Dimensional-Action-for-World-Prosperity-and-Peace-Glo...

3. MY NON-VIOLENCE - MAHATMA GANDHI
www.mkgandhi.org/ebks/my_nonviolence.pdf

4. HUMAN RIGHTS AND THE CONSTITUTION OF INDIA 8th ... - India Juris
www.indiajuris.com/uploads/.../pdf/l1410776927qHuman%20Rights%20080914.pdf

5. THE ETHICS OF SUSTAINABILITY – Research Gate
www.researchgate.net/file.PostFileLoader.html?id...assetKey..

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SEMESTER VIII


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U17EIP8701	CAPSTONE PROJECT	L	T	P	J	C
		0	0	0	24	12

Course Outcomes

After successful completion of this course, the students should be able to

CO1:

CO2: Develop a model / prototype of an idea related to the field of Electronics and instrumentation.

CO3: Work individually or in a team to identify, troubleshoot and build products for environmental and societal issues.

CO4: Conduct surveys towards developing a product which helps in lifetime learning.

Pre-requisite: U17EIP7703

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1 (K2)		S	M	M	S			S				S		S
CO2 (K3)	S		S	M	S	M	S	S				S	S	
CO3 (K3)	S			M				S	S	S	M	S	S	
CO4 (K4)			M	S	M	S		S		M	S	S		S

S-Strong M-Medium L-Low

Course Assessment methods:

Direct	Indirect
Project Reviews Viva Project Demo	Course exit survey

GUIDELINES

1. Selection of a topic or project title in consultation with a faculty member.
2. Develop a project planning strategy.
3. If it is an industry – sponsored project, a concurrent letter from industry is required.
4. A maximum of 3 students per group will do the project.
5. The project may be done in one of the labs under the supervision of a guide or in the selected industry.
6. Continuous assessment of the project will be done by the project review committee based on four reviews consisting of technical presentation.
7. At the end of the project, a report will be written and a technical presentation along with demonstration will be made by the students.
8. The report, project demonstration and technical presentations will be evaluated by the internal and external examiners.

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PROFESSIONAL ELECTIVE – ELECTRONIC AUTOMATION

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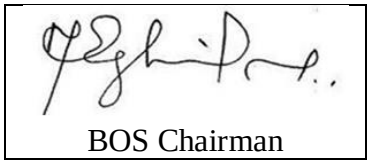

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U17EIE0001 **FLEXIBLE AND WEARABLE ELECTRONICS**

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Identify different types of wearable technology devices and issues involved.

CO2: Design and Verify energy harvesting techniques required for wearable technology devices

CO3: Apply various data mining techniques in Wearable algorithms and Interpret the results

CO4: Detect various types of diseases with wearable devices

CO5: Human Body Communication with high Data rate networks

CO6:

Pre-requisite: Nil

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													
CO2	S													
CO3		S			M			W				M	S	S
CO4	M													M
CO5	S					M				M				
CO6					S		M							

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment/Projects/Reports • End semester exams	• Course Exit Survey

Course Content:

FUNDAMENTALS OF WEARABLE TECHNOLOGIES. **6 Hours**

Wearables: Fundamentals, Advancements, and Roadmap for the future-Case Study: Google Glass - Wearable Haptics (sense of Touch)

WEARABLE CHEMICAL AND BIOCHEMICAL SENSORS -MEDICAL APPLICATIONS OF WEARABLE TECHNOLOGIES. **4 Hours**

Introduction, System Design, Challenges in Chemical Biochemical Sensing, Application Areas, Applications of optical Heart Rate Monitoring

ENERGY EXPENDITURE AND ENERGY HARVESTING **9 Hours**

Measurement of Energy Expenditure by Body-worn heat-Flow Sensors; Energy Harvesting at the Human Body, Energy Harvesting from Temperature Gradient at Human Body, from Foot Motion, from Light, Energy and Power Consumption Issues

Introduction to RF Energy Harvesting, Fundamentals, Practical considerations, Impedance mismatch, Losses, and Efficiency, Distribution of Harvested Power in a Realistic Environment, Charge pump Rectifier Technologies, Effect of Load and Source Variations,

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FLEXIBLE ELECTRONICS AND TEXTILES FOR WEARABLE TECHNOLOGIES **6 Hours**

Knitted Electronic Textiles, From Fibers to Textile Sensors, The Interlaced Network, Textile Sensors for Physiological State Monitoring, Biomechanical Sensing; Non- Invasive Sweat Monitoring by Textile Sensors; Woven Electronic Textiles, Flexible Electronics from Foils to Textiles: Materials, Devices and Assembly; Plastic Electronics for Smart Textiles.

WEARABLE ALGORITHMS: **5 Hours**

An overview of a Truly Multi-Disciplinary Problem, Why Do Wearable Sensors Need Algorithms, what are Wearable Algorithms? Wearable Algorithms: State -of -the-art and Emergency Techniques; Data Mining for Body Sensor Network, Mining Techniques for Body Sensor Network Data Repository; Physical Activity Modeling and Behavior Change, Modelling Physical Activity, Behavior-Change.

HUMAN BODY COMMUNICATION FOR A DATA RATE SENSOR NETWORK **7 Hours**

High Data Rate Sensor Networks, IEEE802.15.6.TG6 Standard Models, Independent Studies-Trust Establishments in Wireless Body Area Networks, WBAN Device Authentication Techniques, Secret Key Establishment in WBAN

WEARABLE SENSORS FOR MONITORING OF PHYSICAL AND PHYSIOLOGICAL CHANGES AND FOR EARLY DETECTION OF DISEASES **4 Hours**

Fundamentals of Wearable sensors for the Monitoring of Physical and Physiological Changes in Daily Life; Wearing Sensors Inside and Outside of the Human Body for Early Detection of Diseases.

WEARABLE AND NON-INVASIVE ASSISTIVE TECHNOLOGIES **4 Hours**

Assistive Devices for Individuals with Severe Paralysis, Why Use of Tongue for Wearable Technology, Wireless Tracking of Tongue Motion, Wearable Tongue Drive System, Sensor Signal-Processing Algorithm, Dual Mode Tongue Driving Systems, Clinical Assessment

Theory Hours: 45	**Practical Hours: 0**	**Total Hours: 45**

REFERENCES

1. Edward Sazonov, Michael R. Neuman (editors), Wearable Sensors: Fundamentals, Implementation and Applications, 2014, Academic Press/Elsevier, ISBN 978- 0124186620

2. Claire Rowland, Elizabeth Goodman, Martin Chalier, Ann Light, Alfred Lui, Designing Connected Products: UX for the Consumer Internet of Things, 2015, O'Reilly Media, Inc, ISBN 978-1449372569

3. Honbo Zhou, Internet of Things in the Cloud – A Middleware Perspective, 2012, CRC Press, ISBN 978-1439892992

(Second and third books will help in designing the devices interfacing with IOT)

(Taken from Harvard Extension School)

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U17EIE0002 **LAB ON A CHIP**

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Comprehend the Operating principles and physical mechanisms unique to microfluidics

CO2: Demonstrate an understanding of scaling of electrical, thermal, and fundamental dynamics in microsystems and the effects on system design

CO3: Propose design strategies for microfluidics systems based on fluid mechanical principles

CO4: Mathematically model microfluidic devices and systems.

Pre-requisite: Nil

COs	POs												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S						W						S	
CO2		M	S											M
CO3	S		M										S	
CO4			S											

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • End Semester Theory	• Course Exit Survey

Course Content:

Unit I **9 Hours**

Principles of miniaturisation, scaling laws - Theory of Microfluidics and nanofluidics - The diffusion of molecules and microscale mixing - Technological production of components: mixers and pumps

Unit II **9 Hours**

Fundamentals of electrical/electrochemical effects in microfluidics - DC fields in microsystems: electro-osmosis and electrophoresis - AC fields in microsystems: spectroscopy and dielectrophoresis

Unit III **9 Hours**

Soft lithography, novel methods and fabrication of Lab-on-a-Chip devices. - Detection methods – electrical, optical, thermal - Bio-analytical applications

Unit IV **9 Hours**

Magnetic particle biotechnology - Surfaces, forces, electrowetting: Digital Microfluidics - Diagnostic systems – medical systems - Separation, purification, concentration technologies

Unit V **9 Hours**

Simulation and design of mixing devices for chemical reactors

Theory Hours: 45	Practical Hours: 0	Total Hours: 45

TEXT BOOKS:

1.https://www.southampton.ac.uk/courses/modules/elec6204.page#learning_and_teaching

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2. Introduction to Microfluidics, Comprehensive online notes, Tabeling (2005)
3. Marc J. Madou (2002). Fundamentals of Microfabrication, The Science of Miniaturization.
4. Gescheke et al, (2004). Microsystems Engineering of Lab-on-a-Chip Devices.
5. Nguyen and Wereley (2002|2006). Fundamentals and applications of microfluidics.

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U17EIE0003 **VLSI DESIGN**

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Describe the various fabrication technology used in developing logic gates.

CO2: Design combinational and sequential circuits using various MOS logic and analyze using simulation tools..

CO3: Describe the structure and operation of Programmable logic devices

CO4: Design simple combinational and sequential logic using VHDL programming.

Pre-requisite:

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W										S	S	
CO2	S	S	M	M	S		M							
CO3	M	W				W						S	S	
CO4	S	S	M	M	M									

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • End semester exams	• Course Exit Survey

Course Content:

INTRODUCTION **9 Hours**

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS technologies. Basic Electrical Properties of MOS and BiCMOS Circuits: Ids-Vds.
relationships, MOS transistor threshold Voltage, CMOS Inverter Circuits. Pass transistor, NMOS Inverter, Various pull ups, analysis and design, Bi-CMOS Inverters.

VLSI CIRCUIT DESIGN PROCESSES **9 Hours**

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout diagrams. Back end tools - CADENCE and Micro wind.

SUBSYSTEM DESIGN **9 Hours**

Subsystem Design, Shifters, Adders, Multipliers, Parity generators, Comparators, Zero/One Detectors, Memory Elements.

SEMICONDUCTOR INTEGRATED CIRCUIT DESIGN **9 Hours**

PLAs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Testing of VLSI circuits – Testing struck at faults –Boolean difference method.

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VHDL SYNTHESIS **9 Hours**

Introduction to VHDL – Types – Operators – Packages – Combinatioanal and Sequential circuit – Sub-programs – Introduction to Test bench Simulation – Programs on counters, flipflops, FSM, Multiplexers / Demltiplexers. Simulation of combinational sequential circuits Modelsim.

Theory Hours: 45	**Practical Hours: 0**	**Total Hours: 45**

REFERENCES

1. Principles of CMOS VLSI Design – Weste and Eshraghian, Pearson Education, 1999.
2. Modern VLSI Design – Wayne Wolf, Pearson Education, 3rd Edition, 1997
3. Eugene D.Fabricius, 'Introduction to VLSI Design', Tata McGraw Hill, 1990.
4. Douglas Perry, 'VHDL Programming by example', Tata McGraw Hill,3rd Edition, 2003.Zainalatsedin Navabi, 'VHDL Analysis and Modelling of Digital Systems',2nd Edition, Tata McGraw Hill, 1998.
5. Charles H.Roth, 'Fundamentals of Logic Design', Jaico Publishing House,1992

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U17EIE0004 **ROBOTICS AND FLEXIBLE AUTOMATION**

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Describe the major concepts, components and applications of robotics (K2)

CO2: Analyze the transformation in different types of robots.(K4)

CO3: Apply the fundamental concepts of robotics path planning & work space.(K3)

CO4: Describe the technology and evaluation strategies (K2)

Pre-requisite: Nil

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	L												
CO2	S		M										M	
CO3	S	M												
CO4	S												M	

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • End semester exams	• Course Exit Survey

Course Content:

CONCEPT OF ROBOTICS **9 Hours**

Introduction – types of robots – classification and specifications – various manipulators – elements of robots – different kinds of actuators – types of transmissions – purpose of sensors – encoders – tachometers – force & torque sensor – vision sensor – robot end effectors.

CO-ORDINATE TRANSFORMATION **9 Hours**

Direct knematic problem in robotics – geometry based direct kinematic analysis co-ordinate & vector transformation using matrices – direct & inverse kinematic analysis for Four axis SCARA robot – five and six articulated robots – homogeneous transformation.

WORK SPACE ANALYSIS AND TRACJECTORY INTERPOLATION **9 Hours**

Work envelope of a four axis SCARA robot and five axis Articulate robot – the pick and place operation – the necessity of interpolations – the tracjectory planning – structure of interpolators.

FLEXIBLE AUTOMATION TECHNOLOGY **9 Hours**

Introduction to Flexible Automation (FA) – FA tools – FA vs robotic technology – flexibility

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of robotization plan – group technology – grouping methods – data acquisitions – evaluation strategies – planning for robot installation.

ROBOT APPLICATIONS **9 Hours**

Robot applications in manufacturing – material transfer and loading/unloading – processing operation like welding & painting – assembly operation – inspection automation – robot cell layouts – multiple robots & machine interference – social aspects of robotics – future applications.

Theory Hours: 45	**Practical Hours: 0**	**Total Hours: 45**

REFERENCES:

1. Automation, Production System & Computer Integrated Manufacturing Groover Prentice Hall India
2. Principles of Automation & Automated Production Process Malov and Ivanov Mir Publication
3. Automation in Production Engineering Oates and Georgy Newness -
4. Stochastic Models of Manufacturing Systems Buzacott & shanty Kumar Prentice Hall India
5. Robotics K.S. Fu, R.C. Gonzalez, C.S.G. Lee McGraw Hill
6. Robotics J.J. Craig Addison-Wesely
7. Robot Engineering: An Integrated Approach R.D. Klafter, t.a. Chmielewski and M. Negin Prentice
8. Robotics & Control – R.K. Mittal & I.J. Nagrath – TMH Publications
9. Robotics for engineers - Yoram Korean- McGrew Hill Co.
10. Industrial Robotics Technology programming and Applications - M.P.Groover, M.Weiss, R.N.Nagel, N.G.Odrey.
11. Robotics Technology and flexible automation, S.R. Deb, TataMcGraw-Hill Education., 2009

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PROFESSIONAL ELECTIVE – ADVANCED INSTRUMENTATION

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U17EIE0005 **WIRELESS SENSOR MEASUREMENT SYSTEMS**

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Describe the structure and configuration of various Buses used in transmission of DATA.(K2)

CO2: Analyze the suitable wireless data for various application.(K4)

CO3: Explain the fundamental concepts of various wireless IEEE protocol.(K2)

CO4: Analyze the specification details for the Smart data transmission.(K4)

Pre-requisite: Nil

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W										S	S	
CO2	S		M											
CO3	M	W				W						S		
CO4		S		M										

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • End semester exams	• Course Exit Survey

Course Content:

MEASUREMENT SYSTEM **7 Hours**

Configuration and structure of Measurement system, interface system, Measurement Accuracy and measurement system dynamics, Interface protection, computer for measurement system, computer architecture, universal serial bus, IEEE-1394 serial bus.

MEASUREMENT SYSTEM WITH SERIAL INTERFACE **9 Hours**

Measurement serial interface – introduction, RS-232 serial interface system, Programming of measurement system with RS-232 Serial interface, measurement system with RS-232 Serial interface and MODEM, Smart sensor interface-Smart sensors, PROFIBUS interface system, MODBUS interface system, Power line communication for measurement-general description of PLC, Communication protocol for PLC.

WIRELESS MEASUREMENT SYSTEM **7 Hours**

Wireless transmission of measurement Data, Radio Modem based measurement system, Bluetooth Radio Link, IEEE 802.15.4 (zigbee) Radio link, Other wireless transmission system.

MEASUREMENT SYSTEM WITH GSM and LTE **7 Hours**

Measurement System with GSM based data transmission, GSM based Distributed measurement

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system, UMTS, LTE, mobile station, positioning systems.

MEASUREMENT SYSTEM WITH IEEE488- INTERFACE **6 hours**

IEEE-488 parallel interface standard, interface message and their transfer, Enhancement in measurement with IEEE-488 interface, interface function state diagram.

CRATE AND MODULAR MEASUREMENT SYSTEM **9 Hours**

Introduction, CAMAC Dataway, VXI measurement system, PXI modular measurement system,IEEE-1284 interface with measurement system.

Theory Hours: 45	Practical Hours: 0	Total Hours: 45

REFERENCES

1. Waldemar Nawrocki, “measurement systems and sensors” , 2nd Edition, 2001
2. National instruments ,“ Short Tutorial on VXI”
3. Tianbiao Zhang “Instrumentation, measurement, circuits and systems” , springer .

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U17EIE0006 **BIO SENSORS AND MEDICAL INSTRUMENTATION**

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Impart basic knowledge about the biosensors and its types. (K3)

CO2: Illustrate the different methods of electrical and nonelectrical medical parameters diagnostic. (K2)

CO3: Explain the basic parameters of the equipment for using in electro diagnostic and electro therapy (K3)

CO4: Outline about the assisting and therapeutic medical equipment. (K2)

Pre-requisite: Nil

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S						W						S	
CO2		M	S											M
CO3	S		M										S	
CO4			S											

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • End Semester Theory Exam	• Course Exit Survey

Course Content:

BIO SENSORS **(9 hours)**

Introduction to bio sensors - Classification of bio sensors based on transducers – types of bio sensors

ELECTRO – PHYSIOLOGICAL MEASUREMENTS **(9 hours)**

ECG Machine– Lead systems, Signal Conditioning, recording methods and typical waveforms. EEG Machine– Lead systems, Signal Conditioning, recording methods and typical waveforms. EMG Machine - Lead systems, Signal Conditioning, recording methods and typical waveforms. Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.Simulation of ECG and EMG signal.

NON-ELECTRICAL PARAMETER MEASUREMENTS **(9 hours)**

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Measurement of blood pressure – Cardiac output – Cardiac rate – Heart sound – Respiratory rate – Plethysmography. Simulation of Blood pressure measurement.

MEDICAL IMAGING AND PMS (9 hours)

X-ray machine - Radio graphic and fluoroscopic techniques – Computer tomography– MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Electrical safety.Processing of bio images using LABVIEW

LIFE ASSISTING AND THERAPEUTIC EQUIPMENTS (9 hours)

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators –Diathermy – Heart – Lung machine – Audio meters – Dialyzers - Lung machine – Audio meters – Lithotripsy - ICCU patient monitoring system

Theory Hours: 45	Practical Hours:0	Total Hours: 45

TEXT BOOKS

1. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 2007, 4th edition.
2. R.S.Khandpur, 'Handbook of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003, 3rd edition
3. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II Edition, Pearson Education, 2011 / PHI.
4. https://nptel.ac.in/courses/118106019/36

References:

1. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities press (India) Ltd, Orient Longman ltd, 2001.
2. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumenta- tion', John Wiley & Sons, 1975.3rd edition.

BOS Chairman

U17EIE0007 SENSOR AND DATA FUSION

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Describe the most important methods and algorithms for sensor fusion

CO2: Apply simple sensor data fusion methods and algorithms to any application

CO3: Implement the most common motion models in target tracking applications

CO4: Implement simple motion models for navigation applications.

Pre-requisite: Nil

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S						W						S	
CO2		M	S											M
CO3	S		M										S	
CO4			S											

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • End Semester Theory	• Course Exit Survey

Course Content:

INTRODUCTION **9 hours**

Perception and Sensing - Background and State of the Art in Perceptual Fusion - Fusion and Dynamic World Modeling - A General Framework for Dynamic World Modeling - Principles for Integrating Perceptual data

BAYESIAN STATISTICS AND RECURSIVE ESTIMATION THEORY **3 hours**

State Representation: A Vector of Properties - Prediction: Discrete State Transition Equations - Matching Observation to Prediction: The Mahalanobis Distance.

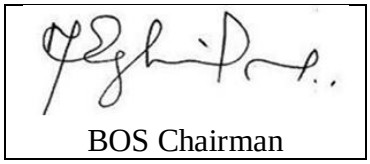
KALMAN FILTER **9 hours**

Updating: The Kalman Filter Update –equations- Eliminating Uncertain Primitives and Adding New Primitives- Fusion of Symbolic properties - Philosophical Foundations- Principles for Symbolic Fusion.

MODELING **9 hours**

A Symbolic Form of the Predict, Match and Update Cycle - Example Systems Constructed in the Framework. - Dynamic World Modeling Using Ultrasound-2D Edge Segment Following - Vertical Line Stereo System - World Modeling Using Ultrasound and Vertical Line Stereo - An Integrated Active Vision System.

SENSOR FUSION APPLICATIONS **9 hours**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Vehicle motion estimation using night vision – Fighter aircraft navigation – Autonomous helicopter landing – Helicoptor pose estimation using map – Indoor positioning using a map – Indoor human motion estimation

Theory Hours: 45	Practical Hours: 0	Total Hours: 45

TEXT BOOKS:

1. https://www.edx.org/course/sensor-fusion-and-non-linear-filtering-for-automotive-systems
2. Dr. Ciza Thomas, "Sensor Fusion and Its Applications" Sciyo Publications, Croatia, 2010
3. "Multi-Sensor Data Fusion: An Introduction" by H B Mitchell, Springer, 1st ed. 2007 edition
4. "Tracking and Sensor Data Fusion (Mathematical Engineering)" by Wolfgang Koch, Springer Nature, 2014
5. "Sensor Data Fusion Systems" by Dakhlallah Tarek, LAP Lambert Academic Publishing, 2012
6. "Sensor and Data Fusion: A Tool for Information Assessment and Decision Making ,Spie Press Monograph, " by Lawrence A Klein, SPIE Press; 2 edition 2012

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U17EIE0008 Machine Vision

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Select suitable Machine vision algorithms using modern computer programming environment as an interactive problem solving tool and Comprehend the complete process involved in solving a machine vision problem.

CO2: Use the suitable Low level Image Transformation techniques for the given application.

CO3: Apply the proper tool for segmentation, edge and region detection for any given problem

CO4: Perform the textural analyses for any application.

Pre-requisite: Nil

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S				M	S		W	S	
CO2	S	S	S	S	S					S			S	
CO3	S	M	W	W	S					W			W	
CO4	S	M	W	W	S			M		M			W	

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • End semester exams	• Course Exit Survey

Course Content:

Machine Vision and Binary Algorithms (9 hrs)

Introduction - Relationships to Other Fields - Image Geometry - Perspective Projection - Coordinate Systems - Binary Image Processing - Binary Algorithms - Region Boundary - Distance Measures and Transforms -Thinning - Expanding and Shrinking - Morphological Operators - Optical Character Recognition

Region and Edge Detection (8 hrs)

Regions and Edges - Region Segmentation - Automatic Thresholding - Region Representation - Array Representation - Edge and Line Detection - Hierarchical Representations - Symbolic Representations - Data Structures for Segmentation - Split and Merge - Region Merging - Removing Weak Edges - Region Splitting - Split and Merge - Region Growing

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Image Filtering and Curve fitting (10 hrs)

Image Filtering - Histogram Modification - Linear Filters - Gaussian Smoothing - Rotational Symmetry - Fourier Transform Property - Gaussian Separability - Designing Gaussian Filters - Geometry of Curves - Curve Fitting - Split and Merge - Hop-Along Algorithm - Circular Arcs - Conic Sections-Curve Approximation- Robust Regression - Hough Transform - Fourier Descriptors

Texture Analyses (8 hrs)

Textural analyses - Statistical Methods - Structural Analysis - Model-Based Methods - Shape from Texture - Optics - Lens Equation - Image Resolution - Depth of Field - View Volume - Shading -Illumination and Reflectance -Surface Orientation - The Reflectance Map - Diffuse Reflectance - SEM - Shape from Shading - Photometric Stereo- Color Physics - Color Processing - Color Constancy - Stereo Imaging

Dynamic Vision (10 hrs)

Stereo Matching - Edge Matching - Active Vision - Rigid Body Transformations - Orientation - Depth from Binocular Stereo - Camera Calibration - Curves and Surfaces - Geometry of Curves and Surfaces - Planes - Differential Geometry - Curve Representations -- Dynamic Vision Segmentation Using a Moving Camera - Classification - Matching - Feature Indexing - Verification - Template Matching - Analogical Methods

Theory Hours: 45	**Practical Hours: 0**	**Total Hours: 45**

REFERENCES

1. Davis, E. R. 1997. Machine Vision. 2nd Ed. San Diego, California: Academic Press.
2. Jain, R. J., R. Kasturi and B. G. Schunck. 1995. Machine Vision. New York: McGraw-Hil
3. Haralick, R. M. and L. G. Shapiro. 1992. Computer and Robot Vision. Vol. 1 & 2. Readin
   Massachusetts: Addison-Wesley Publishing Company, Inc.
4. Faugeras, O. 1999. Three-Dimensional Computer Vision: A Geometric Viewpoint. Cambr
   Massachusetts: The MIT Press.

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PROFESSIONAL ELECTIVE – PROCESS AUTOMATION

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U17EIE0009 **FAULT DETECTION AND DIAGNOSIS**

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Identify the different type of faults occurred in a system.

CO2: Apply mathematical techniques to detect faults.

CO3: Apply structured and directional techniques for FDI design.

CO4: Describe the Artificial Neural network and Fuzzy logic schemes in FDD

Pre-requisite: Nil

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W										S		M
CO2	S	S	M	M										
CO3	M	W				W						S		M
CO4	S	M	W	W						M				

Course Assessment Methods:

Direct	Indirect
• Internal Tests • Assignment • End semester exams	• Course Exit Survey

Course Content:

INTRODUCTION TO FAULT DETECTION AND DIAGNOSIS **9 Hours**

Scope of FDD: Types of faults and different tasks of Fault Diagnosis and Implementation - Different approaches to FDD: Model free and Model based approaches. Classification of Fault and Disturbances -Different issues involved in FDD-Typical applications.

DESIGN OF RESIDUAL GENERATOR FOR LINEAR I/O MODELS **9 Hours**

Analytical Redundancy Concepts: Residual Generation: Linear I/O Models (Continuous and Discrete Time) ; State Estimation : State Observers. Mathematical representation of Fault and Disturbances: Additive and Multiplicative types – Residual Generation: Detection, Isolation, Computational and stability properties – Design of Residual generator – Residual specification and Implementation , Residual Generation with State Estimators.

MULTIPLE FAULT ISOLATION **9 Hours**

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.

DESIGN OF DIRECTIONAL STRUCTURED RESIDUALS **9 Hours**

Introduction– Directional Specifications: Directional specification with and without disturbances – Parity Equation Implementation – Linearly dependent column.

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ARTIFICIAL NEURAL NETWORK AND FUZZY LOGIC SCHEMES IN FDD 9 Hours

Advanced level issues and design involved in FDD: Introduction of Residual generation of parametric fault –Parameter Estimations of Dynamic Models- Robustness Issues –Statistical Hypothesis Testing of Residual generators – Artificial Neural network and Fuzzy logic schemes in FDD – Case study for Automotive systems and Industrial Applications.

Theory Hours: 45	Practical Hours: 0	Total Hours: 45

REFERENCES

1. Rolf Isermann, Fault-Diagnosis Systems an Introduction from Fault Detection to Fault Tolerance, Springer Verlag, 2006.
2. Sachin. C. Patwardhan, Fault Detection and Diagnosis in Industrial Process –Lecture Notes, IIT Bombay, February 2005.
3. Janos J. Gertler, Fault Detection and Diagnosis in Engineering systems, Macel Dekker, 2nd Edition, 1998.
4. Rami S. Mangoubi, Robust Estimation and Failure detection. Springer- Verlag - London 1998.
5. Steven X. Ding, Model based Fault Diagnosis Techniques: Schemes, Algorithms, and Tools, Springer Publication, 2012
6. Hassan Noura, Didier Theilliol, Jean-Christophe Ponsart, Abbas amseddine, FaultTolerant Control Systems: Design and Practical Applications, Springer Publication, 2009.
7. Mogens Blanke, Michel Kinnaert, Jan Lunze, Marcel Staroswiecki., Diagnosis and Fault -Tolerant Control, Springer, 2016.

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U17EIE0010 ADVANCED INTELLIGENT CONTROLLERS

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):
After Successful completion of this course, the students will be able to :
CO1: Apply Various Soft Computing Frame Works. K2
CO2: Design Of Various Neural Networks. K3
CO3: Use of Fuzzy Logic. K3
CO4: Apply Genetic Programming. K3

Pre-requisite: - Nil-

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	S	S	S				W					
CO2		M	S	S	S									M
CO3		M	S	S	S									
CO4		M	S	S	S									

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • End semester exams	• Course Exit Survey

Course Content:

INTRODUCTION TO SOFT COMPUTING **7 Hours**

Concept of computing systems-Soft computing versus Hard-computing Characteristics of Soft computing-Some applications of Soft computing techniques.

NEURAL NETWORKS & ARTIFICIAL NEURAL NETWORKS **10 Hours**

Evolution of neural network-Linear Separability – Hebb Network – Supervised Learning Network: Perceptron Networks – Adaptive Linear Neuron, Multiple Adaptive Linear Neuron, BPN, RBF, TDNN- Biological neurons and its working - Simulation of biolgical neurons to problem solving.- Different ANNs architectures-Training techniques for ANNs- Applications of ANNs to solve some real life problems.

FUZZY LOGIC **10 Hours**

Introduction to Fuzzy logic-Fuzzy sets and membership functions - Operations on Fuzzy sets- Fuzzy relations, rules, propositions, implications and inferences- Defuzzification techniques-Fuzzy logic controller design-Some applications of Fuzzy logic.

GENETIC ALGORITHM **10 Hours**

Concept of "Genetics" and "Evolution" and its application to proablistic search techniques - Basic GA framework and different GA architectures -GA operators: Encoding, Crossover, Selection,

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Mutation-Solving single-objective optimization problems using Gas-Concept of multi-objective optimization problems (MOOPs) and issues of solving them-Multi-Objective Evolutionary Algorithm (MOEA)-Non-Pareto approaches to solve MOOPs.

HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS 8 Hours

Neuro-Fuzzy Hybrid Systems – Genetic Neuro Hybrid Systems – Genetic Fuzzy Hybrid And Fuzzy Genetic Hybrid Systems – Simplified Fuzzy ARTMAP – Applications: A Fusion Approach Of Multispectral Images With SAR, Optimization Of Traveling Salesman Problem Using Genetic Algorithm Approach, Soft Computing Based Hybrid Fuzzy Controllers.

Theory Hours: 45	**Practical Hours:0**	**Total Hours: 45**

Text Books:

1. J.S.R.Jang, C.T. Sun And E.Mizutani, "Neuro-Fuzzy And Soft Computing", PHI / Pearson Education 2004.
2. S.N.Sivanandam And S.N.Deepa, "Principles Of Soft Computing", Wiley India Pvt Ltd, 2011.

REFERENCES:

1. David E. Goldberg, "Genetic Algorithm In Search Optimization And Machine Learning" Pearson Education India, 2013.
2. S.Rajasekaran And G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic And Genetic Algorithm: Synthesis & Applications", Prentice-Hall Of India Pvt. Ltd., 2006.
3. Simon Haykin, "Neural Networks Comprehensive Foundation" Second Edition, Pearson Education, 2005.

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U17EIE0011 **INDUSTRY 4.0**

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Comprehend the drivers and enablers of Industry 4.0

CO2: Understand the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits.

CO3: Outline the various systems used in a manufacturing plant and their role in an Industry 4.0 world

CO4: Analyse the power of Cloud Computing in a networked economy.

Pre-requisite: Nil

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S						W						S	
CO2		S					M	S						M
CO3	S		M										S	
CO4			S											

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • End Semester Theory	• Course Exit Survey

Course Content:

INTRODUCTION **9 Hours**

The Various Industrial revolutions – Digitalization and the networked economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 – Developments in various countries – Comparison and trends of modern tools in Industry 4.0 – Deep shifts: Examples

ROAD TO INDUSTRY 4.0 **9 Hours**

IoT, IIoT,IoS – Smart manufacturing – Design of self-aware machines - Smart devices and products – Smart logistics – smart warehouse - Smart cities – Predictive analytics – Role of Big data and Machine learning.

RELATED SYSTEMS AND TECHNOLOGIES **9 Hours**

Cyber physical systems, Robotic automation and collaborative robots – support system – ERP, MES, SCADA, PLC -mobile computing – IoT Network and security – Machine Intelligence – Process management and Automation – Product life cycle management - Cyber security

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DATA, INFORMATION, KNOWLEDGE **9 Hours**

Resource based view (RBV) - Data as a new resource – Harnessing and sharing knowledge –Best practices - basics of cloud computing and its relevance to Industry 4.0

APPLICATIONS AND CASE STUDIES **9 Hours**

Industry 4.0 laboratories, IIoT case studies – GE Aviation, Komatsu mining equipment, Truck fleet system, Precision farming, high speed train, Wision furniture.

Theory Hours: 45	**Practical hours : 0**	**Total Hours: 45**

TEXT BOOKS:

1. https://courses.edx.org/courses/course-v1:HKPolyUx+I4.0x+2T2018/course/
2. Klaus Schwab, "The Fourth Industrial Revolution" World Economic Forum, 2016
3. Fran Yáñez, "The Goal is Industry 4.0: Technologies and Trends of the Fourth Industrial Revolution", independently published, 2017
4. Klaus Schwab, "The Fourth Industrial Revolution: what it means, how to respond" World Economic Forum, 2016
5. Mr Kiran Kumar Pabbathi, **"**Quick Start Guide to Industry 4.0: One-stop reference guide for Industry 4.0", CreateSpace Independent Publishing Platform, 2018

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U17EIE0012 **SYSTEM IDENTIFICATION, MODELLING AND SIMULATION**

L	T	P	J	C
3	0	0	0	3

Course Outcomes (CO):

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

CO1: Choose the correct model structure

CO2: Design inputs (probe signals) for identification

CO3: Estimate the non-parametric and parametric models

CO4: Perform the data pre-processing for identification

Pre-requisite: Nil

COs	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S						W						S	
CO2		M			S									M
CO3	S	S			M								S	
CO4		M												

Course Assessment Methods:	
Direct	**Indirect**
• Internal Tests • Assignment • End Semester Theory	• Course Exit Survey

Course Content:

MODELS OF DETERMINISTIC LTI SYSTEMS **9 Hours**

Discrete-time convolution models, response-based models, difference equation descriptions, transfer function and state-space models, discretization. Stochastic processes: Review (auto- and cross-correlation functions, white- noise process and ARMA models).

BASICS OF ESTIMATION THEORY **9 Hours**

Estimators, bias and variance, convergence, consistency, asymptotic distribution of parameter estimates. Generic estimation methods: Ordinary least squares, Variants of LS methods, Maximum Likelihood Estimation.

INPUT-OUTPUT MODELS FOR IDENTIFICATION: **9 Hours**

non-parametric (step, impulse and frequency response) and parametric models (ARX, ARMAX, OE, B-J).Prediction: one-step ahead prediction, k-step ahead predictors, simulation

IDENTIFICATION OF NONPARAMETRIC AND PARAMETRIC MODELS:9Hours

Estimation of impulse response and frequency response functions; prediction-error minimization (PEM) methods, correlation methods, instrumental variable (IV) methods. Statistical and Practical Aspects: time-delay estimation, diagnostics for model quality checks, residual analysis, model validation, and handling drifts, outliers and missing data; input design.

IDENTIFICATION OF STATE-SPACE MODELS: **9 Hours**

Kalman filter, subspace identification methods, Grey-box modeling. Advanced topics: Recursive and closed-loop identification..

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Theory Hours: 45	Practical hours : 0	Total Hours: 45

TEXT BOOKS:

1. System Identification: Theory for the User , 2nd Edition, Prentice Hall by Lennart Ljung, 1999.
2. System Identification: An Introduction , 2011by Karel J. Keesman, Springer
3. Mastering System Identification in 100 Exercises –2012 by Johan Schoukens , Wiley-IEEE Press
4. Principles of System Identification: Theory and Practice Hardcover –2014
by Arun K. Tangirala, CRC Press
5. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Second Edition –2017by Trevor Hastie, Springer.

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PROFESSIONAL ELECTIVE
GENERAL

K.K.

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U17EIE0013 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

L	T	P	J	C
3	0	0	0	3

Course Outcomes

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

CO1: Able to understand the practical aspects of data science and its evolution and apply the concepts and methods to solve problems in real-world contexts.

CO2: Able to understand and code basic programs in Python language that pertains to the use of machine learning and related algorithms, Gain knowledge about basic concepts of Machine Learning.

CO3: Develop scaling up machine learning techniques and associated computing techniques and technologies for various applications integrating with the standard ML Libraries.

CO4: Able to understand the deep learning techniques and develop a basic DNN using Tensor flow.

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1 (K2)	S	M	S	S			M			M		M		M
CO2 (K3)	M	M	S	M		M						M		M
CO3 (K3)	M	S	W	W			S			S				S
CO4 (K3)	M	M	S	S				S			S	M		S

S-Strong M-Medium L-Low

Course Assessment methods:

Direct	Indirect
Continuous assessment tests Assignments End Semester Exam	Course exit survey

Course content

Introduction to Artificial Intelligence and Machine learning Basics 9 Hrs

Terminologies and differences between them – Artificial Intelligence, Machine Learning, Deep Learning. Data Analytics, Data Science & AI – The Connection, History of AI (evolution of AI) Real world use cases of AI.

Types of Machine Learning – Supervised, Unsupervised and Reinforcement, Basic ML process, Cost functions, Bias and Variance, Regularization

Python for ML and ML algorithms 12 Hrs

Introduction to python, Variables, Data types, List and Tuple operations, Import, Conditional statements, Functions.

Linear Regression, Logistic Regression, Support Vector Machines, K-Nearest Neighbours, Decision Tree, Random Forest

K.K.

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ML Libraries and Case studies **19 Hrs**

Numpy (key operations), Pandas (Series, DataFrame, key operations), Matplotlib (basic plotting), Seaborn (key plots), Scikit-learn(key algorithms and operations). Case study - Regression problem, Classification problem

Deep Learning **5 Hrs**

Introduction, Forward propagation, Back propagation, Optimizers, Types - Dense Neural Networks (DNN), Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Introduction to Tensor flow, Building a basic DNN using Tensorflow.

TEXT BOOKS:

1 S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.

2 I. Bratko, ―Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

3. Tom M. Mitchell, Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

4. Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

K.K.

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U17EIE0014 **BIG DATA ANALYTICS**

L	T	P	J	C
3	0	0	0	3

Course Outcomes

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

CO1: Work with big data tools and its analysis techniques.

CO2: Analyse data by utilizing clustering and classification algorithms.

CO3: Learn and apply different mining algorithms and recommendation systems for large volumes of data.

CO4: Perform analytics on data streams

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1 (K2)	S	M	S	S			M			M		M		S
CO2 (K3)	M	S	S	M		M						M		S
CO3 (K3)	M	S	W	W			S			S				S
CO4 (K3)	M	S	S	S				S			S	M		S

S-Strong **M-Medium** **L-Low**

Course Assessment methods:

Direct	Indirect
Continuous assessment tests Assignments End Semester Exam	Course exit survey

Course content

INTRODUCTION TO BIG DATA **9 Hrs**

Evolution of Big data – Best Practices for Big data Analytics – Big data characteristics – Validating – The Promotion of the Value of Big Data – Big Data Use Cases- Characteristics of Big Data Applications – Perception and Quantification of Value -Understanding Big Data Storage – A General Overview of High-Performance Architecture – HDFS – MapReduce and YARN – Map Reduce Programming Model Provisioning.

CLUSTERING AND CLASSIFICATION **9 Hrs**

Advanced Analytical Theory and Methods: Overview of Clustering – K-means – Use Cases – Overview of the Method – Determining the Number of Clusters – Diagnostics – Reasons to Choose and Cautions .- Classification: Decision Trees – Overview of a Decision Tree – The General Algorithm – Decision Tree Algorithms – Evaluating a Decision Tree – Decision Trees in R – Naïve Bayes – Bayes‘ Theorem – Naïve Bayes Classifier.

K.K.

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ASSOCIATION AND RECOMMENDATION SYSTEM 9 Hrs

Advanced Analytical Theory and Methods: Association Rules – Overview – Apriori Algorithm – Evaluation of Candidate Rules – Applications of Association Rules – Finding Association& finding similarity – Recommendation System: Collaborative Recommendation- Content Based Recommendation – Knowledge Based Recommendation- Hybrid Recommendation Approaches.

STREAM MEMORY 9 Hrs

Introduction to Streams Concepts – Stream Data Model and Architecture – Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) applications – Case Studies – Real Time Sentiment Analysis, Stock Market Predictions. Using Graph Analytics for Big Data: Graph Analytics

NOSQL DATA MANAGEMENT FOR BIG DATA AND VISUALIZATION 9 Hrs

NoSQL Databases : Schema-less Models‖: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores – Tabular Stores – Object Data Stores – Graph Databases Hive – Sharding –- Hbase – Analyzing big data with twitter – Big data for E-Commerce Big data for blogs – Review of Basic Data Analytic Methods using R.

Theory: 45 Hrs. Total hrs. 45 hrs.

TEXT BOOKS:

1. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
2. David Loshin, “Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph”, Morgan Kaufmann/El sevier Publishers, 2013.

REFERENCES:

1. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley publishers, 2015.
2. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, 2015.
3. Dietmar Jannach and Markus Zanker, “Recommender Systems: An Introduction”, Cambridge University Press, 2010.
4. Kim H. Pries and Robert Dunnigan, “Big Data Analytics: A Practical Guide for Managers ” CRC Press, 2015.
5. Jimmy Lin and Chris Dyer, “Data-Intensive Text Processing with MapReduce”, Synthesis Lectures on Human Language Technologies, Vol. 3, No. 1, Pages 1-177, Morgan Claypool publishers, 2010.

K.K.

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U17EIE0015 **CLOUD COMPUTING**

L	T	P	J	C
3	0	0	0	3

Course Outcomes

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

CO1: Articulate the main concepts, key technologies, strengths and limitations of cloud computing.

CO2: Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.

CO3: Explain the core issues of cloud computing such as resource management and security.

CO4: Evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1 (K2)	S	M	S	S			M			M		M		S
CO2 (K3)	M	M	S	S		M						M		S
CO3 (K3)	M	S	W	W			S			S				S
CO4 (K3)	M	M	S	S				S			S	M		S

S-Strong **M-Medium** **L-Low**

Course Assessment methods:

Direct	Indirect
Continuous assessment tests Assignments End Semester Exam	Course exit survey

Course content

INTRODUCTION **9 Hrs**

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing –Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

CLOUD ENABLING TECHNOLOGIES **9 Hrs**

Service Oriented Architecture – REST and Systems of Systems – Web Services – PublishSubscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices – Virtualization Support and Disaster Recovery.

CLOUD ARCHITECTURE, SERVICES AND STORAGE **9 Hrs**

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage –

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Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

RESOURCE MANAGEMENT AND SECURITY IN CLOUD **9 Hrs**

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges –Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards.

CLOUD TECHNOLOGIES AND ADVANCEMENTS **9 Hrs**

Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack –Federation in the Cloud – Four Levels of Federation –Federated Services and Applications – Future of Federation.

Theory: 45 Hrs. **Total hrs. 45 hrs.**

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security‖, CRC Press, 2017.

REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing‖, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach‖, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)‖, O'Reilly, 2009.

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U17EIE0016 VIRTUAL REALITY AND AUGMENTED REALITY

L	T	P	J	C
3	0	0	0	3

Course Outcomes

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

CO1: Understand the principles of Virtual environments
CO2: Analyse the 3D user interface hardware

CO3: Learn and apply different software technologies in Virtual environments
CO4: Design and develop virtual reality applications

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1 (K2)	S	M	S	S			M			M		M		S
CO2 (K3)	M	S	S	M		M						M		S
CO3 (K3)	M	S	W	W			S			S				S
CO4 (K3)	M	S	S	S				S			S	M		S

Course Content

VIRTUAL REALITY AND VIRTUAL ENVIRONMENTS: 4 hrs

The historical development of VR: Scientific landmarks Computer Graphics, Real-time computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality.

HARDWARE TECHNOLOGIES FOR 3D USER INTERFACES: 6hrs

Visual Displays Auditory Displays, Haptic Displays, Choosing Output Devices for 3D User Interfaces.

3D USER INTERFACE INPUT HARDWARE: 5 hrs

Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home - Brewed Input Devices, Choosing Input Devices for 3D Interfaces.

SOFTWARE TECHNOLOGIES: 10hrs

Database - World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes, VR Environment - VR Database, Tessellated Data, LODs, Cullers and Occluders, Lights and Cameras, Scripts, Interaction - Simple, Feedback, Graphical User Interface, Control Panel, 2D Controls, Hardware Controls, Room / Stage / Area Descriptions, World Authoring and Playback, VR toolkits, Available software in the market

3D INTERACTION TECHNIQUES: 8hrs

3D Manipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation, Deign Guidelines - 3D Travel Tasks, Travel Techniques, Design Guidelines -

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Theoretical Foundations of Wayfinding, User Centered Wayfinding Support, Environment Centered Wayfinding Support, Evaluating Wayfinding Aids, Design Guidelines - System Control, Classification, Graphical Menus, Voice Commands, Gestrual Commands, Tools, Mutimodal System Control Techniques, Design Guidelines, Case Study: Mixing System Control Methods, Symbolic Input Tasks, symbolic Input Techniques, Design Guidelines, Beyond Text and Number entry

DESIGNING AND DEVELOPING 3D USER INTERFACES: 2hrs

Strategies for Designing and Developing Guidelines and Evaluation.

IN 3D USER INTERFACES: 6hrs

3D User Interfaces for the Real World, AR Interfaces as 3D Data Browsers, 3D Augmented Reality Interfaces, Augmented Surfaces and Tangible Interfaces, Agents in AR, Transitional AR-VR Interfaces - The future of 3D User Interfaces, Questions of 3D UI Technology, 3D Interaction Techniques, 3D UI Design and Development, 3D UI Evaluation and Other Issues.

VIRTUAL REALITY APPLICATIONS: 4 hrs

Engineering, Architecture, Education, Medicine, Entertainment, Science, Training.

Theory : 45 Hrs Total Hrs: 45

REFERENCES:

1. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
2. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
4. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
5. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.
6. John Vince, "Virtual Reality Systems", Addison Wesley, 1995.
7. Howard Rheingold, "Virtual Reality: The Revolutionary Technology and how it Promises to Transform Society", Simon and Schuster, 1991.
8. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002.

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U17EIE0017 INDUSTRIAL ELECTRONIC DRIVES

L	T	P	J	C
3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Choose the power devices based on the application. (K3)

CO2: Evaluate the performance parameters of AC-DC converters with R, RL and RLE Load. (K3)

CO3: Describe the functioning of various DC-DC converters and inverters. (K3)

CO4: Identify the drives for various control applications. (K3)

Pre-requisite courses:

1. U17EII1201: Basic Electronics
2. U17EII2201: Electric Circuits
3. U17EII3201: Analog Electronics

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs) / Programme Specific Outcomes (PSOs)													
	PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1 (K4)	PSO2 (K4)
CO1 (K3)	S	M	W										M	
CO2 (K3)	S	M	W	W									M	
CO3 (K3)	S	M	W	W									M	
CO4 (K3)	S	M	W	W									M	

Course Contents

POWER CONVERSION & POWER SEMICONDUCTOR SWITCHES 7 Hrs

Need for power conversion - Power electronic converters - classifications and scope; Construction, Operating Principle, Static and Dynamics Characteristics of Power Diode - Power BJT -SCR - TRIAC- MOSFET – IGBT; Ratings & Protection of Switches.

CONVERTERS 9 Hrs

Single Phase and Three Phase Half & Fully Controlled Rectifier with R, RL, RLE Load - Effect of Source Inductance - Continuous and Discontinuous Mode of Operation - Performance Analysis – Dual Converter – Simulation Analysis of Converters using MATLAB / MULTISIM.

CHOPPERS 8 Hrs

Step up and Step down Chopper – Chopper Classification - Quadrant of Operation – Switching Mode Regulators - Buck, Boost, Buck-Boost, and Cuk Regulators - Simulation Analysis of Choppers using MATLAB / MULTISIM.

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INVERTERS **9 Hrs**

Single Phase and Three Phase (both 120^{o} and 180^{o} Modes of Operation) Inverters - PWM techniques: Sinusoidal PWM, Modified Sinusoidal PWM and Multiple PWM – Voltage Source Inverters - Current Source Inverters - Multilevel Inverters - Simulation Analysis of Inverters using MATLAB / MULTISIM.

INDUSTRIAL DRIVES & APPLICATIONS **12 Hrs**

Determination of Speed and Torque Requirements for Specific Motion Profiles, Introduction to DC Drives & AC Drives - Electrical Braking -Regenerative breaking- Open loop and Closed Loop Control of Drives (Block Diagram Approach only) - Stepper Motor Drives - Position Control - Servo Drives.

Applications: Switched Mode Power Supply - Uninterrupted Power Supply – FACTS – HVDC Transmission.

Theory : 45 Hrs **Total Hrs: 45**

REFERENCES

1. Muhammad H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Prentice Hall of India / Pearson Education, 4th Edition, 2017, ISBN-13: 978-9332584587.
2. Singh M.D. Khanchandani, K.B., "Power Electronics", 3rd Edition, McGraw-Hill, 2017, ISBN 13: 9780070583894.
3. Bimbhra P. S. 'Power Electronics', Khanna Publishers, 2006 ISBN-13: 978-8174092151.
4. Ned Mohan, Tore. M. Undelan, William P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and Sons, Third Edition, 2007, ISBN-13:978126510900.
5. Bimal K. Bose, 'Modern Power Electronics and AC Drives', Pearson Education, 1st Edition, 2015, ISBN-13: 978-9332557550.
6. Moorthi V. R., 'Power Electronics - Devices, Circuits and Industrial Applications', Oxford

   University Press, 2005, ISBN: 9780195670929.
7. Dubey G. K., 'Power Semiconductor Controlled Drives,' Prentice Hall International, New Jersey, 1989, ISBN-13: 978-0136868903.

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