Applied Electronics & Instrumentation Engineering Department

SYLLABUS FOR B.TECH. PROGRAMME

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PART-I: COURSE STUCTURE

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

B. Tech. in Applied Electronics and Instrumentation Engineering (AEIE)
Course Structure

1st Year 1st Semester Course Structure

Theory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Basic Science Courses	CHEM1001	Chemistry-I	3	1	0	4	4
2	Basic Science Courses	MATH1101	Mathematics-I	3	1	0	4	4
3	Engg. Science Courses	ELEC1001	Basic Electrical Engineering	3	1	0	4	4
Total Theory				**9**	**3**	**0**	**12**	**12**

Laboratory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Basic Science Courses	CHEM1051	Chemistry Lab	0	0	3	3	1.5
2	Engg. Science Courses	ELEC1051	Basic Electrical Engineering Lab	0	0	2	2	1
3	Engg. Science Courses	MECH1052	Engineering Graphics & Design	1	0	4	5	3
Total Laboratory				**1**	**0**	**9**	**10**	**5.5**
Total of Semester without Honours Course				**10**	**3**	**9**	**22**	**17.5**

Honours

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Honours	HMTS 1011	Communication for Professionals	3	0	0	3	3
		HMTS 1061	Professional Communication Lab	0	0	2	2	1
Total of Semester with Honours Course				**13**	**3**	**11**	**27**	**21.5**

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1st Year 2nd Semester Course Structure

Theory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Basic Science Courses	PHYS1001	Physics I	3	1	0	4	4
2	Basic Science Courses	MATH1201	Mathematics-II	3	1	0	4	4
3	Engineering Science Courses	CSEN1001	Programming for Problem Solving	3	0	0	3	3
4	Humanities & Social Sciences including Management courses	HMTS1202	Business English	2	0	0	2	2
			Total Theory	**11**	**2**	**0**	**13**	**13**

Laboratory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Basic Science Courses	PHYS1051	Physics Lab I	0	0	3	3	1.5
2	Engineering Science Courses	CSEN1051	Programming for Problem Solving Lab	0	0	4	4	2
3	Engineering Science Courses	MECH1051	Workshop /Manufacturing Practices	1	0	4	5	3
4	Humanities & Social Sciences including Management courses	HMTS1252	Language Lab	0	0	2	2	1
			Total Laboratory	**1**	**0**	**13**	**14**	**7.5**
Total of Semester without Honours Course				**12**	**2**	**13**	**27**	**20.5**

Honours

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Honours	ECEN1011	Basic Electronics	3	0	0	3	3
		ECEN1061	Basic Electronics Engineering Lab	0	0	2	2	1
Total of Semester with Honours Course				**15**	**2**	**13**	**32**	**24.5**

Heritage Institute of Technology
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2nd Year 1st Semester Course Structure

Theory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Basic Science Courses	MATH2001	Mathematical Methods	3	1	0	4	4
2	Core Subject Courses	AEIE2101	Analog Electronic Circuits	3	0	0	3	3
3	Core Subject Courses	AEIE2102	Sensors and Transducers	4	0	0	4	4
4	Core Subject Courses	AEIE2103	Circuit Theory and Network Analysis	3	0	0	3	3
5	Humanities & Social Sciences including Management courses	HMTS2001	Human Values and Professional Ethics	3	0	0	3	3
			Total Theory	**17**	**0**	**0**	**17**	**17**

Laboratory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Core Subject Courses	AEIE2151	Analog Electronics Lab	0	0	3	3	1.5
2	Core Subject Courses	AEIE2152	Sensors and Transducers Lab	0	0	2	2	1
3	Core Subject Courses	AEIE2153	Circuits and Networks Lab	0	0	2	2	1
			Total Laboratory	**0**	**0**	**7**	**7**	**3.5**
Total of Semester without Honours Course				**17**	**0**	**7**	**24**	**20.5**

Honours

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Honours	AEIE2111	Material Science and Technology	4	0	0	4	4
Total of Semester with Honours Course				**21**	**2**	**13**	**28**	**24.5**

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2nd Year 2nd Semester Course Structure

Theory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Engineering Science Courses	CSEN2004	Data Structure and Basic Algorithms	3	0	0	3	3
2	Core Subject Courses	AEIE2201	Digital Electronics	3	0	0	3	3
3	Core Subject Courses	AEIE2202	Industrial Instrumentation	3	0	0	3	3
4	Core Subject Courses	AEIE2203	Electrical and Electronic Measurements	4	0	0	4	4
5	Core Subject Courses	AEIE2204	Control Systems	3	1	0	4	4
6	Mandatory Courses	EVSC2016	Environmental Sciences	2	0	0	2	-
			Total Theory	**19**	**0**	**0**	**19**	**17**

Laboratory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Engineering Science Courses	CSEN2054	Data Structure and Basic Algorithms Lab	0	0	3	3	1.5
2	Core Subject Courses	AEIE2251	Digital Electronics Lab	0	0	2	2	1
3	Core Subject Courses	AEIE2252	Industrial Instrumentation Lab	0	0	2	2	1
4	Core Subject Courses	AEIE2253	Electrical and Electronic Measurements Lab	0	0	2	2	1
5	Core Subject Courses	AEIE2254	Control Systems Lab	0	0	2	2	1
			Total Laboratory	**0**	**0**	**11**	**11**	**5.5**
			Total of Semester	**19**	**0**	**11**	**30**	**22.5**

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3rd Year 1st Semester Course Structure

Theory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Core Subject Courses	AEIE3101	Process Control	4	0	0	4	4
2	Core Subject Courses	AEIE3102	Power Electronics & Drives	3	0	0	3	3
3	Core Subject Courses	AEIE3103	Microprocessors & Microcontrollers	4	0	0	4	4
4	Core Subject Courses	AEIE3104	Fundamentals of Digital Signal Processing	3	0	0	3	3
5	Program Electives Courses - I	AEIE3131/ AEIE3132/ AEIE3133	Communication Techniques/ Non Conventional Energy Sources / Advanced Sensors	3	0	0	3	3
			Total Theory	**17**	**0**	**0**	**17**	**17**

Laboratory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Core Subject Courses	AEIE3151	Process Control Lab	0	0	3	3	1.5
2	Core Subject Courses	AEIE3152	Power Electronics & Drives Lab	0	0	2	2	1
3	Core Subject Courses	AEIE3153	Microprocessors & Microcontrollers Lab	0	0	2	2	1
			Total Laboratory	**0**	**0**	**7**	**7**	**3.5**
Total of Semester without Honours Course				**17**	**0**	**7**	**24**	**20.5**

Honours

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Honours	AEIE3111	Introduction to Mechatronics	4	0	0	4	4
Total of Semester with Honours Course				**21**	**0**	**7**	**28**	**24.5**

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3rd Year 2nd Semester Course Structure

Theory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Engineering Science Courses	CSEN3206	Basics of RDBMS	3	1	0	4	4
2	Humanities & Social Sciences including Management courses	HMTS3201	Economics for Engineers	3	0	0	3	3
3	Core Subject Courses	AEIE3201	Introduction to Internet of Things	3	0	0	3	3
4	Program Elective Courses - II	AEIE3231/ AEIE3232/ AEIE3233	Embedded Systems/ Opto Electronics and Fibre Optics/ Mobile Communication	3	0	0	3	3
5	Emerging Area/ Open Elective Courses - I		OE-01	3	0	0	3	3
6	Mandatory Courses	INCO3016	Indian Constitution and Civil Society	2	0	0	2	-
			Total Theory	**18**	**0**	**0**	**18**	**16**

Laboratory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Engineering Science Courses	CSEN3256	Basics of RDBMS Lab	0	0	3	3	1.5
2	Core Subject Courses	AEIE3251	Internet of Things Lab	0	0	2	2	1
3	Core Subject Courses	AEIE3295	Mini Project/Electronic Design Workshop	0	0	4	4	2
4	Seminar	AEIE3293	Term Paper and Seminar	0	0	4	4	2
			Total Laboratory	**0**	**0**	**13**	**13**	**6.5**
			Total of Semester	**18**	**0**	**13**	**31**	**22.5**

OPEN ELECTIVES BASKET I FOR AEIE B. TECH STUDENTS:

Open Electives	Semester	Paper Code	Paper Name
Open Electives I	VI	AEIE3223	Industrial Automation
		AEIE3224	Electronic Instrumentation
		ECEN3222	Designing with Processors and Controllers
		ECEN3223	Analog and Digital Communication
		INFO3221	Introduction to E-Commerce
		CHEN3221	Water and Liquid Waste Management
		CHEN3222	Industrial Safety and Hazards
		MATH3221	Computational Mathematics
		MATH3222	Advanced Probability and Information Theory
		MATH3223	Scientific Computing

Open Electives to be offered by Dept. of AEIE:

Open Electives	Semester	Paper Code	Paper Name
Open Electives I	VI	AEIE3221	Fundamentals of Sensors and Transducers
		AEIE3222	Fundamentals of Electronic Measurements

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4th Year 1st Semester Course Structure

Theory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Humanities & Social Sciences including Management courses	HMTS4101	Principles of Management	3	0	0	3	3
2	Program Electives Courses - III	AEIE4131/ AEIE4132/ AEIE4133	Analytical Instrumentation/ Soft Computing/ Non Destructive Testing	3	0	0	3	3
3	Open Electives Courses - II		OE-02	3	0	0	3	3
4	Open Electives Courses -III		OE-03	3	0	0	3	3
			Total Theory	**12**	**0**	**0**	**12**	**12**

Laboratory

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Industrial Training	AEIE4191	Industrial Training Evaluation	0	0	0	0	2
2	Project Stage I	AEIE4195	Project I	0	0	8	8	4
			Total Laboratory	**0**	**0**	**8**	**8**	**6**
			Total of Semester without Honours Course	**12**	**0**	**8**	**20**	**18**

Honours

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Honours	AEIE4111	Introduction to MEMS	4	0	0	4	4
			Total of Semester with Honours Course	**21**	**2**	**13**	**28**	**22**

Open Electives basket II & basket III for AEIE B. Tech students:

Open Electives	Semester	Paper Code	Paper Name
Open Electives II	VII	ECEN4121	Software Defined Radio
		ECEN4122	Error Control Coding
		CHEN4121	Industrial Total Quality Management
		CHEN4122	Industrial Pollution Control
		ELEC4121	Automatic Control System
		BIOT4123	Biosensor
		CSEN4121	Fundamentals of Operating Systems
		MATH4121	Methods in Optimization
		HMTS4122	German for Beginners
Open Electives III	VII	HMTS4123	Elementary French
		ECEN4126	Ad Hoc Networks and Security Challenges
		ECEN4127	Introduction to VLSI Design
		INFO4121	Fundamentals of Cloud Computing
		ELEC4126	Electrical Machines
		CHEN4123	Statistical Methods in Design of Experiments
		CHEN4124	Reactor Design
		BIOT4124	Biopolymer
		MATH4122	Advanced Linear Algebra
		CSEN4126	Intelligent Web and Big Data

Open Electives to be offered by Dept. of AEIE:

Open Electives	Semester	Paper Code	Paper Name
Open Electives II	VII	AEIE4121	Instrumentation and Telemetry
		AEIE4122	Linear Control Systems and Applications
Open Electives III	VII	AEIE4126	Optical Instrumentation
		AEIE4127	Introduction to Embedded Systems

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4th Year 2nd Semester Course Structure								
Theory								
Sl. No	**Category**	**Code**	**Course Title**	**Contact hrs/wk**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Program Electives Courses - IV	AEIE4231/ AEIE4232/ AEIE4233	Power plant Instrumentation/ Digital Control Systems/ Artifical Intelligence	3	0	0	3	3
2	Program Electives Courses - V	AEIE4241/ AEIE4242/ AEIE4243	Biomedical Instrumentation/ Digital Image Processing/ Principles of Robotics	3	0	0	3	3
3	Open Electives Courses – IV		OE-04	3	0	0	3	3
			Total Theory	**9**	**0**	**0**	**9**	**9**
Laboratory								
Sl. No	**Category**	**Code**	**Course Title**	**Contact hrs/wk**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Grand Viva Voce	AEIE4297	Comprehensive Viva Voce	0	0	0	0	1
2	Project Stage I	AEIE4295	Project II	0	0	16	16	8
			Total Laboratory	**0**	**0**	**16**	**16**	**9**
			Total of Semester	**9**	**0**	**16**	**25**	**18**

Open Electives basket IV for AEIE B. Tech students:

Open Electives	**Semester**	**Paper Code**	**Paper Name**
Open Electives IV	VIII	ECEN4221	Cellular and Mobile communication
		ECEN4222	Optical Fiber Communication
		INFO4221	Fundamentals of Cryptography
		ELEC4221	Illumination Engineering
		CHEN4221	Nanotechnology
		CHEN4222	Introduction to Solar and Wind Technology
		BIOT4221	Computational Biology
		BIOT4223	Biology for Engineers
		CSEN4221	Basics of Mobile Computing
		HMTS4222	Elementary Spanish

Open Electives to be offered by Dept. of AEIE:

Open Electives	**Semester**	**Paper Code**	**Paper Name**
Open Electives IV	VIII	AEIE4221	Process Instrumentation
		AEIE4222	Medical Instrumentation

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Honours Papers:

Sl No.	Semester	Paper Code	Paper Name	Contact hrs/wk				Credit Points
				L	T	P	Total	
01	1st	HMTS 1011	Communication for Professionals	3	0	0	3	3
		HMTS 1061	Professional Communication Lab	0	0	2	2	1
02	2nd	ECEN1011	Basic Electronics	3	0	0	3	3
		ECEN1061	Basic Electronics Engineering Lab	0	0	2	2	1
03	3rd	AEIE2111	Material Science and Technology	4	0	0	4	4
04	5th	AEIE3111	Introduction to Mechatronics	4	0	0	4	4
05	7th	AEIE4111	Introduction to MEMS	4	0	0	4	4
Total				18	0	4	22	**20**

Definition of Credit (as per AICTE):

- 1 Hour Lecture (L) per Week = 1 Credit
- 1 Hour Tutorial (T) per Week = 1 Credit
- 1 Hour Practical (P) per Week = 0.5 Credits
- 2 Hours Practical (Lab) per Week = 1 Credit

RANGE OF CREDITS (AS PER AICTE):

- ❒ A total of 160 credits will be necessary for a student to be eligible to get B Tech degree.
- ❒ A student will be eligible to get B Tech degree with Honours if he/she completes an additional 20 credits. These could be acquired through various Honours Courses offered by the respective departments.
- ❒ A part or all of the above additional credits may also be acquired through MOOCs. Any student completing any course through MOOC will have to submit an appropriate certificate to earn the corresponding credit.
- ❒ For any additional information, the student may contact the concerned HODs.

SWAYAM/MOOCS COURSES RECOMMENDED TO THE STUDENTS OF AEIE DEPT.

Code	Name	Credit Points	Corresponding Online Course	Offered by	Platform
HMTS1011	Communication for Professionals	3	Effective Business Communication **AND** Developing Soft Skills and Personality	IIM Bangalore	Swayam
HMTS1061	Professional Communication Lab	1		IIT Kanpur	Swayam
ECEN1011	Basic Electronics	3	Fundamentals of Semiconductor Devices	IISc Bangalore	NPTEL
ECEN1061	Basic Electronics Lab	1			
AEIE2111	Material Science & Technology	4	Introduction to Materials Science and Engineering **OR** Introduction to Materials Science and Engineering	IIT Delhi IIT Madras	NPTEL NPTEL
AEIE3111	Introduction to Mechatronics	4	Mechatronics and Manufacturing Automation	IIT Gwahati	NPTEL
AEIE4111	Introduction to MEMS	4	MEMS and Microsystems	IIT Kharagpur	NPTEL

Department of Applied Electronics & Instrumentation Engineering

B.TECH in AEIE

SLYLLABUS OF 1ST YEAR COURSES

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Detailed Syllabus of 1st Year 1st Semester Courses

Course Name: CHEMISTRY-1					
Course Code: CHEM 1001					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

MODULE 1
Atomic structure and Wave Mechanics:

Brief outline of the atomic structure, Duel character of electron, De Broglies's equation, the Heisenberg uncertainty principle, brief introduction of quantum mechanics, the Schrodinger wave equation, Hermitian operator, solution of the Schrodinger equation for particle in a one dimensional box, interpretation of the wave function Ψ, concept of atomic orbital.

3**L**

Thermodynamics:

Carnot cycle, 2nd law of thermodynamics, entropy, Clausius inequality, free energy and work function, Clausius Clapeyron Equation, Chemical Potential, Activity and Activity coefficient. Gibbs Duhem Relation.

4**L**

Spectroscopic Techniques & Application
Electromagnetic spectrum: EMR interaction with matter - absorption and emission of radiation.
Principle and application of UV- visible and IR spectroscopy
Principles of NMR Spectroscopy and X-ray diffraction technique **3L**

MODULE 2
Chemical Bonding

Covalent bond, VSEPR Theory, hybridization, molecular geometries, Dipole moment, Intermolecular forces, V.B. and M.O. Theory and its application in Homo and Heteronuclear diatomic molecules, Band theory of solids, Pi-molecular orbitals of ethylene and butadiene.

5**L**

Periodicity

Effective nuclear charge, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro-negativity, inert pair effect.

3L

Ionic Equilibria

Acid Base Equilibria, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation .

2L

MODULE 3

Conductance

Conductance of electrolytic solutions, Strong and Weak electrolytes, effect of temperature and concentration. Kohlrausch's law of independent migration of ions, transport numbers and hydration of ions. Application of conductance Acid-base and precipitation titration.

3L

Electrochemical Cell

Thermodynamic derivation of Nernst equation, Electrode potential and its application to predict redox reaction; Standard Hydrogen Electrode, Reference electrode, cell configuration, half cell reactions, evaluation of thermodynamic functions; Reversible and Irreversible cells; Electrochemical corrosion.

Electrochemical Energy Conversion: Primary & Secondary batteries, Fuel Cells.

4L

Reaction dynamics

Rate Laws, Order & Molecularity; zero, first and second order kinetics.

Pseudo-unimolecular reaction, Arrhenius equation.
Mechanism and theories of reaction rates (Transition state theory, Collison theory).
Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics).

3L

MODULE 4

Stereochemistry

Representations of 3- dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

4L

Structure and reactivity of Organic molecule

Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion, free radicals, aromaticity.

3L

Organic reactions and synthesis of drug molecule (4 lectures)

Introduction to reaction mechanisms involving substitution, addition, elimination and oxidation-reduction reactions. Synthesis of commonly used drug molecules.

3L

TEXT BOOKS

1. Atkins' Physical Chemistry, P.W. Atkins (10^{th} Edition)
2. Organic Chemistry, I. L. Finar, Vol-1 (6^{th} Edition)

3. Engineering Chemistry, Jain & Jain,(16th Edition)
4. Fundamental Concepts of Inorganic Chemistry, A. K. Das, (2nd Edition)
5. Engineering Chemistry -I, Gourkrishna Dasmohapatra, (3rd Edition)

REFERENCE BOOKS

1. General & Inorganic Chemistry, R. P. Sarkar
2. Physical Chemistry, P. C. Rakshit, (7th Edition)
3. Organic Chemistry, Morrison & Boyd , (7th Edition)
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, (4th Edition)
5. Physical Chemistry, G. W. Castellan, (3rd Edition)
6. Basic Stereo chemistry of Organic Molecules, Subrata Sen Gupta, (1st Edition)

Course outcome for the subject code CHEM1001

The subject code CHEM1001 corresponds to chemistry theory classes for the first year B. Tech students, which is offered as Engineering Chemistry and is common for all branches of engineering subjects. The course provides basic knowledge of theory based subjects like quantum mechanics, thermodynamics, reaction dynamics, electrochemistry, structure and reactivity of molecules. The course outcomes of the subject are

1. Knowledge of understanding the operating principles and reaction involved in batteries and fuel cells and their application in automobiles as well as other sectors to reduce environmental pollution.
2. An ability to analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.for engineering applications.
3. Have knowledge of synthesizing nano materials and their applications in industry, carbon nano tube technology is used in every industry now-a-days.
4. Understanding of bulk properties and processes using thermodynamic considerations.
5. Elementary knowledge of IR, UV, NMR and X-ray spectroscopy is usable in structure elucidation and characterisation of various molecules.
6. Knowledge of electronic effect and stereochemistry for understanding mechanism of the major chemical reactions involved in synthesis of various drug molecules.

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Course Name: MATHEMATICS-I					
Course Code: MATH1101					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Detailed Syllabus:

Module I: [10L]

Matrix: Inverse and rank of a matrix; Elementary row and column operations over a matrix; System of linear equations and its consistency; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigen vectors; Diagonalization of matrices; Cayley Hamilton theorem; Orthogonal transformation.

Module II: [10L]

Vector Calculus: Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, Related problems on these topics.

Infinite Series: Convergence of sequence and series; Tests for conver gence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test(statements and related problems on these tests), Raabe's test; Alternating series; Leibnitz's Test (statement, definition); Absolute convergence and Conditional convergence.

Module III: [10L]

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders: General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods, Method of variation of parameters, Cauchy-Euler equations.

Module IV: [10L]

Calculus of functions of several variables: Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables.

Multiple Integration: Concept of line integrals, Double and triple integrals. Green's Theorem, Stoke's Theorem and Gauss Divergence Theorem.

References:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2000.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2006.

3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

5. K. F. Riley, M. P. Hobson, S. J. Bence. Mathematical Methods for Physics and Engineering, Cambridge University Press, 23-Mar-2006.
6. S. L. Ross, Differential Equations", Wiley India, 1984.

7. G.F. Simmons and S.G. Krantz, Differential Equations, McGraw Hill, 2007.

8. Vector Analysis (Schaum's outline series): M. R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
9. Engineering Mathematics: S. S. Sastry (PHI)

10. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP), Indian Edition.
11. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)

Course Outcomes

After successfully completing this course the students will be able to:

1. Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.
2. Develop the concept of eigen values and eigen vectors.
3. Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.
4. Analyze the nature of sequence and infinite series
5. Choose proper method for finding solution of a specific differential equation.
6. Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

Heritage Institute of Technology
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Course Name: BASIC ELECTRICAL ENGINEERING					
Course Code: ELEC1001					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Module-I:

DC Network Theorem: Kirchhoff's laws, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star-Delta conversion. [6L]

Electromagnetism: Review of magnetic flux, Force on current carrying conductors, Magnetic circuit analysis, Self and Mutual inductance, B-H loop, Hysteresis and Eddy current loss, Lifting power of magnet. [5L]

Module-II

AC single phase system: Generation of alternating emf, Average value, RMS value, Form factor, Peak factor, representation of an alternating quantity by a phasor, phasor diagram, AC series, parallel and series-parallel circuits, Active power, Reactive power, Apparent power, power factor, Resonance in RLC series and parallel circuit. [10L]

Module-III

Three phase system: Generation of three-phase AC power, Balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams, power measurement by two wattmeter method. [4L]

DC Machines: Construction, EMF equation, Principle of operation of DC generator, Open circuit characteristics, External characteristics, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of DC motor. [7L]

Module-IV

Transformer: Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, Open and Short circuit tests, Efficiency, Introduction to three phase transformer. [6L]

Three-phase induction motor: Concept of rotating magnetic field, Principle of operation, Construction, Equivalent circuit and phasor diagram, torque-speed/slip characteristics. [4L]

Text Books:

1. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition
2. Basic Electrical Engineering, V.N Mittle & Arvind Mittal, TMH, Second Edition
3. Basic Electrical Engineering, Hughes
4. Electrical Technology, Vol-I,Vol-II,Surinder Pal Bali, Pearson Publication
5. A Text Book of Electrical Technology, Vol. I & II, B.L. Theraja, A.K. Theraja, S.Chand &

Company

Reference Books:

1. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice-Hall
2. Advance Electrical Technology, H.Cotton, Reem Publication
3. Basic Electrical Engineering, R.A. Natarajan, P.R. Babu, Sictech Publishers
4. Basic Electrical Engineering, N.K. Mondal, Dhanpat Rai
5. Basic Electrical Engineering, Nath & Chakraborti
6. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005.

Course Outcomes

After attending the course, the students will be able to

1. Analyse DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.
2. Analyse DC Machines; Starters and speed control of DC motors.
3. Analyse magnetic circuits.
4. Analyse single and three phase AC circuits.
5. Analyse the operation of single phase transformers.
6. Analyse the operation of three phase induction motors.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: CHEMISTRY LAB					
Course Code: CHEM 1051					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	1.5

List of Experiments:

1. Estimation of iron using $KMnO_4$ self indicator.
2. Iodometric estimation of Cu^{2+}.
3. Determination of Viscosity.
4. Determination of surface tension.
5. Adsorption of acetic acid by charcoal.
6. Potentiometric determination of redox potentials.
7. Determination of total hardness and amount of calcium and magnesium separately in a given water sample.
8. Determination of the rate constant for acid catalyzed hydrolysis of ethyl acetate.
9. Heterogeneous equilibrium (determination of partition coefficient of acetic acid in n-butanol and water mixture).
10. Conductometric titration for the determination of strength of a given HCl solution against a standard NaOH solution.
11. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
12. Determination of chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis-G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney.
2. Advanced Practical Chemistry- S. C. Das
3. Practicals in Physical Chemistry- P. S. Sindhu

Course outcome for the subject code CHEM1051

Course outcome for the subject code CHEM1051
The subject code CHEM1051 corresponds to chemistry laboratory classes for the first year B. Tech students. This course enhances the students' experience regarding handling of various chemicals along with various laboratory equipments. Hands on experiments increase the depth of knowledge that is taught in the theory classes as well as it increases research aptitude in students because they can see the direct application of theoretical knowledge in practical field. The course outcomes of the subject are

1. Knowledge to estimate the hardness of water which is required to determine the usability of water used in industries.
2. Estimation of ions like Fe2+, Cu2+ and Cl- present in water sample to know the composition of industrial water.
3. Study of reaction dynamics to control the speed and yield of various manufactured goods produced in polymer, metallurgical and pharmaceutical industries.
4. Handling physico-chemical instruments like viscometer, stalagmometer, pH-meter, potentiometer and conductometer.
5. Understanding the miscibility of solutes in various solvents required in paint, emulsion, biochemical and material industries.
6. Knowledge of sampling water can be employed for water treatment to prepare pollution free water.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: BASIC ELECTRICAL ENGINEERING LABORATORY					
Course Code: ELEC1051					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

List of Experiments:

1. Characteristics of Fluorescent lamps
2. Characteristics of Tungsten and Carbon filament lamps
3. Verification of Thevenin's & Norton's theorem.
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
6. Calibration of ammeter and voltmeter.
7. Open circuit and Short circuit test of a single phase Transformer.
8. Study of R-L-C Series / Parallel circuit
9. Starting and reversing of speed of a D.C. shunt Motor
10. Speed control of DC shunt motor.
11. No load characteristics of D.C shunt Generators
12. Measurement of power in a three phase circuit by two wattmeter method.

Course Outcomes:

After successfully completing this course the students are expected :

1. Get an exposure to common electrical apparatus and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the application of common electrical measuring instruments.
4. Understand the basic characteristics of different electrical machines.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Engineering Graphics & Design					
Course Code: MECH 1052					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	1	**0**	**4**	**5**	**3**

Lecture Plan (13L)

1. Importance and principles of engineering drawing (1 L)
2. Concepts of Conic sections and Scale (1 L)
3. Introduction to concept of projection (Projections of points, lines and surfaces) (4 L)
4. Definitions of different solids and their projections (1 L)
5. Section of solids and sectional view (1 L)
6. Isometric projection (2 L)
7. Introduction to CAD (2 L)
8. Viva Voce (1 L)

Detailed contents of Lab hours (52 hrs)

Module 1: Introduction to Engineering Drawing covering,
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lines, lettering & dimensioning, Conic section like Ellipse (General method only); Involute; Scales – Plain, Diagonal.

(4 hrs + 4 hrs)

Module 2: Orthographic Projections covering,
Principles of Orthographic Projections - Conventions - Projections of Points and lines inclined to both planes; Projections on Auxiliary Planes. Projection of lamina.

(4 hrs+4 hrs + 4 hrs)

Module 3: Projections of Regular Solids covering,
those inclined to both the Planes- Auxiliary Views.

(4 hrs + 4 hrs)

Module 4: Sections and Sectional Views of Right Angular Solids covering,
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids.

(4 hrs)

Module 5: Isometric Projections covering,
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

(4 hrs + 4 hrs)

Module 6: Overview of Computer Graphics covering,
listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where

applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

(4 hrs)

Module 7: Customisation & CAD Drawing
consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

(2 hrs)

Annotations, layering & other functions covering
applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation.

(2 hrs)

Module 6: Demonstration of a simple team design project that illustrates
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame.

(4 hrs)

References:

1. Bhatt, N.D., Panchal V.M. & Ingle P.R., (2014) "Elementary Engineering Drawing" ; Charotan Publishing House
2. Narayana, K.L. and Kannaaiah P "Engineering Graphics"; TMH
3. Lakshminarayanan, V. and Vaish Wanar, R.S "Engineering Graphics" Jain Brothers.
4. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Edication.
5. Agarwal B. & Agarwal C. M. (2012), Engineering graphics, TMH Publications.

Course Outcomes:

After going through the course, the students will be able

1. To understand the meaning of engineering drawing.
2. To have acquaintance with the various standards (like lines, dimensions, scale etc.) and symbols followed in engineering drawing.
3. To represent a 3-D object into 2-D drawing with the help of orthographic and isometric projections.
4. To read and understand projection drawings.
5. To draw the section view and true shape of a surface when a regular object is cut by a section plane.
6. To use engineering drawing software (CAD).

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering
B. Tech. Honors Paper

Course Name: COMMUNICATION for PROFESSIONALS					
Course Code: HMTS-1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module- I (9hrs.)

Introduction to Linguistics

- Phonetics- Vowel and Consonant Sounds (Identification & Articulation)
- Word- stress, stress in connected speech
- Intonation (Falling and Rising Tone)
- Voice Modulation
- Accent Training
- Vocabulary Building
- The concept of Word Formation
- Root words from foreign languages and their use in English
- Acquaintance with prefixes and suffixes from foreign languages in Englishto formderivatives
- Synonyms, Antonyms and standard abbreviations

Module- II (10hrs.)

Communication Skills

- Definition, nature & attributes of Communication
- Process of Communication
- Models or Theories of Communication
- Types of Communication
- Levels or Channels of Communication
- Barriers to Communication

Module- III (10hrs.)

Professional Writing Skills

- Letter Writing : Importance, Types , Process, Form and Structure, Style and Tone
- Proposal Writing: Purpose,Types of Proposals, Structure of Formal Proposals.
- Report Writing: Importance and Purpose, Types of Reports, Report Formats, Structure of Formal Reports, Writing Strategies.

Module- IV (10hrs.)

Communication skills at Work

- Communication and its role in the workplace
- Benefits of effective communication in the workplace
- Common obstacles to effective communication
- Approaches and Communication techniques for multiple needs at workplace: persuading, convincing, responding, resolving conflict, delivering bad news, making positive connections,
- Identify common audiences and design techniques for communicating with each audience

References:

1 Kumar,S. &Lata, P. Communication Skills, OUP, New Delhi2011
2 Rizvi,Ashraf,M. Effective Technical Communication, Mc Graw Hill Education(India) Pvt. Ltd..Chennai,2018
3 Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011

Course Outcome:

Students will be able to

1. Write business letters and reports
2. Communicate in an official and formal environment.
3. Effectively use the various channels of communication at work place.
4. Use language as a tool to build bridges and develop interpersonal relations in multi-cultural environment.
5. Learn to articulate opinions and views with clarity.
6. Use various techniques of communication for multiple requirements of globalized workplaces.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering
B. Tech. Honors Paper

Course Name: PROFESSIONAL COMMUNICATION LAB					
Course Code: HMTS-1061					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Module- I (4hrs)

Techniques for Effective Speaking

Voice Modulation: Developing correct tone

Using correct stress patterns: word stress, primary stress, secondary stress

Rhythm in connected speech

Module- II (6hrs.)

Effective Speaking and Social awareness

The Art of Speaking

- Encoding Meaning Using Nonverbal Symbols
- How to Improve Body Language
- Eye Communication, Facial Expression, Dress and Appearance
- Posture and Movement, Gesture, Paralanguage
- Encoding meaning using Verbal symbols: How words work and how to use words
- Volume, Pace, Pitch and Pause
- Cross-Cultural Communication : Multiple aspects/dimensions of culture
- Challenges of cross-cultural communication
- Improving cross-cultural communication skills at workplace.

Module- III (6hrs)

- Group Discussion: Nature and purpose
- Characteristics of a successful Group Discussion
- Group discussion Strategies: Getting the GD started, contributing systematically, moving the discussion along, promoting optimal participation, Handling conflict, Effecting closure.

Module- IV (10hrs.)

Professional Presentation Skills

Nature and Importance of Presentation skills

Planning the Presentation: Define the purpose, analyze the Audience, Analyze the occasion and choose a suitable title.

Preparing the Presentation: The central idea, main ideas, collecting support material, plan visual aids, design the slides

Organizing the Presentation: Introduction-Getting audience attention, introduce the subject, establish credibility, preview the main ideas, Body-develop the main idea, present information sequentially and logically, Conclusion-summaries, re-emphasize, focus on the purpose, provide closure.

Improving Delivery: Choosing Delivery methods, handling stage fright

Post-Presentation discussion: Handling Questions-opportunities and challenges.

References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3rd Ed., 2004
3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999
4. R. Anand, Job Readiness For IT & ITES- A Placement and Career Companion, , McGraw Hill Education.2015
5. Malhotra, A.,Campus Placements, McGraw Hill Education.2015.

Course Outcome:

Students will be able to

1. Communicate in an official and formal environment.
2. Effectively communicate in a group and engage in relevant discussion.
3. Engage in research and prepare presentations on selected topics.
4. Understand the dynamics of multicultural circumstances at workplace and act accordingly.
5. Organize content in an attempt to prepare official documents
6. Appreciate the use of language to create beautiful expressions

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering
Detailed Syllabus of 1st Year 2nd Semester Courses

Course Name: PHYSICS I					
Course Code: PHYS-1001					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Module 1 : Mechanics (7+5)= 12L

Elementary concepts of grad, divergence and curl. Potential energy function; F=-grad V, Equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, Curl of a force field; Central forces ; conservation of angular momentum; Energy equation and energy diagrams; elliptical, parabolic and hyperbolic orbit; Kepler Problem; Application : Satellite manoeuvres .
Non-inertial frames of reference; rotating coordinate system; five term acceleration formula-centripetal and coriolis accelerations; applications: Weather system, Foucault pendulum.

Module 2 : Optics = (4 +3+ 5) = 12 L

Oscillatory Motion:
Damped harmonic motion – Over damped, critically damped and lightly damped oscillators; Forced oscillation and resonance. Electrical equivalent of mechanical oscillator, Wave equation, plane wave solution.
Optics:
Elementary features of polarization of light waves. Double refraction, Production and analysis of linearly, elliptic and Circularly polarized light, Polaroid and application of polarizations.: Polarimeter.
Laser & Fiber Optics:
Characteristics of Lasers, Spontaneous and Stimulated Emission of Radiation, Meta-stable State, Population Inversion, Lasing Action, Einstein's Coefficients and Relation between them, Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers.
Fiber optics - principle of operation, numerical aperture, acceptance angle, Single mode , graded indexed fiber.

Module 3: **Electrostatics (8+4) = 12 L**

Electrostatics in free space
Calculation of electric field and electrostatic potential for a charge distribution, Divergence and curl of electrostatic field, Laplace's and Poisson's equation for electrostatic potential. Boundary conditions of electric field and electrostatic potential. Method of images , energy of a charge distribution and its expression in terms of electric field.

Electrostatics in a linear dielectric medium
Electrostatic field and potential of a dipole, Bound charges due to electric polarization, Electric displacement, Boundary conditions on displacement, Solving simple electrostatic problem in presence of dielectric – point charge at the centre of a dielectric sphere, charge in front of dielectric slab, Dielectric slab and dielectric sphere in uniform electric field.

Module 4: **(6+3+3)= 12L**

Magnetostatics :

Biot-Savart law, divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; equation for vector potential and it's solutions for given current densities .

Magnetostatics in a linear magnetic medium:

Magnetization and associated bound currents; Auxiliary magnetic field $\vec{H}$; boundary conditions on $\vec{B}$ and $\vec{H}$. Solving for magnetic field due to simple magnet like a bar magnet; Magnetic susceptibility ; ferromagnetic , paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Faraday's Law:

Differential form of Faraday's law expressing curl of electric field in terms of time derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi static approximation. Energy stored in a magnetic field.

Books of reference :

1. Optics – **Eugene Hecht** Pearson Education India Private Limited
2. Introduction to Electrodynamics, **David J. Griffiths**, Pearson Education India Learning Private Limited
3. Waves and Oscillations by **N.K. Bajaj**
4. Principles of Physics, 10ed, **David Halliday, Robert Resnick Jearl Walker** , Wiley
5. Electricity, Magnetism, and Light, **Wayne M. Saslow**, Academic Press
6. Classical mechanics, **Narayan Rana, Pramod Joag**, McGraw Hill Education
7. Introduction to Classical Mechanics, **R Takwale, P Puranik**, McGraw Hill Education
8. Optics, **Ghatak**, McGraw Hill Education India Private Limited
9. Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – **C.L.Arora**

Course outcome:

After successfully completing this course the students will be able to:

1. To develop basic understanding of the modern science to the technology related domain.
2. Analytical & logical skill development through solving problems.
3. To impart idea of concise notation for presenting equations arising from mathematical formulation of physical as well as geometrical problems percolating ability of forming mental pictures of them.
4. Imparting the essence and developing the knowledge of controlling distant object like satellite, data transfer through optical fiber, implication of laser technology, handling materials in terms of their electrical and magnetic properties etc.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Mathematics-II					
Course Code: MATH1201					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Detailed Syllabus:

Module I: [10L]

Basic Probability: Random experiment, Sample space and events, Classical and Axiomatic definition of probability, Addition and Multiplication law of probability, Conditional probability, Bayes' Theorem, Random variables, General discussion on discrete and continuous distributions, Expectation and Variance, Examples of special distribution: Binomial and Normal Distribution.

Module II: [10L]

Basic Numerical Methods: Solution of non-linear algebraic and transcendental equations: Bisection Method, Newton-Raphson Method, Regula-Falsi Method. Solution of linear system of equations: Gauss Elimination Method, Gauss-Seidel Method, LU Factorization Method, Matrix Inversion Method. Solution of Ordinary differential equations: Euler's Method, Modified Euler's Method, Runge-Kutta Method of 4th order.

Module III: [10L]

Basic Graph Theory: Graph, Digraph, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Sub-graph, Walk, Path, Circuit, Euler Graph, Cut sets and cut vertices, Matrix representation of a graph, Adjacency and incidence matrices of a graph, Graph isomorphism, Bipartite graph, Dijkstra's Algorithm for shortest path problem. Definition and properties of a Tree, Binary tree and its properties, Spanning tree of a graph, Minimal spanning tree, Determination of spanning trees using BFS and DFS algorithms, Determination of minimal spanning tree using Kruskal's and Prim's algorithms.

Module IV: [10L]

Laplace Transformation: Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations. Introduction to integral transformation, Functions of exponential order, Definition and existence of Laplace Transform(LT) (statement of initial and final value theorem only), LT of elementary functions, Properties of Laplace Transformations , Evaluation of sine , cosine and exponential integrals using LT, LT of periodic and step functions, Definition and properties of inverse LT, Convolution Theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODEs with constant coefficients (initial value problem) using LT

References:

1. Advanced Engineering Mathematics, E.Kreyszig, Wiley Publications
2. Introduction to Probability and Statistics for Engineers and Scientists, S.Ross, Elsevier
3. Introductory methods of Numerical Analysis, S.S. Sastry, PHI learning
4. Introduction to Graph Theory, D. B. West, Prentice-Hall of India
5. Engineering Mathematics, B.S. Grewal, S. Chand & Co.

Course Outcomes

After successfully completing this course the students will be able to:

1. Demonstrate the knowledge of probabilistic approaches to solve wide range of engineering problem.
2. Recognize probability distribution for discrete and continuous variables to quantify physical and engineering phenomenon.
3. Develop numerical techniques to obtain approximate solutions to mathematical problems where analytical solutions are not possible to evaluate.
4. Analyze certain physical problems that can be transformed in terms of graphs and trees and solving problems involving searching, sorting and such other algorithms.
5. Apply techniques of Laplace Transform and its inverse in various advanced engineering problems.
6. Interpret differential equations and reduce them to mere algebraic equations using Laplace Transform to solve easily

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Programming for Problem Solving					
Course Code: CSEN 1001					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Learning Objectives: Introduction to the concept of computer and computation and solving of problems using C as a programming language. Coverage of C will include basic concepts, arithmetic and logic, flow control, and data handling using arrays, structures, pointers and files.

Total load – 40 hours

Module I: [10L]

Fundamentals of Computer

History of Computers, Generations of Computers, Classification of Computers.

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Basic Concepts of Assembly language, High level language, Compiler and Assembler.

Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double- 64 bit).

Basic concepts of operating systems like MS WINDOWS, LINUX

How to write algorithms & draw flow charts.

Module II: [10L]

Basic Concepts of C

C Fundamentals:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions:

Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf.

Flow of Control:

Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

Module III: [10L]

Program Structures in C

Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes - auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables.

C preprocessor (macro, header files), command line arguments.

Arrays and Pointers:

One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality.

String and character arrays; C library string functions and their use.

Module IV: [10L]

Data Handling in C

User defined data types and files:
Basic of structures; structures and functions; arrays of structures.

Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs(), fseek(), ftell().

Text Books
1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Reference Books
1. C: The Complete Reference – Herbert Schildt
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan

Course outcome:

On completion of this course, students are able to

1. Understand and remember functions of the different parts of a computer.
2. Understand and remember how a high-level language (C programming language, in this course) works, different stages a program goes through.
3. Understand and remember syntax and semantics of a high-level language (C programming language, in this course).
4. Understand how code can be optimized in high-level languages.
5. Apply high-level language to automate the solution to a problem.
6. Apply high-level language to implement different solutions for the same problem and analyze why one solution is better than the other.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: BUSINESS ENGLISH					
Course Code: HMTS 1202					
Contact Hours per week	L	T	P	Total	Credit Points
	2	0	0	2	2

Module- I (6hrs.)

Grammar (Identifying Common Errors in Writing)

- Subject-verb agreement
- Noun-pronoun agreement
- Misplaced Modifiers
- Articles
- Prepositions
- Redundancies

Module- II (6hrs.)

Basic Writing Strategies

Sentence Structures

- Use of phrases and clauses in sentences
- Creating coherence
- Organizing principles –accuracy, clarity, brevity
- Techniques for writing precisely
- Different styles of writing: descriptive,narrative, expository
- Importance of proper punctuation

Module- III (8hrs)

Business Communication- Scope & Importance

Writing Formal Business Letters:Form and Structure-Parts ofa Business letter, Business Letter Formats, Style and Tone, Writing strategies.

Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular

Organizing e-mail messages, E-mail etiquette

Job Application Letter: Responding to Advertisements and Forced Applications, Qualities of well-written Application Letters: The You-Attitude, Length, Knowledge of Job Requirement, Reader-Benefit Information, Organization, Style, Mechanics – Letter Plan: Opening Section, Middle Section, Closing Section

Resume and CV: Difference, Content of the Resume – Formulating Career Plans: Self Analysis, Career Analysis, Job Analysis, Matching Personal Needs with Job Profile – Planning your Resume – Structuring the Resume: Chronological Resume, The Functional Resume, Combination of Chronological and Functional Resume, Content of the Resume: Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honors and Achievements, Personal Profile, Special Interests, References

Module- IV (6hrs)

Writing skills

- Comprehension: Identifying the central idea, inferring the lexical and contextual meaning, comprehension passage - practice
- Paragraph Writing: Structure of a paragraph, Construction of a paragraph, Features of a paragraph, Writing techniques/developing a paragraph.
- Précis: The Art of Condensation-some working principles and strategies. Practice sessions of writing précis of given passages.
- Essay Writing:Characteristic features of an Essay, Stages in Essay writing, Components comprising an Essay, Types of Essays-Argumentative Essay, Analytical Essay, Descriptive Essays, Expository Essays, Reflective Essays

References:

1. Theories of Communication: A Short Introduction, Armand Matterlart and Michele Matterlart, Sage Publications Ltd.
2. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
3. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.
4. Kalia, S. &Agarwal,S. Business Communication,Wiley India Pvt. Ltd., New Delhi, 2015
5. Mukherjee, H.S., Business Communication- Connecting at work., , Oxford University Press.2nd Edition.2015
6. Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011.

Course Outcome

The learner will

1. Acquire competence in using English language to communicate.
2. Be aware of the four essential skills of language usage-listening, speaking, reading and writing.
3. Be adept at using various modes of written communication at work.
4. Attain the skills to face formal interview sessions.
5. Write reports according to various specifications.
6. Acquire the skill to express with brevity and clarity

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: PHYSICS Lab 1					
Course Code: PHYS 1051					
Contact Hours	L	T	P	Total	Credit Points
per week	0	0	3	3	1.5

Minimum of six experiments taking at least one from each of the following four groups:

Group 1 : Experiments in General Properties of matter

1. Determination of **Young's modulus** by **Flexure Method**
2. Determination of **bending moment** and **shear force** of a rectangular beam of uniform cross-section.
3. Determination of **modulus of rigidity** of the material of a rod by **static method**
4. Determination of **rigidity modulus** of the material of a **wire by dynamic method.**
5. Determination of **coefficient of viscosity** by Poiseulle's capillary flow method.

Group 2: Experiments in Optics

1. Determination of **dispersive power** of the material of a prism
2. Determination of wavelength of light by **Newton's ring** method.
3. Determination of wavelength of light by **Fresnel's biprism method.**
4. Determination of the **wavelength of a given laser** source by diffraction method

Group 3: Electricity & Magnetism experiments

1. Determination of **dielectric constant** of a given dielectric material.
2. Determination of resistance of **ballistic galvanometer by half deflection** method and study of variation of **logarithmic decrement** with series resistance.
3. Determination of the **thermo-electric power** at a certain temperature of the given thermocouple.
4. Determination of **specific charge (e/m)** of electron.

Group 4: Quantum Physics Experiments

1. Determination of **Planck's constant**.
2. Determination of **Stefan's radiation** constant.
3. Verification of **Bohr's atomic orbital** theory through **Frank-Hertz experiment**.
4. Determination of **Rydberg constant** by studying **Hydrogen/ Helium** spectrum.
5. Determination of **Hall co-efficient of semiconductors.**
6. Determination of **band gap** of semiconductors.
7. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

Course Outcomes:

After the completion of the course the students will be able to:

1. To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
2. To learn the usage of electrical and optical systems for various measurements.
3. Apply the analytical techniques and graphical analysis to the experimental data.
4. Understand measurement technology, usage of new instruments and real time applications in engineering studies.
5. To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Programming for Problem Solving Lab					
Course Code: CSEN1051					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Software to be used: GNU C Compiler (GCC) with LINUX
NB: Cygwin (Windows based) may be used in place of LINUX

Topic 1: LINUX commands and LINUX based editors
Topic 2: Basic Problem Solving
Topic 3: Control Statements (if, if-else, if-elseif-else, switch-case)
Topic 4: Loops - Part I (for, while, do-while)
Topic 5: Loops - Part II
Topic 6: One Dimensional Array
Topic 7: Array of Arrays
Topic 8: Character Arrays/ Strings
Topic 9: Basics of C Functions
Topic 10: Recursive Functions
Topic 11: Pointers
Topic 12: Structures
Topic 13: File Handling

Text Books

1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Course outcome:
After completion of this course the students should be able:

1. To write simple programs relating to arithmetic and logical problems.
2. To be able to interpret, understand and debug syntax errors reported by the compiler.
3. To implement conditional branching, iteration (loops) and recursion.
4. To decompose a problem into modules (functions) and amalgamating the modules to generate a complete program.
5. To use arrays, pointers and structures effectively in writing programs.
6. To be able to create, read from and write into simple text files.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Workshop /Manufacturing Practices					
Course Code: MECH 1051					
Contact Hours per week	L	T	P	Total	Credit Points
	1	0	4	5	3

(i) Lectures & videos: (13 hours)

Detailed contents

1. Introduction on Workshop and Safety Precautions. **(1 lecture)**
2. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
3. CNC machining, Additive manufacturing **(1 lecture)**
4. Fitting operations & power tools **(1 lecture)**
5. Electrical & Electronics **(1 lecture)**
6. Carpentry **(1 lecture)**
7. Plastic moulding, glass cutting **(1 lecture)**
8. Metal casting **(1 lecture)**
9. Welding (arc welding & gas welding), brazing **(2 lecture)**
10. Viva-voce **(1 lecture)**

(ii) Workshop Practice :(52 hours)[L : 0; T:0 ; P : 4 (2 credits)]

1. Machine shop **(12 hours)**
2. Fitting shop **(8 hours)**
3. Carpentry **(4 hours)**
4. Electrical & Electronics **(4 hours)**
5. Welding shop **(Arc welding 4 hrs + gas welding 4 hrs) (8 hours)**
6. Casting **(4 hours)**
7. Smithy **(4 hours)**

8. Plastic moulding& Glass Cutting **(4 hours)**

9. Sheet metal Shop **(4 hours)**

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Suggested Text/Reference Books:

(i). Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

(ii). Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.

(iii). Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.

(iv). Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

(v). Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Outcomes:

Upon completion of this course

1. The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
2. The students will be able to fabricate components with their own hands.
3. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
4. By assembling different components, they will be able to produce small devices of their interest.
5. The students will be able to describe different components and processes of machine tools.
6. The students will be able to apply the knowledge of welding technology and they can perform arc and gas welding to join the material.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Language Lab					
Course Code: HMTS 1252					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Module- I (4hrs)

Listening Skills

- Principles of Listening: Characteristics, Stages.
- Types of Listening: Passive listening, Marginal or superficial listening, Projective Listening, Sensitive or Empathetic Listening, Active or Attentive listening.
- Guidelines for Effective Listening
- Barriers to Effective Listening
- Listening Comprehension

Module- II (8hrs)

- Interviewing
  Types of Interviews, Format for Job Interviews: One-to-one and Panel Interviews, Telephonic Interviews,Interview through video conferencing.
- Interview Preparation Techniques, Frequently Asked Questions, Answering Strategies, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews.

Module- III (6hrs)

- Public Speaking: The Speech Process: The Message, The Audience, The Speech Style, Encoding, Feedback.
- Characteristics of a good speech : content and delivery, structure of a speech
- Modes of delivery in public speaking: Impromptu, Extemporaneous, Prepared or Memorized, Manuscript.
- Conversation: Types of conversation: formal and informal, Strategies for effective conversation, Improving fluency.
- Situational conversation practice: Greetings and making introductions, Asking for information and giving instructions, agreeing and disagreeing.
- Conversational skills in the business scenario: One-to-one and Group communication, Gender and Culture Sensitivity, Etiquette, Sample Business Conversation, Telephonic Conversation

Module- IV (8hrs)

Presentation Skills

- Speaking from a Manuscript, Speaking from Memory, Impromptu Delivery, Extemporaneous Delivery, Analyzing the Audience, Nonverbal Dimensions of Presentation
- Organizing the Presentation: The Message Statement, Organizing the Presentation: Organizing the Speech to Inform, The Conclusion, Supporting Your Ideas – Visual Aids: Designing and Presenting Visual Aids, Selecting the Right Medium.
- Project Team/Group Presentations

References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3rd Ed., 2004
3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999
4. Sen, S.,Mahendra,A. &Patnaik,P.,Communication and Language Skills, Cambridge University Press, 2015
5. Locker,Kitty O. Business and Administrative Communication McGraw-Hill/ Irwin.
6. Chaney,L.andMartin,J., Intercultural Business Communication. Prentice Hall

Course Outcome

The learner will

1. Acquire the techniques to become an effective listener.
2. Acquire the skill to become an effortless speaker.
3. Organize and present information for specific audience.
4. Communicate to make a positive impact in professional and personal environment.
5. Engage in research and prepare authentic, formal, official documents.
6. Acquire reading skills for specific purpose.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering
B. Tech. Honors Paper

Course Name : Basic Electronics					
Course Code: ECEN1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I [10 L]

Basic Semiconductor Physics:
Crystalline materials, Energy band theory, Conductors, Semiconductors and Insulators, Concept of Fermi Energy level, intrinsic and extrinsic semiconductors, drift and diffusion currents in semiconductor

Diodes and Diode Circuits:
Formation of p-n junction, Energy Band diagram, forward & reverse biased configurations, V-I characteristics, load line, breakdown mechanisms, Zener Diode and its Application.
Rectifier circuits: half wave & full wave rectifiers: ripple factor, rectification efficiency.

Module II [8 L]

Bipolar Junction Transistors (BJT):
PNP & NPN BJT structures, current components in BJT, CE, CB, CC configurations, V-I Characteristics of CB & CE modes, regions of operation, Base width modulation & Early effect, thermal runaway, Concept of Biasing: DC load line, Q-point, basics of BJT amplifier operation, current amplification factors, different biasing circuits: fixed bias, collector to base bias, voltage divider bias.

Module III [9 L]

Field Effect Transistors (FET):
n-channel Junction Field Effect Transistor (JFET) structure & V-I characteristics.

Metal Oxide Semiconductor Field Effect Transistor (MOSFET): enhancement & depletion type MOSFETs (for both n & p channel devices), drain & transfer characteristics.

MOSFET as a digital switch, CMOS inverter, voltage transfer characteristic (VTC), NAND & NOR gate realization using CMOS logic.

Moore's Law, evolution of process node, state of integration (SSI, MSI, LSI, VLSI, ULSI), Classification of Integrated circuits (IC) and their applications.

Module IV [9 L]

Feedback in amplifiers :
Concept of feedback, advantages of negative feedback (qualitative), Barkhausen criteria.

Operational Amplifier:
Ideal OPAMP characteristics, OPAMP circuits: inverting and non-inverting amplifiers, Adder, Subtractor, Integrator, Differentiator, Basic Comparator.

Special Semiconductor Devices:
Light Emitting Diode (LED), Silicon Controlled Rectifier (SCR), Photodiode: Operations, characteristics & applications.

References:

1. Boylestad & Nashelsky:Electronic Devices & Circuit Theory
2. R.A Gayakwad:Op Amps and Linear IC's, PHI
3. D. Chattopadhyay, P. C Rakshit : Electronics Fundamentals and Applications
4. Adel S. Sedra, Kenneth Carless Smith: Microelectronics Engineering
5. Millman & Halkias: Integrated Electronics.
6. Salivahanan: Electronics Devices & Circuits.
7. Albert Paul Malvino: Electronic Principle.

Course Outcomes:

After going through this course, the students will be able to

1. Categorize different semiconductor materials based on their energy bands and analyze the characteristics of those materials for different doping concentrations based on previous knowledge on semiconductors acquired.
2. Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode both from device and circuit perspectives.
3. Design different application specific circuits associated with diodes operating both in forward and reverse bias.
4. Analyze various biasing configurations of Bipolar Junction Transistor and categorize different biasing circuits based on stability.
5. Categorize different field-effect transistors based on their constructions, physics and working principles and solve problems associated with analog circuits based on operational amplifiers.
6. Design and implement various practical purpose electronic circuits and systems meant for both special purpose and general purpose and anlayze their performance depending on the type of required output and subsequently the applied input.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering
B. Tech. Honors Paper

Course Name : Basic Electronics Engineering Laboratory					
Course Code: ECEN1061					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

List of Experiments (from)

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multi-meters etc.
2. Familiarization with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs in CB mode
7. Study of I-V characteristics of BJTs in CE mode
8. Study of I-V characteristics of Field Effect Transistors.
9. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
10. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
11. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators.

Course Outcomes:

1. The students will correlate theory with diode behavior.
2. They will design and check rectifier operation with regulation etc.
3. Students will design different modes with BJT and FET and check the operations.
4. They will design and study adder, integrator etc. with OP-AMPs.

Department of Applied Electronics & Instrumentation Engineering

B.TECH in AEIE

Syllabus for 2nd Year Courses

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Detailed Syllabus of 2nd Year 1st Semester Courses

Course Name: Mathematical Methods					
Course Code: MATH 2001					
Contact hours per week	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Detailed Syllabus:

Module I:[12L]

Functions of Complex Variables: Complex numbers and its geometrical representation.Functions of a complex variable – Limits, Continuity, and Differentiability.Analytic Functions, Cauchy- Riemann equations, Necessary and sufficient conditions for analyticity of complex functions (Statement only), Harmonic functions.Line Integral on complex plane, Cauchy-Goursat theorem, Cauchy's Integral Formula. Taylor's and Laurent's series expansion.Zeros, Different types of Singularities. Definitions of poles and residues, Residue Theorem, Evaluation of real integrals using residue theorem.

Module II:[12L]

Fourier Series, Integrals And Transforms: Definite Integral, Orthogonality Of Trigonometric Functions, Power Series And Its Convergence. Periodic Functions, Even And Odd Functions, Dirichlet's Conditions, Euler Formulas For Fourier Coefficients, Fourier Series Representation Of A Function, E.G. Periodic Square Wave, Half Wave Rectifier, Unit Step Function. Half Range Series, Parseval's Identity. Fourier Integral Theorem, Fourier Transform, Fourier Sine And Cosine Transform, Linearity, Scaling, Frequency Shifting And Time Shifting Properties, Convolution Theorem. Discussion Of Some Physical Problems: E.G Forced Oscillations.

Module III:[12L]

Series Solutions to Ordinary Differential Equations and Special Functions: Series solution of ODE: Ordinary point, Singular point and Regular Singular point, seriessolutionwhen $x = a$is an ordinary point, Frobenius method.Legendre's Equation, Legendre's polynomial and its graphical representation. Bessel's equation, Bessel's function of first kind and its graphical representation.Finite Difference Method and its application to Boundary Value Problem.

Module IV:[12L]

Partial Differential Equations: Introduction to partial differential equations, Formation of partial differential equations,Linear and Nonlinear PDEs of first order, Lagrange's and Charpit's method of solution.Second order partial differential equations with constant coefficients, Illustration of wave equation, one dimensional heat equation, Laplace's equation, Boundary value problems and their solution by the method of separation of variables.Solution of Boundary value problems by Laplace and Fourier transforms.

References:

1. Complex Variables and Applications, BrownChurchill, McGrawHill
2. Complex Variable, MurreyR. Spiegel,Schaum's OutlineSeries
3. Theory of Functions of a Complex Variable, Shanti Narayan, P. K.Mittal, S. Chand
4. Larry C. Andrew, B. K.Shivamoggi, Integral Transforms for Engineers and Applied Mathematicians, Macmillan
5. Fourier Analysis with Boundary ValueProblem,Murrey R.Spiegel, Schaum's Outline Series
6. MathematicalMethods, Potter, MerleC., Goldberg, Jack. PHI Learning
7. Ordinary and Partial DifferentialEquations, M. D. Raisinghania, S. Chand
8. Elements of Partial DifferentialEquation, Ian NaismithSneddon,Dover Publications
9. Advanced EngineeringMathematics,Kreyszig, Willey
10. Higher EngineeringMathematics, B. V. Ramana, TataMcGraw-Hill

Course Outcome

After successfully completing this course the students will be able to:

1. Construct appropriate mathematical models of physical systems.
2. Recognize the concepts of complex integration, Poles and Residuals in the stability analysis of engineering problems.
3. Generate the complex exponential Fourier series of a function and make out how the complex Fourier coefficients are related to the Fourier cosine and sine coefficients.
4. Interpret the nature of a physical phenomena when the domain is shifted by Fourier Transform e.g. continuous time signals and systems.
5. Develop computational understanding of second order differential equations with analytic coefficients along with Bessel and Legendre differential equations with their corresponding recurrence relations.
6. Master how partial differentials equations can serve as models for physical processes such as vibrations, heat transfer etc.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Analog Electronic Circuits					
Course Code: AEIE2101					
Contact hours per week	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module-I (10L)

Small signal analysis of transistor amplifier circuits with different biasing methods, operational amplifier (Op-Amp) fundamentals, Op-Amp characteristics, Op-Amp in open loop comparator mode, linear Op-Amp circuits:

Basic (inverting/ non-inverting) Op-Amp circuits, V-I converter, constant current source, level shifter, current amplifier, difference amplifier, instrumentation amplifier.

Module-II (8L)

Non-linear Op-Amp circuits: Schmitt trigger, precision rectifiers, peak detector, log/antilog amplifiers, S/H circuit. practical Op-Amp limitations: d.c. errors, slew rate, frequency response, noise effect, frequency compensation.

Active integrators, differentiators and solution of differential equations.

Module-III (9L)

Active filters: Butterworth and Chebyshev, signal generators: Colpitts, Hartley, phase shift, Wein bridge and crystal oscillators, triangular wave generator and sawtooth wave generator using op-amp.

Module-IV (8L)

Multivibrators and its applications: astable, monostable using op-amp (IC741) and integrated circuit timer 555, voltage controlled oscillator and phase locked loop.

References:

1. Sedra & Smith-*Microelectronic Circuits*- Oxford UP
2. Franco—*Design with Operational Amplifiers & Analog Integrated Circuits* , 3/e, McGraw Hill
3. Boylested & Nashelsky- *Electronic Devices and Circuit Theory*- Pearson/PHI.
4. Coughlin and Driscol – *Operational Amplifier and Linear Integrated Circuits*–Pearson Education
5. Millman & Halkias – *Integrated Electronics*, McGraw Hill.
6. Schilling & Belove—*Electronic Circuit: Discrete & Integrated* , 3/e , McGraw Hill.

Course Outcomes:

After completion of the course, students will be able to

1. Apply the knowledge of semiconductor fundamentals to analyze simple electronic circuits based on diodes and transistors with special focus on designing different biasing methods of BJT.
2. Design and analyze BJT amplifiers for small and large signal.
3. Learn basic function of operational amplifier, ideal and practical characteristics and their mathematical applications.
4. Design and compare between different types of Oscillators to meet the specified needs with appropriate consideration.
5. Design, analyze and understand the application of different types of multivibrators with and without IC 555.
6. Analyze and design analog electronic circuits using discrete components with specified needs for enhancement of knowledge.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Sensors and Transducers					
Course Code: AEIE2102					
Contact hours per week	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

Module I – [12L]

Definition, principles of sensing and transduction, classification;
Concept of signal conditioning;
Resistive (potentiometric) sensors: theory, types, materials, specifications, error in measurements, reducing mechanism, measurement of vibration and its parameters like displacement, velocity and acceleration; Strain Gauges: theory, types, materials, sensitivity, gauge factor, temperature dependence, adhesives, rosettes, applications-force, velocity and torque measurements;
Capacitive sensors: theory, types- parallel plates, semicircular and cylindrical; calculation of sensitivities, response characteristics, microphones;
Inductive sensors: theory, types- reluctance, LVDT: Construction, materials, electromechanical relationship, phase sensitive detector.

Module II – [8L]

Piezoelectric sensors: piezoelectric effects, materials- natural and synthetic types, charge and voltage coefficients, crystal model, characteristics; Pyroelectric sensors.
Magnetic sensors: theory, types, force, torque, rpm meters;
Proximity sensors: inductive, capacitive and photoelectric;
Hall Effect and performance characteristics of Hall sensors.

Module III – [10L]

Thermal sensors: RTD- materials, construction, types, working principle, 2-wire, 3-wire and 4-wire configurations and respective circuit arrangements.
Thermistor – materials, construction, types, working principle
Thermocouple – thermoelectric laws, types, working principle, thermopile, series and parallel configuration of thermocouples, cold junction compensation, compensating and extension cables, burnout feature.
Pyrometer (total radiation and optical types)

Module IV – [6L]

Optical sensors: light dependent resistor (LDR), photodiode, photovoltaic cell, photomultiplier tube;

Ionization sensors: construction and working principle of Geiger counters, Scintillation detectors; Introduction to Radiation sensor.

Ultrasonic sensors: working principle, industrial applications;

References:

1. D Patranabis, *Sensors and Transducers*, PHI, 2nd ed.
2. E. A. Doebelin, *Measurement Systems: Application and Design*, Mc Graw Hill, New York
3. H. K. P. Neubert, *Instrument Transducers*, Oxford University Press, London and Calcutta.
4. S. Renganathan, *Transducer engineering*, Allied Publishers Limited, 2003.
5. D. V. S. Murty, *Transducer and instrumentation*, PHI, second edition, 2008.
6. Jacob Fraden, *Handbook of Modern Sensors: Physics, Designs and applications*, Third edition, Springer International, 2010.
7. A. K. Ghosh, *Introduction to transducers*, PHI, 2015
8. J. P. Bentley, *Principle of Measurement Systems, Pearson Education, Third edition.*

Course Outcomes:

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

1. Acquire the knowledge of mechanical, electromechanical, thermal and magnetic sensors.
2. Explain the working principles of mechanical, electromechanical, thermal and magnetic sensors.
3. Classify sensors based on type of measurands such as strain, force, pressure, displacement, temperature, flow, etc.
4. Design the signal conditioning circuits for the sensors.
5. Justify the selection of Sensors and Transducers in the process of Measurement and instrumentation.
6. Use the sensors in various applications.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

.Course Name: Circuit Theory and Network Analysis					
Course Code: AEIE2103					
Contact hours per week	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I – [10L]

Analysis of DC circuits: Circuit elements and their various configurations: Passive, active, Analysis tools: Analysis of resistive circuits with and without controlled sources using mesh, node analysis, Concepts on super mesh and super node, DC network theorems: Superposition, Thevenin, Norton, Millman and Maximum Power Transfer Theorem.

Module II – [10L]

Analysis of AC circuits: Representing circuit elements in AC circuits, concept of phasors, Parameters in the AC circuits: Average, RMS, Form factor, peak factor; Tools of analysis of AC circuits: mesh, nodal tools; Network theorems: Superposition, Thevenin, Norton, Millman, Power and Maximum Power Transfer Theorem.

Resonance circuits: Series and parallel, condition of resonance, impedance curve, current curve, half power points, bandwidth, quality factor, selectivity, application to different combination of parallel circuits, Analysis of magnetically coupled circuits: Self and mutual inductances, coefficient of coupling, dot convention.

Module III – [10L]

Two Port Network: open circuit, short circuit, transmission and hybrid parameters, relationships among parameters, reciprocity and symmetry conditions. T and Pi representations of 2-port networks;
Interconnection of networks: Series, parallel and cascade connections.

Transient analysis: Time domain analysis of R-L and R-C circuits- time constant, initial and final values, transient and steady state responses;
Time domain analysis of RLC circuits: Transient and steady state responses, effect of damping;

Module IV – [6L]

Basic filter circuit Design & Synthesis: Classifications, ideal and practical characteristics of filters, cutoff frequency, bandwidth, quality factor, Butterworth filter 2nd, 3rd and 4th order design (RC).

References:

1. Franklin F Kuo, *Network Analysis and Synthesis*, Wiley India Edition.
2. M E Van Valkenburg, *Network Analysis",* Prentice-Hall of India Pvt Ltd, New Delhi.
3. K V V Murty and M S Kamth, *Basic Circuit Analysis*, Jaico Publishing house, London.
4. Reinhold Lud0wig and Pavel Bretchko, *RF Circuit Design*, Pearson Education, Asia.
5. Joseph J. Carr, *Secrets of RF Circuit Design*, Tata McGraw-Hill, New Delhi.
6. William H. Hayt, Jack E. Kemmerly, *Engineering Circuit Analysis*, McGraw-Hill Higher Education.
7. K.M.Soni, *Circuit Analysis & Synthesis*, S. K. Kataria & Sons.

Course Outcomes:

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

1. Apply knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits.
2. Identify, formulate, and solve engineering problems in the area circuits and systems.
3. Acquire skills in analyzing electrical measuring devices, analog electronic circuits, and power electronic circuits.
4. Analyze and synthesize RL, RC and RLC networks, passive and active filters.
5. Obtain circuit matrices of linear graphs and analyze networks using graph theory.
6. Design an electric system, components or process to meet desired needs within realistic constraints.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Human Values and Professional Ethics						
Course Code: HMTS2001						
Contact hrs per week:	**L**	**T**	**P**	**S**	**Total**	**Credit points**
	3	**0**	**0**	**0**	**3**	**3**

Module I (10 L)

Human society and the Value System

Values: Definition, Importance and application.

Formation of Values: The process of Socialization

Self and the integrated personality

Morality, courage, integrity

Types of Values:

Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism

Aesthetic Values: Perception and appreciation of beauty

Organizational Values: Employee: Employer--- rights, relationships, obligations

Psychological Values: Integrated personality and mental health

Spiritual Values &their role in our everyday life

Value Spectrum for a Good Life, meaning of Good Life

Value Crisis in Contemporary Society

Value crisis at----

Individual Level

Societal Level

Cultural Level

Value Crisis management --- Strategies and Case Studies

Module II (10L)

Ethics and Ethical Values

Principles and theories of ethics

Consequential and non-consequential ethics

Egotism,Utilitarianism, Kant's theory and other non-consequential perspectives

Ethics of care, justice and fairness, rights and duties

Ethics-- Standardization
Codification
Acceptance
Application

Types of Ethics--- Ethics of rights and Duties
Ethics of Responsibility
Ethics and Moral judgment
Ethics of care
Ethics of justice and fairness
Work ethics and quality of life at work

Professional Ethics

Ethics in Engineering Profession;

moral issues and dilemmas, moral autonomy(types of inquiry)

Kohlberg's theory, Gilligan'stheory (consensus and controversy)

Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEEInstitute of Engineers, Indian Institute of materials management, Institute of Electronics and telecommunication engineers

Violation of Code of Ethics---conflict, causes and consequences

Engineering as social experimentation, engineers as responsible experimenters (computer ethics, weapons development)

Engineers as managers, consulting engineers, engineers as experts, witnesses and advisors, moral leadership

Conflict between business demands and professional ideals

social and ethical responsibilities of technologies.

Whistle Blowing: Facts, contexts, justifications and case studies

Ethics and Industrial Law

Institutionalizing Ethics: Relevance, Application, Digression and Consequences

Module III (10L)

Science, Technology and Engineering
Science, Technology and Engineering as knowledge and profession
----Definition, Nature, Social Function and Practical application of science
Rapid Industrial Growth and its Consequences
Renewable and Non- renewable Resources: Definition and varieties
Energy Crisis
Industry and Industrialization
Man and Machine interaction
Impact of assembly line and automation
Technology assessment and Impact analysis
Industrial hazards and safety
Safety regulations and safety engineering
Safety responsibilities and rights
Safety and risk, risk benefit analysis and reducing risk
Technology Transfer: Definition and Types
The Indian Context

Module IV (6L)

Environment and Eco- friendly Technology
Human Development and Environment
Ecological Ethics/Environment ethics
Depletion of Natural Resources: Environmental degradation
Pollution and Pollution Control
Eco-friendly Technology: Implementation, impact and assessment

Sustainable Development: Definition and Concept
Strategies for sustainable development
Sustainable Development--- The Modern Trends

Appropriate technology movement by Schumacher and later development
Reports of Club of Rome.

Suggested Readings:

1. Tripathi,A.N., Human Values, New Age International, New Delhi,2006

2. Ritzer, G., Classical Sociological Theory, The McGraw Hill Companies, New York,1996.

3. Doshi,S.L., Postmodern Perspectives on Indian Society, Rawat Publications, New Delhi,2008.

4. Bhatnagar, D.K., Sustainable Development, Cyber Tech Publications, New Delhi, 2008.

5. Kurzwell,R., The age of Spiritual Machines, Penguin Books, New Delhi,1999.

6. Weinberg, S.K., Social Problems in Modern Urban Society, Prentice Hall,Inc.,USA, 1970.

7. Giddens, Anthony 2009. Sociology. London: Polity Press (reprint 13th Edition).

Course Outcome:

After the completion of the course, the students will:

1. be aware of the value system and the importance of following such values at workplace
2. learn to apply ethical theories in the decision making process
3. follow the ethical code of conduct as formulated by institutions and organizations
4. Implement the principles governing work ethics
5. Develop strategies to implement the principles of sustainable model of development
6. Implement ecological ethics wherever relevant and also develop eco-friendly technology

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Analog Electronics Lab					
Course Code: AEIE2151					
Contact hours per week	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**1.5**

List of experiments:

1. Study the frequency response of a single-stage and a two-stage R-C coupled amplifier.
2. Design a series-regulated power supply to provide output voltage of 5-25V with load current I_L< 1Amp and verify the design using PSpice.
3. Implementation of zero crossing detector using operational amplifier.
4. Implementation of level shifter circuit using operational amplifier.
5. Study of half wave and full wave precision rectifiers and verify the design using PSpice.
6. Study of Multivibrators (Astable/ Monostable) using op-amps.
7. Study of Multivibrators (Astable/ Monostable) using IC 555.
8. Design of an oscillator circuit (Wien bridge).
9. Design of signal generator (Triangular wave/ Sawtooth wave) using IC741.

References:

1. Sedra & Smith-*Microelectronic Circuits*- Oxford UP
2. Boylested & Nashelsky- *Electronic Devices and Circuit Theory*- Pearson/PHI.
3. Coughlin and Driscol – *Operational Amplifier and Linear Integrated Circuits*–Pearson Education
4. Schilling & Belove—*Electronic Circuit: Discrete & Integrated* , 3/e , McGraw Hill.

Course Outcomes:

After completion of the course, students will be able to

1. Identify different components of electronic circuits.
2. Evaluate the performance characteristics of electronic circuits.
3. Design different kind of electronic circuits appropriately to obtain the best possible circuits that can be applied to any electronic systems.
4. Evaluate possible causes of discrepancies in practical experimental observations in comparison to theory.
5. Practice different types of wiring and instruments connections for efficient operation.
6. Evaluate the use of computer-based analysis tool to review the performance of electronic circuit.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Sensors and Transducers Lab					
Course Code: AEIE 2152					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

List of Experiments:

1. Comparative studies of some temperature measuring sensors like AD590 IC sensor, RTD and thermistor.
2. Study of capacitive transducer.
3. Study of I/O characteristics of LVDT and hence measure pressure & displacement through it.
4. Study of a load cell with tensile and compressive load.
5. Rotational speed measurement using magnetic proximity sensor
6. Measurement of rotational speed measurement using stroboscopic principle
7. Comparative studies of some optical sensors like LDR, photo diode and photo transistor
8. Design of a suitable signal conditioning circuit for a given sensor

Course Outcome:

After completion of the course, students will be able to

1. Compare various temperature sensors and select the best-fit sensor for a specific application.
2. Choose different transduction techniques for measuring linear and angular displacements.
3. Demonstrate various pressure and stress sensing elements.
4. Measure rotational speeds using non contact type various principles like proximity and stroboscopic principles
5. Select different application based optical sensors.
6. Design sensing system based signal-conditioning circuits.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Circuits and Networks Lab					
Course Code: AEIE 2153					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

A. Hardware Based Experiments:

1. Verification of Thevenin's and Norton's theorems
2. Verification of Superposition Theorem
3. Transient response in RC, RL & RLC networks
4. Frequency response of passive and active (LP, HP, BP, BR) filters of 1st & 2nd order

B. Software Based Experiments:

1. PSPICE Based:

i. Transient analysis of RC and RL circuits
ii. Leading and lagging analysis for RC and RL circuits
iii. Over damped, under damped, critically damped analysis of a 2nd order system by appling different inputs
iv. Frequency response of 2nd order system

2. MATLAB Based:

i. Different types of signal generation
ii. Laplace and inverse Laplace transforms

Course outcomes:

After completing the course, the students will be able to

1. Use basic laboratory equipments such as multimeters, power supplies, signal generators, and oscilloscopes and techniques to measure electrical quantities
2. Apply analysis tools, theorems to analyze the experimental result.
3. Analyze RL, RC, RLC circuits in time and frequency domains.
4. Carry out time & frequency domain measurements on elementary RL, RC, RLC circuits using PSPICE simulation software.
5. Develop technical writing skills important for effective communication
6. Acquire teamwork skills for working effectively in group

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering
Honours Course:

Course Name: Material Science and Technology					
Course Code: AEIE2111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

Module I: [12L]

Introduction, properties of materials, classification of materials, advanced materials, future materials and modern materials. 3L

Atomic structure, atomic bonding in solids, crystal structures, crystalline and non-crystalline materials, Miller indices, anisotropic elasticity, elastic behavior of composites, structure and properties of polymers, structure and properties of ceramics. 5L

Electrical conduction, semi conductivity, super conductivity, electrical conduction in ionic ceramics and in polymers, dielectric behavior, ferroelectricity, piezoelectricity. 1L

Heat capacity, thermal expansion, thermal conductivity, thermal stresses. 1L

Diamagnetism and paramagnetism, ferromagnetism, anti-ferromagnetism and ferrimagnetism. Influence of temperature on magnetic behavior. 1L

Optical properties of metals, optical properties of nonmetals, application of optical phenomena. 1L

Module II: [10L]

Point defects, theoretical yield point, line defects and dislocations, interfacial defects, bulk or volume defects. 2L

Elastic deformation, plastic deformation, interpretation of tensile stress-strain curves yielding under multi-axial stress, yield criteria and macroscopic aspects of plastic deformation, property variability and design factors. 3L

Diffusion mechanisms, steady and non-steady state diffusion, factors that influence diffusion, non-equilibrium transformation and microstructure. 2L

Dislocation and plastic deformation, mechanisms of strengthening in metals, recovery, re-crystallization and grain growth, strengthening by second phase particles, optimum distribution of particles, lattice resistance to dislocation motion. 3L

Module III: [9L]

Equilibrium phase diagrams, particle strengthening by precipitation, precipitation reactions, kinetics of nucleation and growth, the iron-carbon system, phase transformations, transformation rate effects and TTT diagrams, microstructure and property changes in iron-carbon system. 4L

Fracture, ductile and brittle fracture, fracture mechanics, impact fracture, ductile brittle transition, fatigue, crack initiation and propagation, crack propagation rate, creep, generalized creep behavior, stress and temperature effects. 5L

Module IV: [9L]

Types of metals and alloys, fabrication of metals, thermal processing of metals, heat treatment, precipitation hardening. 2L

Types and applications of ceramics, fabrication and processing of ceramics. 1L

Mechanical behavior of polymers, mechanisms of deformation and strengthening of polymers, crystallization, melting & glass transition, polymer types, polymer synthesis & processing. 2L

Particle reinforced composites, fiber reinforced composites, structural composites. 1L

Corrosion of metals, corrosion of ceramics, degradation of polymers. 1L

Economic considerations, environmental and societal considerations, recycling issues, life cycle analysis and its use in design. 2L

References:

1. Material Science and Engineering by V. Raghavan, Prentice Hall.
2. Introduction to Engineering Materials by B. K. Agarwal, TMH.
3. Elements of Material Science & Engineering, Van Black, Pearson Education
4. Materials Science and Engineering by W. F. Smith, J. Hashemi and R. Prakash, McGraw Hill.
5. A Textbook of Material Science and Engineering by R.K.Rajput, S.K.Kataria & Sons.
6. Materials Science and Engineering by W. D. Callister and adapted by R. Balasubraniam, Wiley India.

Course Outcomes:

After the completion of the course the student will be able to:

1. Explain the properties and structure of engineering materials.
2. Analyze defects in materials and their effect on engineering properties as well as limit their use in service.
3. Make use of phase diagrams to predict microstructures and also to understand precipitation hardening.
4. Compare & Evaluate the processing of engineering materials.
5. Choose the proper engineering material for defined field of applications with economic, environmental and societal considerations.
6. Determine the importance of material properties in engineering design.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering
Detailed Syllabus of 2nd Year 2nd Semester Courses

Course Name: Data Structure and Basic Algorithms					
Course Code: CSEN 2004					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module-1: Linear Data structures I [8L]
Introduction [2L]
i. Concepts of Data and data structure, Data Type and Abstract Data Type.
ii. Algorithms and programs, Different types of algorithms with example
iii. Algorithm efficiency and analysis, time and space analysis of algorithms–order notations.
Array [3L]
i. Different representations – row major, column major
ii. Sparse matrix - its implementation and usage
Linked List [3L]
i. Singly linked list, its operations – with and without tail pointer
ii. Circular linked list, its operations, Doubly linked list,

Module-2: Linear Data structures II [8L]
Stack [3L]
i. Concept, Operations
ii. Implementation (using array, using linked list)
iii. Applications – Evaluation of expressions
Queue [3L]
i. Concept, Operations
ii. Implementation (using array, using linked list)
iii. Circular queue, implementation (using array)
iv. Applications
Recursion [2L]
i. Principles of recursion
ii. Use of stack
iii. Differences between recursion and iteration
iv. Tail recursion

Module-3: Non-linear Data structures [8L]
Trees [5L]
i. Basic terminologies, tree representation (using array, using linked list)
ii. Binary trees-traversal (pre, in, post - order), reconstruction

iii. Binary search tree-operations (creation, insertion, deletion, searching)
iv. Height balanced binary tree –AVL tree (insertion, deletion with examples only)

Graphs [3L]:
i. Basic Terminologies and definitions
ii. Representations/storage implementations–adjacency matrix, adjacency list,
iii. Graph traversal and connectivity–Depth first search (DFS), Breadth first search (BFS)

Module-4: Searching, Sorting, Hashing [8L]

Sorting Algorithms [4L]
i. Bubble sort, Insertion sort, Selection sort
ii. Merge sort, Quicksort,
iii. Comparisons

Searching [2L]
Sequential search, binary search

Hashing [2L]:
Hashing functions, collision resolution techniques

Text Books:

1. "Data Structures And Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson
3. "Data Structures in C" by Aaron M. Tenenbaum.
4. "Data Structures" by S. Lipschutz.
5. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein.

Course Outcomes:

After the completion of the course the student will be able to:

1. Understand the data structures, their advantages and drawbacks
2. Identify the efficiency aspects of the graph and sorting algorithms covered in this course.
3. Learn about the data structures/ methods/ algorithms mentioned in the course with a comparative perspective
4. Describe problem statements and to design the solutions using programming language
5. Analyze and apply most appropriate data structure/ method/algorithm in a program to enhance the efficiency
6. Develop an efficient program modifying an efficient one using the knowledge gathered from this course.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Digital Electronics					
Course Code: AEIE2201					
Contact hours per week	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I - [9L]

Data and number systems: binary, octal and hexadecimal representation and their conversions, BCD,ASCII, Gray codes and their conversions; signed binary number representation with 1's and 2's complement methods, binary arithmetic. Boolean algebra: various logic gates- their truth tables and circuits, combinational logic design: Definition, truth table, SOP and POS realization from truth table, logic minimization using K-map, minterms and maxterms, minimization with don't care terms.

Module II - [8L]

Combinational circuits: adder / subtractor circuits; parity generator/checker circuit, binary to Gray and Gray to binary conversion circuits, encoder, decoder, demultiplexer and multiplexer, function realization using decoder and multiplexer.

Module III - [9L]

Sequential Circuits: basic concepts, flip-flop, RS, JK, Master Slave, T and D flip-flops, shift registers and their applications, synchronous and asynchronous counters, up/down counters, ring counter.

Module IV - [9L]

Characteristics of Aanalog to digital and digital to analog converters: resolution, quantization, significant bits, conversion/settling time, types of analog to digital converters: successive approximation, integrating, flash and sigma-delta, types of digital to analog converters: weighted R, R-2R ladder. Introduction to various logic families: TTL, ECL, and CMOS, programmable logic devices – PROM, PLA, and PAL.

References:

1. Malvino & Brown, *Digital Computer Electronics*, TMH
2. H. Taub & D. Shilling, *Digital Integrated Electronics*, Mc Graw Hill
3. M. Mano, *Digital Logic and Design*, PHI
4. A. Anand Kumar, *Fundamentals of Digital Circuits*, PHI
5. Kharate, *Digital Electronics*, Oxford
6. Floyed & Jain, *Digital Fundamentals*, Pearson.

Course outcomes:

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

1. Understand the fundamentals of converting from one number system to another.
2. Explain the basic logic operations of NOT, AND, OR, NAND, NOR, and XOR.
3. Analyze, design and implement combinational logic circuits.
4. Analyze, design and implement sequential logic circuits.
5. Describe the nomenclature and technology in the area of memory devices: ROM, PROM, PLD etc. and different kind of ADCs and DACs.
6. Understand the basic operating principles of different logic families.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Paper Name: Industrial Instrumentation					
Paper Code: AEIE2202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module I [10L]

Pressure: unit, absolute, gauge and vacuum pressures; manometers – u-tube, inclined tube and well type; elastic pressure sensing instruments – diaphragm, capsule, bellows, Bourdon tube pressure gauge, and pressure switch; DP transmitters: capacitive, piezo - resistive and resonating wire type, installation of DP measuring instruments and valve manifolds; flapper nozzle system & basic operation, pneumatic transmitter; vacuum: Mcleod gauge, thermal conductivity gauge and ionization gauge.

Module II [10L]

Variable head type flow measurement – orifice, venturi, pitot tube, analysis and calculation; variable area flowmeters – glass and metal tube rotameters; electromagnetic type; ultrasonic type; vortex type; positive displacement type; Coriolis mass flow meters; impeller type mass flow meters; open channel flow metering; solid flow measurement.

Module III [9L]

Level measurement: gauge glass, float, displacer type – gauge and switch;
resistive and capacitive type level instrument; boiler drum level measurement; ultrasonic, radioactive type and radar type level instrument; solid level measurement

Module IV [7L]

Analytical measurements: pH, conductivity, viscosity, density, humidity and moisture
Hazardous area instrumentation: basic concepts, classification- intrinsically safe and explosion proof, NEMA and IP codes, intrinsically safe measurement system.

References:

1. B. G. Liptak, *Instrument Engineers Handbook, vol-I and vol-II*; Chilton Book Co. Philadelphia.
2. Eckman, *Industrial Instrumentation*; Wiley Eastern Ltd.
3. D. M. Considine and G. D. Considine (Eds.) *Process Instruments and controls Handbook*; Mc Graw Hill, New York.
4. D. Patranabis, *Principles of industrial Instrumentation*; TMH, New Delhi, 2nd Ed.
5. Ernest O. Doeblin, *Measurement Systems – Application and Design*; Tata-McGraw Hill.
6. K Krishnaswamy, *Industrial Instrumentation*; New Age International.
7. S. K. Singh, *Industrial Instrumentation & Control*; Tata McGraw-Hill.

Course Outcome:

After the completion of the course students will be able to

1. Explain the working principles of pressure measuring devices and apply acquired knowledge for selection and installation of application specific pressure sensing instruments.
2. Interpret the working principles, selection criteria and installations of application specific industrial flow measuring instruments
3. Demonstrate different level measuring devices and apply the knowledge towards the choice of proper sensing industrial instruments.
4. Illustrate various analytical instruments to measure pH, conductivity, moisture, humidity etc. and hazardous area instrumentation.
5. Formulate industrial process parameters towards the analysis of process data
6. Design electronic instrumentation system for the acquisition of measurement data produced by measuring instruments for flow, level, and pressure

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Electrical and Electronic Measurements						
Course Code: AEIE2203						
Contact hrs per week:	**L**	**T**	**P**	**S**	**Total**	**Credit points**
	4	**0**	**0**	**0**	**4**	**4**

Module I – [11L]

Static and dynamic characteristics of instruments: accuracy, sensitivity, repeatability, precision, drift, hysteresis, threshold, resolution, fidelity, speed of response.

Classification of analog instruments, types of torques in indicating instruments, construction and principle of operation of permanent magnet moving coil, moving iron, dynamometer and electrostatic type instruments, extension of instrument ranges using shunts and multipliers.

Introduction to instrument transformers: current transformer and potential transformer.

Measurement of energy by single phase induction type meter.

Module II – [9L]

Measurement of medium resistance: ammeter-voltmeter methods, substitution method, Wheatstone bridge method; measurement of low resistance by Kelvin double bridge; 4-terminal resistance.

Measurement of high resistance: direct deflection method, loss of charge method, megger ;

Measurement of self inductance: Maxwell's inductance bridge, Maxwell's inductance-capacitance bridge, Anderson's bridge; Measurement of capacitance: DeSauty's bridge, Schering bridge; Measurement of frequency by Wien's bridge.

Localization of cable faults using Murray and Varley loop methods.

Module III – [10L]

Voltage controlled oscillator, phase locked loop, applications; basic emitter follower voltmeter, DC and AC voltmeters with operational amplifiers, true rms voltmeter, chopper stabilized amplifiers for measurement of very low voltage.

Cathode ray oscilloscope: cathode ray tube, sweep generator, oscilloscope automatic time base, waveform display, dual-trace oscilloscopes, oscilloscope probes, applications.

Module IV – [10L]

Digital voltmeters: characteristics, types- ramp type, dual slope integrating type, successive approximation type, microprocessor based ramp type; basic digital displays, LEDs and LCD panels, display drivers; time base generation with crystal oscillators and dividers.

Design and implementation of a simple digital frequency meter, errors in frequency measurement – possible remedies, pulse time period and width measurement, frequency ratio measurement.

Q meter: basic circuit, series connection method, parallel connection method, sources of errors.

References:

1. Golding & Widdis, Electrical Measurements & Measuring Instruments ; Wheeler
2. Forest K. Harris, Electrical Measurement; Willey Eastern Pvt. Ltd. India
3. M.B. Stout, Basic Electrical Measurement; Prentice Hall of India
4. David Bell, Electronic Instrumentation & Measurement; Reston Publishers.
5. H.S. Kalsi, Electronic Instrumentation; Tata McGraw Hill.
6. A.D. Helfrick & W.D. Cooper , Modern Electronic Instrumentation & Measuring Instruments; Wheeler
7. D.C. Patranabis, Principles of Electronic Instrumentation; PHI

Course Outcomes:

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

1. Interpret the static and dynamic characteristics of measuring instruments.
2. Compare among the operation of measuring instruments and select the suitable one for measurement of electrical quantities.
3. Choose appropriate bridge for measurement of resistance, capacitance and inductance.
4. Select electronic voltmeters suitable for typical measurements and explain the construction of cathode ray tube, circuits of oscilloscope time base, CRO probes , dual trace oscilloscope and applications.
5. Analyze the working of different types of digital voltmeters, digital frequency meter and digital display units.
6. Determine the quality of a coil, capacitor using Q meter.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Control Systems						
Course Code: AEIE2204						
Contact hrs per week:	**L**	**T**	**P**	**S**	**Total**	**Credit points**
	3	**1**	**0**	**0**	**4**	**4**

Module-1-[10L]

Introduction- application of control theory in engineering and non-engineering fields, mathematical model of physical systems- importance, differential equation representation of physical systems, transfer function models, block diagram models, signal flow graphs models, reduction of parameter variations by use of feedback.

Control system components- DC servomotor, Brushless DC motor, AC servomotor, synchro, stepper motor.

Module-II-[10L]

Time domain analysis - transient response of first order and second order with standard test signals, steady state error coefficients, effect of pole–zero addition in system response, design specifications of second order systems, performance indices.

Stability analysis - concept of stability, necessary and sufficient condition for stability, Routh stability criterion, concept of relative stability; root locus technique - the root locus concept, root locus construction rules, stability analysis from the root locus plot.

Module- III-[10L]

Frequency domain analysis techniques – correlation between time and frequency response; Polar plots, Nyquist plots- mapping of close contour and principle of arguments, development of Nyquist stability criterion; Bode plots - minimum and non minimum phase system, concept of phase margin and gain margin, procedure for drawing Bode plots, assessment of relative stability–gain margin and phase margin.

Module –IV-[10L]

State space analysis - concepts of state, state variables and state model, state space representation of linear continuous-time systems, solution of linear time invariant state equation, concept on controllability and observability, illustrative examples.

Basic compensation techniques- the design problems, lead compensation, lag compensation and lag-lead compensation.

Reference

1. Nagrath I. J. and Gopal M., "Control System Engineering", 5th Ed., New Age International Private Ltd. Publishers.
2. Kuo B. C., "Automatic Control Systems", 8th Ed., Wiley India
3. Ogata K., "Modern Control Engineering", 4th Ed., Pearson Education.
4. Dorf R. C. and Bishop R. H., "Modern Control Systems" Pearson Education.
5. Norman S. N., "Control Systems Engineering", 4th Ed., Wiley India.
6. Gopal M., "Control Systems principles and Design", Tata McGraw Hill

Course Outcomes:

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

1. Develop mathematical model of physical systems in forms of differential equation and transfer function.
2. Represent the systems using block diagram and signal flow graph models.
3. Investigate the time response of systems and calculate performance indices.
4. Apply the concept of stability in s-domain by using Routh stability criterion and root locus technique.
5. Analyze frequency response and stability of linear systems using different stability criterion.
6. Understand the concept of state variable analysis and compensation techniques for design.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Environmental Sciences					
Course Code: EVSC2016					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**0**

Module 1: [6L]

Socio Environmental Impact:

Basic ideas of environment and its component

Population growth: exponential and logistic; resources; sustainable development. 3L

Concept of green chemistry, green catalyst, green solvents

Environmental disaster and social issue, environmental impact assessment, environmental audit, environmental laws and protection act of India. 3L

Module 2: [6L]

Air Pollution:

Structures of the atmosphere, global temperature models

Green house effect, global warming; acid rain: causes, effects and control. 3L

Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution. 3L

Module 3: [6L]

Water Pollution:

Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts.

Biochemical effects of heavy metals; eutrophication: source, effect and control. 2L

Water quality parameters: DO, BOD, COD.

Water treatment: surface water and waste water. 4L

Module 4: [6L]

Land Pollution

Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal. 3L

Noise Pollution

Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control. 3L

Text/Books

1. Gour Krishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.
2. A. K. De, "Environmental Chemistry", New Age International.
3. A. K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd

References/Books

1. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
2. D. De, D. De, Fundamentals of Environment & Ecology, S. Chand & Company Ltd.

Course Outcome:

The subject code EVSC2016 corresponds to basic environmental chemistry for the 2nd year B.Tech students, which is offered as Environmental Sciences and is mandatory for all branches of engineering. The course provides basic knowledge of various environmental pollutions as well as its impact and ways to curb it. The course outcomes of the subject are

1. Understand the natural environment and its relationships with human activities.
2. Characterize and analyze human impacts on the environment.
3. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
4. Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
5. Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.
6. Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Data Structure and Basic Algorithms Lab					
Course Code: CSEN 2054					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**1.5**

List of Experiments:

1. Implementation of array operations.
2. Stacks and Queues: adding, deleting elements
3. Circular Queue: Adding & deleting elements
4. Evaluation of expressions operations using stacks.
5. Implementation of linked lists: inserting, deleting, inverting a linked list.
6. Implementation of stacks & queues using linked lists:
7. Sparse Matrices: Multiplication, addition
8. Recursive and Non-recursive traversal of Trees.
9. Binary tree traversal.
10. DFS and BFS.
11. Application of sorting and searching algorithms.

Course Outcome:

After the completion of the course the student will be able to:

1. Write well-structured programs
2. Analyze run-time execution of sorting methods, including selection, merge sort and Quick sort.
3. Implement any ADT using both array based and linked-list based data structures.
4. Design advance data structure using Non-Linear data structure.
5. Select appropriate data structures as applied to specified problem definition.
6. Determine and analyze the complexity of given Algorithms.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Digital Electronics Lab					
Course Code: AEIE2251					
Contact hours per week	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

List of Experiments:

Design and Implementation of:

1. Basic gates using Universal logic gates.
2. Adder/ Subtractor.
3. Binary to Gray and Gray to Binary Code Converters.
4. Simple Decoder & Multiplexer circuits using logic gates.
5. 4-bit parity generator & checker circuits.
6. RS, JK, D, and T flip-flops using Universal logic gates/ Pspice.
7. Synchronous Up/Down counter using flip-flops / Pspice.
8. Asynchronous Up/Down counter using flip-flops/ Pspice.
9. Shift register (Right and Left) using flip-flops.
10. Ring counter and Johnson's counter.

References:

1. Malvino & Brown, *Digital Computer Electronics*, TMH
2. M. Mano, *Digital Logic and Design*, PHI
3. Floyed & Jain, *Digital Fundamentals*, Pearson.

Course outcomes:

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

1. Analyze and identify different components of digital electronic circuits.
2. Set up testing strategies and select proper instruments to evaluate the performance characteristics of digital electronic circuits.
3. Evaluate the use of computer-based analysis tool to review the performance of digita electronic circuit.
4. Analyze, design and implement combinational logic circuits.
5. Analyze, design and implement sequential logic circuits.
6. Develop necessary digital logic and apply it to solve real life problems keeping in mind technical, economical, safety issues.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Paper Name: Industrial Instrumentation Lab					
Paper Code: AEIE2252					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

List of Experiments:

1. Familiarization of/with diaphragm, capsule, bellow, Bourdon tube, orifice plate, pitot tube, etc.
2. Calibration of pressure gauges using dead weight tester.
3. Study the characteristics of thermocouple.
4. Study the characteristics of RTD.
5. Fluid flow rate measurement using orifice meter.
6. Measurement of fluid flow rate using rotameter.
7. Level measurement using capacitive/ultrasonic type level transducer.
8. Moisture measurement using moisture analyzer.
9. Measurement of kinematic viscosity using Ostwald viscometer.

Course Outcome:

After the completion of the course students will be able to

1. Build a knowledge selecting particular sensing elements for the measurement of physical parameters.
2. Demonstrate the calibration process of pressure measuring devices using dead weight taster.
3. Measure process parameters like flow and level using different measuring devices.
4. Select particular temperature sensing elements for the measurement of temperature.
5. Determine the measurement of viscosity of a specific solution.
6. Formulate moisture percentage of a given sample.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Electrical and Electronic Measurements Lab					
Course Code: AEIE2253					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

List of Experiments:

1. Calibration of Single Phase A.C. Energy Meter.
2. Measurement of Power using Instrument Transformer.
2. Measurement of low resistance using Kelvin's Double Bridge.
4. Measurement of Inductance by Anderson's Bridge.
5. Study of static characteristics of a measuring instrument.
6. Study of dynamic characteristics of a measuring instrument.
7. Realization of data acquisition system.
8. Study of VCO (voltage controlled oscillator) and PLL (phase locked loop).
9. Study of analog to digital converter and digital to analog converter.

Course Outcomes:

After the completion of this course students will be able to

1. Measure electrical energy and power using single phase ac energy meter and instrument transformer respectively.

2. Choose appropriate bridge for measurement of impedance.

3. Examine static and dynamic characteristics of measuring instrument.

4. Design data acquisition system to gather real time data coming from transducer.

5. Explain the working of voltage controlled oscillator and phase locked loop.

6. Develop analog to digital and digital to analog converter.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Control Systems Lab					
Course Code: AEIE2254					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

List of Experiments:

1. Familiarization with MATLAB /OCTAVE control system toolbox.

2. Block diagram reduction techniques using MATLAB/ OCTAVE.

3. Transient response of first order and second order system with standard test signals, and study of system parameter using MATLAB/ OCTAVE.

4. Design and study of the response of first and second order electrical circuits using RC and RLC circuits in simulation /hardware.

5. Study of system stability by Root-locus, Bode plot and Nyquist plot using MATLAB/ OCTAVE toolbox for any given transfer function with P-Z mapping.

6. Familiarization with state space representation of models using MATLAB/ OCTAVE toolbox.

7. Study the effect of P, I, D actions on first order / second order simulated processes.

8. Study of Position and speed control of DC servo motor.

Course Outcomes:

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

1. Understand the concept of pole-zero and transfer function.
2. Derive the overall transfer function from block diagram.
3. Analyze the time response of first order and second order system for different standard input signals and calculate the transient response parameters.
4. Check the stability of a system using root locus method.
5. Find the frequency response of a system using Bode plot and Nyquist plot method.
6. Control the speed of dc motor using different controllers.

Department of Applied Electronics & Instrumentation Engineering

B.TECH in AEIE

SLYLLABUS OF 3RD YEAR COURSES

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: PROCESS CONTROL					
Paper Code: AEIE3101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

Module I – [8L]

Process control system: process control and automation, basic process control loop block diagram, terms and objectives, servo and regulatory control, classification of variables; process characteristic: process equation, degrees of freedom, process lag, process dead time, self-regulating processes, interacting and non- interacting processes; modeling of simple systems: liquid, thermal system, piping and instrumentation diagram.

Module II – [12L]

Theory of controllers: basic control action, ON/OFF control, continuous controller modes: proportional, integral, derivative; composite controller modes: P-I, P-D, P-I-D, integral wind-up and prevention, auto/manual transfer, bump less transfer, position and velocity algorithm; closed loop response of 1st & 2nd order systems, selection of control modes for processes like: level, pressure, temperature and flow; design of electronic/pneumatic controllers; controller tuning methods: evaluation criteria - IAE, ISE, ITAE, process reaction curve method, continuous oscillation method, auto tuning.

Module III – [10L]

Final control elements: actuators (pneumatic actuators, electrical actuators) and control valves (globe, ball, butterfly, gate, pinch), different parts, single & double seated valves, fail-safe operation, valve sequencing, inherent and installed valve characteristics, valve sizing, valve selection, flashing, cavitation, noise, instrument air; control valve accessories: air filter regulator, I/P converter, pneumatic positioner, electro-pneumatic positioner, limit switches.

Module IV – [10L]

Complex control system: feed forward control, cascade control, ratio control, override and split range control, multivariable process control; case studies: boiler drum level control, combustion control and pH control.

Introduction to programmable logic controllers (PLC): basic architecture and functions, input-output modules and interfacing, CPU and memory, relays, timers, counters and their uses, PLC programming and applications, introduction to DCS and SCADA, digital control, automation hierarchy.

References:

1. Surekha Bhanot, *Process Control: Principles and Applications*, Oxford University Press, 1st Edition, 2008.

2. G. Stephanopoulos, *Chemical Process Control-An Introduction to Theory and Practice*
Prentice Hall of India, New Delhi, 2nd Edition, 2005.
3. B.W. Bequette, *Process Control Modeling, Design and Simulation,* Prentice Hall of India, New Delhi, 2004.
4. Curtis D. Johnson, *Process Control: Instrumentation Technology*, Prentice Hall College Div; Custom edition, 2008.
5. Béla G. Lipták, *Process Control: Instrument Engineers' Handbook*, Butterworth-Heinemann

Course Outcome:

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

1. Develop mathematical model of the liquid, thermal and gas systems by their knowledge of Mathematics, Science and engineering and analyze the process response.
2. Explore the controller modes and analyse the close loop response of the 1^{st} and 2^{nd} order process in presence of P, PI, PD, PID controllers.
3. Design and simulate the ON-OFF, P, PI, PID controllers with the electronic components and software like simulink, LabVIEW etc.
4. Select the control valve necessary to provide engineering solutions of various societal, professional & environmental responsibilities if imposed.
5. Identify, formulate/model, analyze the process and provide solution using knowledge of complex control systems like feed forward, cascade, ratio, override, split range and multivariable process control.
6. Design and develop the ladder logic program in PLC for the solution of the sequential events performed in industry.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: POWER ELECTRONICS AND DRIVES					
Paper Code: AEIE 3102					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**0**	**3**

Module I – [10L]
Power Semiconductor devices: Power diodes, Power BJT, Power MOSFET, DIAC, TRIAC and IGBT: Construction, Characteristics, Working principles, Applications.
Thyristor: Principle of operation of SCR, Static characteristics, two-transistor analogy, SCR construction, Gate characteristics of SCR, Turn-on methods of SCR, Dynamic turn-on switching characteristics, Turn-off mechanisms, SCR ratings, Comparison between SCR and Transistor.

Module II - [6L]
Phase controlled rectifiers:
Single phase converters: Half controlled and fully controlled converters ,Evaluation of input power factor and harmonic factor ,continuous and Discontinuous load current ,single phase dual converters, power factor Improvements, Extinction angle control, symmetrical angle control, PWM, single phase sinusoidal PWM, single phase series converters, Three Phase Converters, Applications.

Module III - [10L]
Inverters:
Single phase and three phase (both 120° mode and 180° mode) inverters - PWM techniques: Sinusoidal PWM, modified sinusoidal PWM - multiple PWM – Introduction to space vector modulations - Voltage and harmonic control - Series resonant inverter - Current source inverter.
Choppers: Step-down and step-up chopper - Time ratio control and current limit control – Buck, boost, buck- boost converter.

Module IV - [10L]

DC drives:
Basic machine equations, schemes for DC Motor speed control, Single phase separately excited drives, Braking Operation of Rectifier Controlled Separately Excited Drives, DC Chopper Drives, Phase-Locked Loop (PLL) Controlled of DC drives.

AC drives:
Basic Principle of operation, Speed Control of induction motor, Stator voltage control, Variable frequency control, Rotor resistance control, Slip power recovery scheme, Synchronous motor drives.

References:

1. K B Khanchandani, *Power Electronics*, McGraw Hill.
2. K. Hari Babu, *Power Electronics*, Schitech.

3. M H Rashid, *Power Electronics*, Pearson Education.
4. P C Sen, *Modern power electronics*, S. Chand.
5. Lander, *Power Electronics*, McGraw Hill.

Course Outcome:

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

1. Gain knowledge on basic power electronics devices.
2. Describe single phase power converter circuits and understand their applications.
3. Analyze three phase power converter circuits and understand their applications.
4. Explain inverter, chopper circuits and list their industrial uses.
5. Understand the applications of AC and DC drives in industry.
6. Learn about power converters for sustainable energy technologies.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: MICROPROCESSORS AND MICROCONTROLLERS					
Paper Code: AEIE3103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

Module I - [10L]

Introduction to 8 bit Microprocessor: History of microprocessor, 8085A microprocessor internal architecture, buses, 8085 pin description. Software instruction set, addressing modes and assembly language programming, Stack and subroutine, counter and time delay generation.

Module II - [10L]

Instruction cycle, machine cycle, timing diagrams. Interfacing of memory chip and input / output devices: Absolute and partial address decoding, interfacing of different size of memory chips with 8085A, Memory mapped I/O and I/O mapped I/O, interfacing of input/output devices with 8085A. Interrupts, DMA operation.

Module III - [10L]

Programmable peripherals and applications: Block diagram, pin description and interfacing of 8255(PPI) with 8085A microprocessor. Interfacing of LEDs, switches, stepper motor, ADC and DAC using 8255. Block diagram, pin description and interfacing of 8254 with 8085A microprocessor.

Module IV - [10L]

Introduction to microcontrollers: Intel MCS-51 and PIC microcontroller features, architecture, pin configuration, I/O ports and memory organization. MCS51: Instruction set and basic assembly language programming, interrupts, timer/counter and serial communication. MCS-51 applications: square wave generation, LED, A/D converter and D/A converter interfacing with 8051.

References:

1. Ramesh S. Gaonkar, *Microprocessor architecture, programming and applications with 8085/8085A*; Wiley eastern Ltd.
2. B. Ram, *Fundamental of Microprocessor and Microcontrollers*; Dhanpat Rai Publications.
3. A. Nagoor Kani, *8085 Microprocessor and its Applications*; Third Edition, TMH Education Pvt. Ltd.
4. Muhammed Ali Mazidi and Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education Inc.
5. Ajay V Deshmukh, Microcontrollers Theory and Applications, Tata McGraw-Hill.
6. Muhammed Ali Mazidi, Rolin D. McKinlay, Danny Causey, PIC Microcontroller and Embedded Systems, Pearson Education Inc.

Course Outcome:

After the completion of the course the students will be able to:

1. Learn the architecture of 8 bit microprocessor (8085), 8051 and PIC (PIC16F877) microcontrollers.
2. Develop the skill in program writing for 8085 microprocessor, 8051 microcontroller.
3. Realize the interfacing of memory, input/output devices with 8085 microprocessor.
4. Understand the interrupts of 8085 microprocessor, 8051 microcontroller.
5. Learn the use of timer/counter and serial data communication process in 8085 microprocessor and 8051 microcontroller.
6. Apply the knowledge to interface different type of I/O devices with 8085 microprocessor and 8051 microcontroller.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

SUBJECT NAME: FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING					
Paper Code: AEIE3104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I – [10L]

Introduction: Signals, systems and signal processing, classification of signals.

Discrete time signals- generation of discrete and digital signals, sampling of continuous time signals and aliasing, classification of discrete time signals, mathematical operations on discrete time signals- time shifting, scaling, folding, addition and multiplication; correlation of discrete time signals.

Discrete time systems: description, block diagram representation, classification of discrete time systems- static and dynamic, time invariant and time variant, linear and nonlinear, stable and unstable, FIR and IIR and recursive and non-recursive systems; response of LTI discrete time system to arbitrary inputs: convolution sum, properties and interconnections of LTI systems.

Z-transform to analysis of LTI systems: z-transform, properties of z-transform, inverse z-transform, difference equation using z-transform, analysis of Linear Time Invariant (LTI) systems in z domain. Examples of implementation using MATLAB functions.

Module II - [8L]

Frequency analysis of Discrete-time signals: Fourier series for discrete-time periodic signal, Fourier transform of discrete - time Aperiodic signal, relation of Fourier transform to z-transform, properties of Fourier transform for discrete time signals.

Discrete Fourier Transform (DFT) – definition of forward and inverse DFT, frequency spectrum using DFT, properties and limitations of DFT; concepts of circular convolution, relationship between linear convolution and circular convolution, computation of linear convolution from circular convolution.

Fast Fourier Transform (FFT): Decimation in Time (DIT) and Decimation in frequency (DIF) algorithms. Examples of implementation using MATLAB functions.

Module III-[10L]

IIR Filter design: Discrete time IIR Butterworth filter design from analog filter – approximation of derivatives, impulse invariance technique and bilinear transformation; filter design using frequency translation, structures for realization of IIR filters- direct form-I, direct form-II, cascade and parallel form.

Design of FIR filters: symmetric and antisymmetric filters; FIR filter using windows techniques (Rectangular Window), frequency sampling method; structures for realization of FIR filters- direct form, cascade form and linear phase structure; finite word length effect in digital filters. Filter design examples using MATLAB functions.

Module IV- [8L]

Introduction to time-frequency analysis- Short Time Fourier Transform (STFT), Continuous and Discrete Wavelet Transform (CWT and DWT) and their applications in signal processing.

The discrete cosine transforms (DCT): use and application of DCT.

Multirate digital signal processing: decimation, interpolation, sampling rate conversion by rational factor; application of multirate signal processing.

Examples of implementation using MATLAB functions.

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, 4th Edition, Pearson Education Inc., New Delhi, India.
2. Li Tan, Jean Jiang, *Digital Signal Processing: Fundamentals and Applications*, 2nd Edition, Academic Press.
3. A.V. Oppenheim, R.W. Schaffer and John R. Buck, *Discrete Time Signal Processing*, 3rd Edition, Prentice-Hall Signal Processing Series.
4. Sanjit K. Mitra, *Digital Signal Processing- A computer based Approach*, 4th Edition McGraw-Hill.

Reference Books:

1. S. Salivahanan, *Digital Signal Processing*, 3rd Edition, McGraw-Hill, India
2. A. Nagoor Kani, *Digital Signal Processing*, 2nd Edition, Tata McGraw-Hill, India
3. P. Ramesh Babu, *Digital Signal Processing*, 4th Edition, Scitech Publications, India
4. B. Venkatramani, M Bhaskar, *Digital Signal Processors, Architecture, programming and applications*, 2nd Edition Tata Mc-Graw Hill, India

Course Outcome:

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

1. Characterize and analyze the properties of discrete time signals and systems.
2. Analyze a discrete linear time invariant system using Z-transform.
3. Perform Fourier Transform of Discrete-Time signals and learn implementation of Fast Fourier Transform algorithms.
4. Distinguish between analog and digital filter, methods to transform from one type to another types of filter.
5. Design digital FIR and IIR filters according to the given specification and realize structure of a digital filter for given transfer function
6. Familiarize with short time Fourier transform, discrete cosine transform, wavelet transform and multirate digital signal processing.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: COMMUNICATION TECHNIQUES					
Paper Code: AEIE3131					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I – [9L]

Introduction to Communication Process: elements of communication systems (mention of transmitter, receiver and channel), modulation, analog vs digital; origin of noise and its effect, importance of SNR in system design; amplitude modulation (AM), envelop detection, limitations of AM, DSB-SC modulation, coherent detection, SSB and VSB modulations, angle modulation, phase modulation, frequency modulation, narrowband FM, generation of FM, detection of FM, Phased locked Loop, frequency division multiplexing technique.

Module II – [10L]

Digital Modulation Techniques: Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques, Geometrical representation, generation, detection, error probability and power spectra of basic digital carrier modulation techniques: ASK, PSK and FSK. Concept of QAM and M-ary Communication, M-ary phase shift keying, average probability of symbol error for coherent M-ary PSK, power spectra of MPSK, Quadrature Phase Shift Keying (QPSK), Generation, detection, error probability and power spectra of QPSK signal, Offset Quadrature Phase shift Queuing (OQPSK), Minimum Shift Keying (MSK), signal constellation of MSK waveforms, error probability of MSK signal, Gaussian Minimum Shift Keying: GMSK, Basic Concept of OFDM and Spread Spectrum Modulation.

Module III – [8L]

Pulse Modulation: sampling process, PAM, PPM & PWM, time division multiplexing technique, quantization process, quantization noise, PCM encoding and decoding, Polar/Unipolar/Bipolar NRZ and RZ, Manchester, error control codes: ARQ, Hamming codes, differential pulse code modulation, delta modulation, delta-sigma modulation, matched filter, properties of matched filter, ISI, distortion-less baseband binary transmission, raised cosine spectrum, equalization.

Module IV – [9L]

Cellular Mobile Wireless Networks: Systems and Design Fundamentals: Brief introduction to mobile wireless communication and systems, Description of cellular system, Cellular Structure, Frequency Reuse, Cell clustering, Capacity enhancement techniques for cellular networks, cell splitting, antenna sectoring, Co-channel and Adjacent channel interferences, Channel assignment schemes – Fixed channel, Dynamic channel and Hybrid channel, mobility management – location management and handoff management, handoff process, different types of handoff.
Wireless Local Area Networks (WLAN): IEEE 802.11 Standards and Protocols IEEE 802.11 standards, WLAN family, WLAN transmission technology, WLAN system architecture, Collision Sense Multiple Access with Collision Detection (CSMA/CD) and CSMA collision avoidance (CSMA/CA), WLAN applications.

References:

1. Simon Haykin, *Communication Systems;* 4th Edition, John Wiley & Sons. 2001.
2. B. P. Lathi, *Modern Analog And Digital Communication systems;* 3/e, Oxford University Press, 2007.
3. H. Taub, D. L. Schilling, G. Saha, *Principles of Communication;* 3/e, 2007.
4. Martin S. Roden, *Analog and Digital Communication System*; 3rd Edition, PHI.
5. S. Sharma, *Communication Systems: Analog and Digital*- Katson Books, 2012.
6. V. Chandra Sekar, *Communication Systems* - Oxford University Press, 2012.
7. T.S. Rappaport, *Wireless communications*; Pearson Education, 2003.
8. Simon Haykin & Michael Moher, *Modern Wireless Communications*; Pearson Education, 2007.

Course Outcomes:

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

1. Identify and apply detailed knowledge of analog modulation and demodulation techniques.
2. Examine the merits and short comings of the basic digital modulation techniques.
3. Compare the characteristics of standard multiplexing techniques and select the suitable one for specific requirement.
4. Evaluate the performance of coding techniques.
5. Analyze cellular concept and the strategies associated with cellular communication.
6. Explain the role of wireless local area networks in communication systems.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

	Subject Name: NON CONVENTIONAL ENERGY SOURCES				
	Paper Code: AEIE3132				
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [8L]
Introduction: fossil fuel based systems, impact of fossil fuel based systems, non-conventional energy, seasonal variations and availability, renewable energy – sources and features, hybrid energy systems, distributed energy systems and dispersed generation (DG); concept of energy management and audit.

Module II – [8L]
Solar thermal systems: solar radiation spectrum, radiation measurement, conversion technologies, applications- heating, cooling, drying, distillation, power generation.
Solar photovoltaic systems: operating principle, photovoltaic cell concepts - cell, module, array, series and parallel connections, maximum power point tracking, applications – battery charging, pumping, lighting, solar cell power plant, limitations.

Module III - [10L]
Wind energy: wind patterns and wind data, site selection, types of wind mills, characteristics of wind generators, performance and limitations of energy conversion systems, load matching, recent developments.
Energy from bio-mass: resources and conversion process: bio gas conversion, bio gas plant, biomass gasifier, cogeneration, bio-diesel.

Module IV - [10L]
Energy from the ocean: ocean thermal electric conversion (OTEC) systems like open cycle, closed cycle, hybrid cycle, prospects of OTEC in India; energy from tides: basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy; energy power from wave: wave energy conversion devices, advantages and disadvantages of wave energy.
Geothermal energy: resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

References:

1. G.D. Rai, *Non-conventional energy sources*; Khanna Publishers.
2. H.P. Garg & Jai Prakash, *Solar Energy: Fundamentals and Applications;* Tata McGraw Hill.
3. Bansal, Kleeman & Melisa, Renewable Energy Sources & Conversion Technology; Tata McGraw Hill New Delhi.
4. Twidell & Weir, Renewable Energy Resources; ELBS
5. D.S. Chauhan, Non-conventional Energy Resources; New Age International.
6. C.S. Solanki, Renewal Energy Technologies: A Practical Guide for Beginners; PHI Learning.
7. Peter Auer, Advances in Energy System and Technology- Vol. 1 & II; Edited by Academic Press.

Course Outcome:

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

1. Understand the issue of fuel availability, analyze the supply and demand of fuel in the world.
2. Identify the different sources of renewable energy and innovative technologies in harnessing energy from renewable sources.
3. Explain production of electricity from clean resources.
4. Study the environmental impacts of a power plant with various resources.
5. Apply the wind energy for human usage.
6. Learn the conception of the economical use of renewable energy resources over conventional energy sources.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: ADVANCED SENSORS					
Paper Code: AEIE3133					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

MODULE I – [9L]

Overview of micro-sensors: Introduction, principle of transduction**;** classification of micro-sensors; chemical, thermal, pressure, acoustic, optical, electrical, mechanical, biological sensors, their calibration and determination of characteristics, process flow of micro-sensor fabrication.

MODULE II - [9L]

Materials for micro-sensors: Substrates and wafers, silicon as substrate material, *e*nergy bands, types of semiconductors, charge carriers, intrinsic and extrinsic materials, Fermi level, electron-hole concentration equilibrium, temperature dependence of carrier concentration, compensation and charge neutrality. *Crystal structure*: Quartz, GaAs, SiO_2, SiC, Si_3N_4, conductivity and mobility, effect of temperature, doping and high electric field.

MODULE III - [10L]

Micro-fabrication process: IC technology used in micro sensor system; crystal growth and wafer making, different techniques of deposition; physical vapor deposition - evaporation, thermal oxidation, sputtering, epitaxy, ion implantation and diffusion; chemical vapor deposition- LPCVD, APCVD, PECVD, spin coating, electrochemical deposition; pattern generation and transfer-masking, photolithography, photoresists, *Etching techniques:* Dry and wet etching techniques.

MODULE IV - [8L]

Overview of micro-manufacturing techniques: Bulk micro-machining, surface micro-machining, LIGA. *Smart sensors:* Introduction, working principle, block diagram, sensor output, integrated sensor principle.

References:

1. J. W Gardner, V. K. Varadan, *Microsensors, MEMS And Smart Devices*, Wiley, 2001.
2. Stephen Beedy, *MEMS Mechanical Sensors*, Artech House, 2004
3. N. P. Mahalik, *MEMS*, McGraw Hill, 2007
4. Jon Wilson, *Sensor Technology Handbook*, Elseiver, 2005.
5. Leondes, Cornelius T. (Ed.), *Mems/Nems Handbook Techniques and Applications*, Springer, 2006
6. Mohamed Gad-el-Hak, *The MEMS Handbook*, CRC Press; 2nd edition, 2005.
7. G. Steetman and Sanjay Banerjee, *Solid State Electronic Devices*, Prentice Hall; 6th edition, 2005.

Course Outcomes:

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

1. Gather concepts of micro sensors.
2. Know the basic concepts of semiconductor characteristics.
3. Learn the basic selection criteria and industrial applications for smart sensors.
4. Acquaint the fundamentals of sensing materials, properties and industrial applications.
5. Acquire knowledge on microfabrication techniques.
6. Learn the basics of micro sensor packaging techniques.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: PROCESS CONTROL LAB					
Paper Code: AEIE3151					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**1.5**

List of Experiments

1. Familiarization with transmitters (pressure, flow, level, temperature), air pressure regulators, I/P converters, control valves, electromechanical relays, SIEMENS PLC hardware etc.
2. Study of flow, level and pressure processes and building of P&I diagram as per ISA guidelines /Standards.
3. Study of controller responses for different values of K_P, T_I and T_D in flow control loops (air duct and water flow system).
4. Study of controller responses for different values of K_P, T_I and T_D in pressure control loop.
5. Study of controller responses for different values of K_P, T_I and T_D in Level control loop.
6. Study of a furnace temperature control loop.
7. Realization of ladder logic programs in SIEMENS PLC.
8. Study of single element & three element boiler drum level control and burner management system using boiler simulation software (WinCC).

Course Outcomes:

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

1. Draw and explain P&I diagram of flow, pressure, level and temperature control loop from their engineering knowledge.
2. Analyze the process responses with respect to various process parameter values.
3. Use software tool to study the close loop process responses.
4. Create ladder logic diagram for various sequential operations commonly used in industrial environment.
5. Conduct experiments either in group or by individual means.
6. Provide engineering solutions of various societal, professional & environmental responsibilities.

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Subject Name: POWER ELECTRONICS AND DRIVES LAB					
Paper Code: AEIE3152					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

1. Study of V-I Characteristics of SCR.
2. UJT Triggering circuits for SCR.
3. Study of the operation of a single-phase fully controlled bridge converter supplying
   a) Resistive load.
   b) R-L load with freewheeling diode including generation of triggering pulses for the devices for both continuous and discontinuous modes of conduction.
4. Study of V-I Characteristics of a TRIAC.
5. Simulation of DC to DC step down chopper and step up chopper.
6. Simulation of PWM bridge inverter using MOSFET/IGBT with R and R-L loads.
7. Simulation of Single-phase AC regulator.
8. DC motor speed control using DC drives.

Course Outcomes:

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

1. Gather knowledge about Gate firing circuits.
2. Understand how to design Rectifier, Chopper and AC Voltage Controller.
3. Develop skills to build and troubleshoot power electronics circuits.
4. Design and simulate PWM bridge inverter using MOSFET/IGBT with R and R-L loads.
5. Analyze single-phase AC voltage regulator.
6. Study DC motor speed control using chopper.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: MICROPROCESSORS & MICROCONTROLLERS LAB					
Paper Code: AEIE3153					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

List of Experiments:

1. Familiarization with 8085A trainer kit components with the process of storing and viewing the contents of memory as well as registers.
2. Study of programs using basic instruction set (data transfer, load/store, arithmetic, logical) of 8085A microprocessor.
3. Programming using 8085A trainer kit/simulator for:
   a) Copying and Shifting block of memory,
   b) Packing and unpacking of BCD numbers,
   c) Addition/Subtraction of two 8/ 16-bit Hex numbers,
   d) BCD Addition,
   e) Binary to ASCII conversion,
   f) String Matching and Sorting.
4. Familiarization of 8051 Microcontroller using different instructions.
5. Interfacing of 8085A through 8255A PPI/ 8051 Microcontroller with switches and LEDs to perform
   a) Display operation
   b) Blinking operation and
   c) Scrolling operation
6. Interfacing with seven segment displays through 8-bit latch (e.g., 74LS373) using a) 8085A trainer kit through 8255A PPI, b) 8051 Microcontroller.

7. Interfacing of ADC, DAC, and Stepper motor with 8085A microprocessor and 8051 Microcontroller.

Course Outcomes:

After completion of this course, students will be able to

1. Understand the architecture and program execution of 8 bit microprocessor (8085A), and Microcontroller (8051).
2. Understand the application of 8085A Microprocessor, and 8051 Microcontroller.
3. Develop the skill in program writing for 8085A microprocessor, and 8051 Microcontroller.
4. Apply different types of memory and I/O interfacing techniques with 8085A microprocessor.
5. Understand the necessity of different types of programmable peripheral devices and their interfacing with 8085A microprocessor.
6. Develop the skill to interface different types of I/O devices with 8085A microprocessor using programmable peripheral device and 8051 Microcontroller.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Honours Course:

Subject Name: INTRODUCTION TO MECHATRONICS					
Paper Code: AEIE 3111					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

MODULE I – [10L]

Overview of Mechatronics: Definition of Mechatronics; Mechatronics system design: Introduction, integrated design issues in mechatronics, key elements, the mechatronics design process, advanced approaches in mechatronics, Mechatronics-based Product Realization. Review of fundamentals of electronics: Different types of Amplifiers, Instrumentation Amplifiers, Comparators, Filters etc.

Modelling and simulation of physical systems: simulation and block diagrams, analogies and impedance diagrams, electrical systems, mechanical translational systems, mechanical rotational systems, electro mechanical coupling, fluid systems.

Module -II - [10L]

Mechatronics elements and Drives: Review of working principle of sensors and actuators; Sensors for motion and position measurement, force, torque and tactile sensors, flow sensors, temperature-sensing devices, concept of micro sensors and signal processing devices. Overview of Electromechanical actuators- relays, contactors and timers, Drives: DC motor, AC motor, Servo motor, BLDC motor etc.

MODULE III - [10L]

Mechanisms of actuations: Introduction to Actuator types and Application Areas Fluid Power Actuators - Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs; Pneumatic systems: production, distribution and conditioning of compressed air, system components. *Micro-Actuators:* Overview of different types of micro-actuation process.

Module IV - [**10L**]

Micro-Controller programming and real time interfacing: Review of microcontroller programming; Control with Embedded Computers and Programmable Logic Controllers; Real time case studies with Data acquisition techniques. Introduction to Shape memory alloy (SMA): concept, working principle, materials, and applications.

REFERENCES:

1. Robert H. Bishop, *The Mechatronics Handbook*, CRC Press 2006
2. W. Bolton, *Mechatronics, Electronic Control Systems in Mechanical and Electrical Engineering*, Pearson Education, 2003.
3. N. P. Mahalik, *Mechatronics, Principles, Concept and Applications*, McGraw Hill, 2003.
4. R. Isermann, *Mechatronic Systems Fundamental*, Springer, 2005.
5. Denny K. Miu, *Mechatronics*, Springer-Verlag, New York, 1993.
6. Boucher, T. O., Computer automation in manufacturing - an Introduction, Chapman and, Hall, 1996.

Course outcome:

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

1. Understand a real time mechatronics system.
2. Identify the key elements of mechatronics systems and its representation in terms of block diagram.
3. Gain knowledge of different types of Sensors required for developing mechatronics systems.
4. Learn the functions of different types of actuators and identify their application areas.
5. Understand concept of signal conditioning and use of interfacing systems such as comparator, filters, amplifiers, etc.
6. Learn the hardware and software interfacing for embedded systems.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: BASICS OF RDBMS					
Paper Code: CSEN3206					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Module I

Introduction [4L]

Concepts relating to Overview of DBMS, Comparison among file-based data management and DBMS, Types of DBMS and RDBMS, Data Models, Database Languages, Role of database administrator and database Users, Three Tier architecture of DBMS.

Entity-Relationship Model [5L]

Basic concepts, Design Issues, Mapping Constraint Types, Various types of Keys, Entity and Attributes, Cardinality Ratio, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

Module II

Relational Model [4L]

Structure of relational Databases, Relational Algebra, Union compatibility and Different types of Joins, Extended Relational Algebra Operations, Views, Modifications of the Database.

Relational Database Design [7L]

Functional Dependency, Different anomalies in designing a Database, Normal Forms, 1NF, 2NF, 3NF, BCNF, Normalization using functional dependencies, Decomposition, Normalization using multi-valued dependencies.

Module III

SQL and Integrity Constraints [8L]

Concept of DDL, DML, DCL, Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, Views, Nested Subqueries, Stored procedures and triggers.

Module IV

Internals of RDBMS [6L]

Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols, two phase locking.

File Organization & Index Structures [6L]

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree.

Textbooks:

1. Henry F. Korth and Silberschatz Abraham, Database System Concept, McGraw Hill.
2. Elmasri Ramez and Navathe Shamkant, Fundamentals of Database Systems, Pearson Education.

3. Ramakrishnan, Database Management System, McGraw-Hill.
4. Gray Jim and Reuter Address, Transaction Processing: Concepts and Techniques, Morgan Kauffman Publishers.
5. Jain, Advanced Database Management System CyberTech.
6. Date C. J., Introduction to Database Management, Addison Wesley.
7. Ullman JD., Principles of Database Systems, Galgotia Publication.

References:

1. James Martin, Principles of Database Management Systems, Prentice Hall of India, New Delhi
2. Arun K.Majumdar, Pritimay Bhattacharya, Database Management Systems, Tata McGraw Hill.

Course Outcomes:

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

CO1. Identify the basic concepts and various data model used in database design. Be able to model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.
CO2. Formulate relational algebra expression for queries and evaluate it using the concept of query processing and optimization.
CO3. Create RDBMS schema mapping various business validations and formulate queries based on that schema using SQL to satisfy business requirements.
CO4. Apply normalization and various types of dependencies for evaluating a relational database design.
CO5. Apply and relate the concept of transaction, concurrency control and recovery in database.
CO6. Understand with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: ECONOMICS FOR ENGINEERS					
Paper Code: HMTS3201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I [6 L]
Market: Meaning of Market, Types of Market, Perfect Competition, Monopoly, Monopolistic and Oligopoly market.
The basic concept of economics – needs, wants, utility.
National Income-GDP, GNP. Demand & Supply, Law of demand, Role of demand and supply in price determination, Price Elasticity.
Inflation: meaning, reasons, etc.

Module II [4 L]
Business: Types of business, Proprietorship, Partnership, Joint-stock company, and cooperative society – their characteristics.
Banking: role of commercial banks; credit and its importance in industrial functioning. Role of central bank: Reserve Bank of India.
International Business or Trade Environment.

Module III [14 L]
Financial Accounting-Journals. Ledgers, Trial Balance, Profit & Loss Account, Balance Sheet. Financial Statement Analysis (Ratio and Cash Flow analysis). [8L]
Cost Accounting- Terminology, Fixed, Variable and Semi-variable costs. Break Even Analysis. Cost Sheet. Budgeting and Variance Analysis. Marginal Cost based decisions. [6L]

Module IV [12 L]
Time Value of Money: Present and Future Value, Annuity, Perpetuity. Equity and Debt, Cost of Capital. [4L]
Capital Budgeting: Methods of project appraisal - average rate of return - payback period- discounted cash flow method: net present value, benefit cost ratio, internal rate of return. Depreciation and its types, Replacement Analysis, Sensitivity Analysis. [8L]

References:

1. R. Narayanswami, *Financial Accounting- A Managerial Perspective.* Prentice-Hall of India Private Limited. New Delhi.
2. Horne, James C Van, *Fundamentals of Financial Management*. Prentice-Hall of India Private Limited, New Delhi.
3. H. L. Ahuja., *Modern Economic Theory.* S. Chand. New Delhi.
4. Newman, Donald G., Eschenbach, Ted G., and Lavelle, Jerome P. Engineering Economic Analysis. New York: Oxford University Press. 2012.

Course Outcomes:

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

1. Evaluate a project and estimate the total cost of the project.
2. Apply financial analytical methodologies to prepare a report regarding the financial performance of an organization.
3. Participate actively in an organization's capital budgeting process.
4. Provide vital inputs regarding the pricing of a product.
5. Apply the knowledge of the interplay of various economic variables and indicators in workplace.
6. Provide insight about different accounting concepts and apply broader concepts like costs, revenues, assets, liabilities, capital, profit, investment and interest.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

SUBJECT NAME: INTRODUCTION TO INTERNET OF THINGS					
Paper Code : AEIE 3201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I – [8 L]
Introduction of IoT systems:
Architectural overview on an IoT systems- Edge/Fog computing, Machine to Machine (M2M) communication, Wireless Sensor Network, IoT and M2M value chains; *IoT protocol suite*- MQTT, LoRa, CoAP and HTTP-REST; *IoT server architecture*- Infrastructure as a Service (IaaS), Everything as a Service (XaaS).

Module II – [10 L]
Programing tools for IoT systems:
Introduction to Python 3- I/O statements, condition statements, loops, functions, classes, Python packages (i.e. Flask, urllib, httplib, JSON), Eclipse Paho-MQTT and MQTT-SN; *Introduction to NoSQL database*- Basics of MongoDB, PyMongo API*; Introduction to MicroPython (on ESP 8266)*- General board control, Networking, Pins and GPIO control, ADC (analog to digital conversion) modules, Software SPI bus, Software I2C bus; *Application study*- Building a REST API server with MongoDB backend using Python Flask module.

Module III – [10 L]
Embedded devices for IoT systems:
Introduction to ESP 8266/ESP 32 WiFi modules- AT command set, TCP/IP stack, Lua firmware, UART interface; *Introduction to Arduino boards family*- Basic code structure, I/O applications, UART applications, ADC interface with sensors (i.e. LM35 and DHT11), communication with ESP 8266 modules; *Application study*- Connecting ESP 8266 with an Arduino to send POST (REST API) requests.

Module IV – [8 L]
Edge intelligence tools IoT systems:
Machine learning on the Edge: Introduction to TensorFlow lite on Raspberry Pi Zero W, transferring TensorFlow model parameters, classification of sensor data using TinyML framework; *Edge interfaces*- Communication between an Arduino UNO rev.3 with Raspberry Pi Zero W over UART serial.

References:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, ***"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",*** 1st Edition, Academic Press, 2014.
2. Gaston C. Hillar***, "Internet of Things with Python",*** 1st Ed. Packet Publishing, 2016

3. Pete Warden "***TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers***", Publisher: Shroff/O'Reilly; First edition (20 January 2020)
4. Bernd Scholz-Reiter, Florian Michahelles, "**Architecting the Internet of Things**", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
5. Massimo Banzi, Michael Shiloh, "Getting Started with Arduino" 3rd edition
6. Daniel Minoli, "**Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications**", ISBN: 978-1-118-47347-4, Willy Publications
7. Vijay Madisetti and Arshdeep Bahga, **"Internet of Things (A Hands-on-Approach)",** 1st Edition, VPT, 2014.

Course Outcomes:

After the completion of the course students will be able to:

1. Learn and familiarize the design challenges related to IoT systems.
2. Develop Python applications for IoT systems.
3. Demonstrate working knowledge of MicroPython on an ESP 8266 board.
4. Design of an IoT system with an Arduino and ESP 8266 for sensor data acquisition.
5. Understand functional components in an IoT Edge device.
6. Develop machine learning applications for microcontrollers.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

	Subject Name: EMBEDDED SYSTEMS				
	Paper Code: AEIE3231				
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [10L]

Introduction To Embedded Systems: Definition Of Embedded Systems, Embedded System V/S General Computing System, Challenges In Embedded System Design, Design Process, Requirements, Examples Of Embedded Systems. Embedded System Architecture: Harvard Vs. Princeton, CISC Vs. RISC. Memory Organization.

Module II – [9L]

Embedded Interfacing & Communication: Memory Interfacing, USB Interfacing, AD/DA interfacing, Serial Bus communication protocols – RS232 standard – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I^2C).

Module III – [9L]

Embedded Operating Systems: Introduction to Basic Concepts Of RTOS- Tasks, Process And Threads, Multiprocessing And Multitasking, Task Scheduling; Task Communication: Shared Memory, Message Passing, Remote Procedure Call And Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, Selection of RTOS.

Module IV – [8L]

Embedded System Application Examples: Washing Machine, Automotive Systems, Auto-focusing digital camera, Air-conditioner, Elevator Control System, ATM System, etc.

References:

1. Raj Kamal, “Embedded System-Architecture, Programming, Design”, Mc Graw Hill, 2013.
2. Shibu K.V, “Introduction to Embedded Systems”, Tata McGraw Hill, 2009.
3. Peckol, “Embedded system Design”, John Wiley & Sons, 2010.
4. Lyla B Das, “Embedded Systems-An Integrated Approach”, Pearson, 2013.
5. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.
6. Rajib Mall, “Real-Time systems Theory and Practice”, Pearson Education, 2007.

Course Outcome:

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

1. Explain the definitions, components and requirements of the Embedded System.
2. Describe the processor, architecture and memory organization of the Embedded System.
3. Develop the interfacing and communication techniques of the Embedded System.
4. Learn the basic concept of RTOS.
5. Understand the message passing technique, task synchronization techniques.
6. Develop algorithms for real time applications of Embedded System.

Heritage Institute of Technology
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Subject Name: OPTO ELECTRONICS AND FIBRE OPTICS					
Paper Code: AEIE3232					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [8L]
Optoelectronics: Characteristics of optical emission, electro-luminescence, photo electric effect, photo conducting effect, photo voltaic effect, solar cell, LDR, phototransistor .

Module II – [8L]
Photo diode: PIN photodiode, hetero junction diode, avalanche photo diode.
LED: Power and efficiency calculation, structure of LED and its characteristics, heterojunction LED.

Module III - [10L]
LASER fundamentals: Fundamental characteristics of lasers, three level and four level lasers, properties of lasers, laser modes, resonator configuration-Q switching and mode locking, cavity damping, types of lasers- gas lasers, liquid laser, solid lasers, semi-conductor lasers: double heterojunction broad area laser, stripe geometry DH laser; Industrial applications of LASER: Laser for measurement of distance, length, velocity, acceleration and atmospheric effect; Material processing :Laser heating, welding, melting and trimming of material-removal and vaporization.

Module IV - [10L]
Optical fibers and their performances : Principle of light propagation through fiber, different types of fibers and their properties, fiber characteristics, absorption losses, scattering losses, dispersions, connectors ; Industrial applications of optical fiber; Fiber optic sensors, fiber optic instrumentation system; Different types of modulators, inferometric method of measurement of length, Moire fringes, birefringence fringes, measurement of pressure, temperature, current, voltage, liquid level and strain.

References:

1. J.M. Senior, *Optical Fibre Communication , Principles and Practice;* Prentice Hall of India, 1985.
2. J. Wilson and J.F.B. Hawkes, *Introduction to Opto Electronics*; Prentice Hall of India, 2001.
3. Donald J.Sterling Jr, *Technicians Guide to Fibre Optics ;* 3rd Edition, Vikas Publishing House, 2000.
4. M. Arumugam, *Optical Fibre Communication and Sensor;* Anuradha Agencies, 2002.
5. John F. Read, *Industrial Applications of Lasers;* Academic Press, 1978.
6. Monte Ross, *Laser Applications*; McGraw Hill, 1968.
7. G. Keiser, *Optical Fibre Communication*; McGraw Hill, 1995.
8. S.M Zse, *Physics of Semiconductor Devices;* Wiley; Third edition , 2008
9. Ajay Ghatak, *Optics*;TMH,2012

Course Outcomes:

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

1. Learn the basic concepts of opto- electronics, properties and industrial applications.
2. Gain the fundamentals of Lasers, properties and industrial applications.
3. Understand the characteristic of optical fibers and their performances, properties and industrial applications industrial.
4. Specify and analyze optoelectronic devices in optical fiber communication.
5. Analyze various types of losses in optical fiber communication.
6. Acquire the knowledge of different types of Optical Fiber sensors and their applications.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

SUBJECT NAME: MOBILE COMMUNICATION					
Paper Code: AEIE3233					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I – [8L]
Cellular concept and system design fundamentals: introduction to wire1ess communication-evolution of mobile communication, mobile radio systems- examples, trends in cellular radio and personal communications; cellular concept- frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, trunking and grade of service, improving coverage and capacity of cellular systems.

Module II – [9L]
Mobile radio propagation: reflection, ground reflection model (2 ray model), diffraction, practical link budget design using path loss models, small-scale multipath propagation, parameter of multi-path channels, types of small scale fading, Rayleigh and Ricean distribution, diversity, rake receiver; instrumentation for multiple access technique in wireless communications: review of frequency division multiple access (FDMA) and time division multiple access (TDMA), spread spectrum multiple access (SSMA), space division multiple access (SDMA).

Module III – [9L]
Introduction to modern technologies: GSM network architecture, signaling protocol architecture, identifiers, channels, introduction frame structure, speech coder RPE-LTP, authentication and security, call procedure, handoff procedure, services and features; GPRS and EDGE: architecture and services offered; IS-95 A & B (CDMA-1): frequency and channel specifications of forward and reverse CDMA channel, packet and frame formats, mobility and radio resource management.

Module IV – [10L]
Wireless network & access protocols: wireless LAN – IEEE 802.11 standards – architecture – services – wireless local loop (WLL), WAP model mobile, location based services, WAP gateway, WAP protocols, WAP user agent profile-caching model and wireless bearers for WAP; 3G Technology: IMT-2000/UMTS: network architecture, air interface specification, forward and reverse channels in W-CDMA and CDMA 2000, WiMAX, RFID, introduction to 4G technology.

References:

1. Schiller, *Mobile Communication;* Pearson Ed.
2. C.Y Lee, *Mobile Communication*; Wiley.
3. Rappaport. T.S., *Wireless communications*; Pearson Education, 2003.
4. Simon Haykin & Michael Moher, *Modern Wireless Communications*; Pearson Education, 2007.

5. Gordon L. Stuber, *Principles of Mobile Communication*; Springer International Ltd., 2001.

Course Outcomes:

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

1. Familier with cellular concept and the strategies associated with cellular communication.
2. Understand mobile radio propagation models considering losses and fading.
3. Compare multiple access techniques used for mobile communications.
4. Evaluate GSM and CDMA technologies with their architecture, frame structure, system capacity as well as services provided by them.
5. Learn wireless local area networks utilizing the wireless access protocols.
6. Get familier with the merits and limitations of 3G technology.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: INDIAN CONSTITUTION AND CIVIL SOCIETY					
Paper Code: INCO3016					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**0**

Module 1 [6L]
Introduction to the Constitution of India-Historical Background.
Making of Indian Constitution -the process of framing the constitution, the constituent assembly.

Module II [6L]
Salient Features of the Indian constitution.
Comparison with the constitutions of other countries.

Module III [6L]
Relevance of the Constitution of India.
Constitution and Governance.
Constitution and Judiciary.
Constitution and Parliament-Constitutional amendments.

Module IV [6L]
Constitution and Society- democracy, secularism, justice.
Constitution and the individual citizen- Fundamental Rights, Directive Principles of state policy and Fundamental Duties.

References:

1. C. M. Elliot, (ed.), Civil Society and Democracy, OUP, Oxford, 20012.
2. David Held et.al (ed), The Idea of the Modern State, Open Univ. Press, Bristol, 1993
3. Neera Chandoke, State and Civil Society, Sage, Delhi, 19953

Course Outcomes

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

1. Analyse the historical, political and philosophical context behind the Indian Constitution-making process.
2. Appreciate the important principles characterizing the Indian Constitution and institute comparisons with other constitutions.
3. Understand the contemporaneity and application of the Indian Constitution in present times.
4. Critique the contexts for constitutional amendments in consonance with changing times and society.
5. Establish the relationship between the Indian Constitution and civil society at the collective as well as the individual levels.
6. Consciously exercise the rights and the duties emanating from the Indian Constitution to one's own life and work.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: BASICS OF RDBMS LAB					
Paper Code: CSEN3256					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**1.5**

Experiments on Database on RDBMS Platform (Oracle):
DDL Commands: Creating Tables along with constraints like: Primary Key, Foreign Key, unique, Not Null, Check. Altering Table Structure like adding and modifying constraints, adding and modifying column data types, etc.

DML: Inserting rows, Updating rows, Deleting rows.

SQL Query: Cartesian Product, All types of Join, Union, Intersect, Minus, Single Row functions, multiple row functions using GROUP BY clause, ORDER BY Clause.

Nested Sub-Queries, Views, Programming using Stored Procedures, Triggers.

Introduction to PL/SQL: Programming Language Constructs in PL SQL like variable declaration, Conditional Statements, different types of loop structures, functions, etc.

Textbooks:
Ivan Bayross, SQL PL/SQL: The Programming Language of Oracle, BPB Publications.

Course Outcomes:

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

1. Understand the formal foundation on the relational model of data.
2. Define SQL and procedural interfaces to SQL comprehensively
3. Analyse systematic database design approaches covering conceptual design, logical design and an overview of physical design.
4. Demonstrate techniques relating to query processing by SQL engines.
5. Demonstrate the concepts and techniques relating to ODBC and its implementations.
6. Understand the concepts of transactions and transaction processing.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: INTERNET OF THINGS LAB					
Paper Code: AEIE3251					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

1. Introduction to Arduino IDE/PyCharm IDE (with Anaconda framework) and GitHub for code sharing for this lab.
2. Experiment with Arduino:
   a) *Input:* Read UART serial data, interfacing analog LM35 and DHT-11 digital sensor
   b) *Output:* Blinking LED, relay control
3. Experiments with Python:
   a) Introduction to the Python Flask module
   b) Rendering a simple HTML page with Flask
   c) Creating a REST API end point with Flask-RESTful module
4. Experiments with ESP8266-01:
   a) Interfacing analog LM35 temperature sensor
   b) Making REST API requests to web server with sensor data as payload
5. Programming NodeMCU with MicroPython
   a) Simple LED blink with GPIO module
   b) Connecting to WiFi access point with network module
   c) Making REST API requests with urequests module
6. Interfacing an Arduino with ESP8266 over UART.
7. Developing a MQTT subscriber using paho-mqtt Python library
8. Deploying a Flask server on a Raspberry Pi with MongoDB backend.
9. Classification of WiFi RSSI data using TinyML for indoor localization on the NodeMCU.

Course Outcomes:

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

1. Design and conduct experiments with input and output devices using an Arduino.
2. Program low power microcontrollers with MicroPython.
3. Interface analog sensors with NodeMCU and Arduino for IoT applications.
4. Develop Flask application server with NoSQL databases.
5. Design MQTT applications using Python.
6. Develop simple machine learning models on low power microcontrollers.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

	SUBJECT NAME: MINI PROJECT/ ELECTRONIC DESIGN WORKSHOP				
	Paper Code: AEIE3295				
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	4	4	2

The students are required to develop and execute mini project work or electronic design in the relevant field of Instrumentation Engineering that comprises of both hardware and software. The Semester Mini Project will be for a group of 3 to 5 students under the guidance of a faculty member. Group formation, discussion with faculty advisor/guide, formation of the Semester Mini Project statement, resource requirement, if any should be carried out in the earlier part of the Semester. The students are expected to utilize the laboratory resources before or after their contact hours as per the prescribed module. The students should demonstrate their work as well as submit a report at the end of the semester. Assessment will be made by a group of internal examiners appointed by the Head of the Department.

Course Outcomes:

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

1. Plan and implement hardware/ software project with proper budget.
2. Demonstrate a through and systematic understanding of project contents.
3. Understand methodologies and professional way of documentation and communication.
4. Work as a team member.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: TERM PAPER AND SEMINAR					
Paper Code: AEIE3293					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**4**	**4**	**2**

The students are required to search/gather the material/information on a specific topic, comprehend it and present/discuss in the class. The paper topic should be relevant with Instrumentation engineering and related areas of technology. The topic should be decided by the student and concerned teacher. Seminar work shall be in the form of presentation to be delivered by the student regularly throughout the semester. The students should submit a report consisting of a preliminary outline of paper, a list of the references that they have reviewed to date, a short statement of the findings of the paper and analysis of how this information fits, or does not fit, into the paper. The candidate will deliver a final talk on the topic at the end of the semester and assessment will be made by a group of internal examiners.

Course Outcomes:

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

1. Understand the contemporary/emerging technology for various processes and systems.
2. Learn the structure of technical document and how to write it.
3. Demonstrate the ability to deliver technical seminar.
4. Interact effectively with audience to share knowledge through presentation skill.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: FUNDAMENTALS OF SENSORS AND TRANSDUCERS					
Paper Code: AEIE3221					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I [10 L]
Definition, principle of sensing & transduction, classification of transducers.
Resistive Transducers:
Potentiometric transducer- Construction, symbol, materials, loading effect, error calculations, sensitivity.
Strain gauge- Theory, type, materials, gauge factor, temperature compensation and dummy gauge, Strain measurement circuit- quarter, half and full bridge configuration.
Inductive sensor- Principle, common types, Reluctance change type, Mutual inductance change type, transformer action type. LVDT- Construction, working principle.

Module II [6 L]
Capacitive sensors: Variable distance-parallel plate type, variable area- parallel plate, variable dielectric constant type, calculation of sensitivity, Microphone, response characteristics.

Piezoelectric transducers: piezoelectric effect, charge and voltage co-efficient and relationships, crystal model, materials, natural & synthetic type, charge amplifier.
Ultrasonic sensors- Liquid velocity and level measurements.
Magnetoresistive effect and Magnetostrictive sensors.

Module III [12 L]
Thermal sensors:
Resistance Temperature Detector (RTD) - materials, temperature range, R-T characteristics, configurations, applications.
Thermistors- materials, shape, R-T characteristics, ranges and accuracy specification.
Thermocouple- Thermo electric laws, types, temperature ranges, series and parallel configurations, cold junction compensation, compensating cables.
Thermal Radiation sensors- types, constructions and comparison.
Introduction to semiconductor type temperature sensors.

Module IV [8 L]
Radiation sensors:
LED, LDR, photodiodes, Photovoltaic cells, photo emissive cell types, materials, construction, response, applications.
Geiger counters, Scintillation detectors.
Introduction to smart sensors.

References:

1. Sensor & transducers, D. Patranabis, 2nd edition, PHI
2. Instrument transducers, H.K.P. Neubert, Oxford University press.
3. Measurement systems: application & design, E.A.Doebelin, Mc Graw Hill

Course Outcomes:

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

1. Use different methods for converting a physical parameter into an electrical quantity.
2. Select the best fit transducers, including those for measurement of temperature, strain, motion, position and light intensity.
3. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like displacement, stress, force, acceleration, flow, etc.
4. Acquire knowledge on high temperature sensing systems used in steel, aluminium, and copper plants.
5. Learn basic principle of smart sensors.
6. Identify different type of sensors used in real life applications and know their importance.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: FUNDAMENTALS OF ELECTRONIC MEASUREMENTS					
Paper Code: AEIE3222					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module-I [9L]

Basics of Measurement systems: Static Characteristics: Accuracy, Precision, Resolution, Reproducibility, Repeatability, Static errors. Dynamic Characteristics: Fidelity, Lag, Drift, Errors and their analysis, Standards of error measurement.

Electronic meters: Electronic Voltmeter, Electronic Ammeter, Electronic Ohmmeter, their constructional circuit operation, types, advantages, disadvantages. Concept of Digital Frequency meters and Digital Multimeters.

Module-II [9L]

DC and AC Bridges: Measurement of resistance- Wheatstone Bridge, Kelvin double Bridge; Measurement of inductance- Maxwell's bridge, Anderson bridge; Measurement of capacitance- Schering bridge; Measurement of Frequency- Wien Bridge.

Their construction, operating principle, calculation, advantages, disadvantages, industrial application, Q-factor, Errors, precautions and related problems.

Module-III [9L]

Oscilloscopes: Cathode Ray Tube, Vertical and Horizontal Deflection Systems, Time base, Delay lines, Concept of Dual trace-Dual Beam Oscilloscope, CRO Probes, Specification of an Oscilloscope. Oscilloscope measurement techniques, Lissajous figure. Special Oscilloscopes – Analog and Digital Storage Oscilloscope, Sampling Oscilloscopes.

Module-IV [9L]

Signal Generators and Analyzers and DAS: Waveform generator- pulse, square, triangular, sinusoidal; Waveform analyzer, Spectrum analyzer.

Basic concept of Data Acquisition System.

References:

1. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI
2. Electronic Instrumentation & Measurements - David A. Bell, PHI
3. Electronic instrumentation – H.S.Kalsi, Tata McGraw Hill

Course Outcomes:

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

1. Familiar with the basic characteristics of a measurement system.
2. Understand the circuit and operations for the measurement of electronic meters.
3. Use AC and DC bridges and apply the knowledge for relevant parameter measurement.
4. Learn the operation and construction of CRO and other special type Oscilloscopes and their applications.
5. Know the principle and functions of signal Generator and spectrum analyzers.
6. Get the basic knowledge about single and multichannel DAS.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: INDUSTRIAL AUTOMATION					
Paper Code: AEIE3223					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I – [9L]

Introduction to Automation: Definition and fundamentals of automation, basic elements of an automated system, representative process control problems: a blending process, a distillation column. The hierarchy of process control activities, the rationale of dynamic process models, dynamic models of representative processes.

Module II - [8L]

Dynamic behavior of Processes: Transfer function and state space models, dynamic behavior of first and second order processes, dynamic behavior of MIMO, interacting and non-interacting processes, introduction to development of empirical models from process data.

Module III - [10L]

Control for Industrial automation: Feedback and feedforward control system, PID controller design, ratio control, cascade control, model predictive control, internal model control, batch process control. Computer based data acquisition system, Internet of things (IoT) and artificial intelligence for plant automation.

Module IV - [9L]

Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS supervisory computer tasks, DCS integration with PLC and computers, features of DCS, advantages of DCS, introduction to Plantwide control.

References:

1. Process Control Modeling, Design and Simulation, B. Wayne Bequette, PHI Learning, 2012.
2. Process Dynamics and Control, Seborg, Edgar and Mellichamp, Wiley India,2005
3. Chemical Process Control, An Introduction to Theory and Practice, George Stephanopoulos, Prentice Hall India, 2012
4. Electric Motor Drives, Modelling, Analysis and Control, R. Krishnan, Prentice Hall India, 2002.
5. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A. K.Deb, Jaico Publishing House, 2013.

Course Outcomes:

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

1. Learn and familiarize with the automation technologies which typically exist in industry.
2. Explain the concept of process modeling, process dynamics and process instrumentation.
3. Understand and develop the transfer function, state space models, time series models and empirical models from process data.
4. Explain feedback and feedforward control schemes and learn the controller design.
5. Understand advanced control strategies- internal model control, cascade control, model predictive control and batch process control.
6. Acquire knowledge about the distributed control system and its function.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: ELECTRONIC INSTRUMENTATION					
Paper Code: AEIE3224					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module –I [12L]
Oscilloscopes: Construction of cathode ray tube, horizontal and deflecting plate systems, deflection amplifier, analysis of time base circuit, display of waveforms, automatic time base synchronization circuit analysis, measurement techniques with oscilloscope, Lissajaus figure, dual trace and dual beam oscilloscope circuit analysis, delayed time base oscilloscope, sampling oscilloscope, analog storage oscilloscope, digital storage oscilloscope and its applications.

Module –II [10L]
Voltage to frequency converter, frequency to voltage converter, voltage to current converter, current to voltage converter, voltage controlled oscillator, phase locked loop, frequency synthesizer, noise eliminator, FM demodulator, programmable gain amplifier, charge amplifier.

Module –III [6L]
Spectrum Analyzer: Swept tuned radio frequency spectrum analyzer, swept superheterodyne spectrum analyzer, spectrum analyzer controls and specifications.
Distortion Meter: Harmonic distortion, rejection amplifier, distortion meter block diagram and controls. Interference and noises in electronic circuits.

Module –IV [8L]
Electronic ohmmeter, Electronic multimeter, Signal generators: Requirement of signal generator, standard signal generator, modern signal generator, audio frequency sine and square wave generator, pulse characteristics and terminology, function generator.
Recoders, basic concept of data logger and laser printer, Introduction to virtual instrumentation.

References:

1. Bell, David: Electronic Instrumentation & Measurement, Oxford Publishers
2 Helfrick A.D. & Cooper W.D.: Modern Electronic Instrumentation & Measuring Instruments; Wheeler
3. D.C. Patranabis, Principles of Electronic Instrumentation, PHI
4. H.S. Kalsi, Electronic Instrumentation, Tata McGraw Hill
5. Wolf S., Student Reference Manual for Electronic Instrumentation Laboratories, Englewood Cliffs, Prentice Hall

Course Outcomes:

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

1. Gain the knowledge about the construction and working of CRO, waveform display and phase difference measurement of two signals by CRO.

2. Familiar with the working and applications of dual trace, dual beam oscilloscope, delayed time base oscilloscope, sampling oscilloscope, analog storage and digital storage oscilloscope.

3. Use phase locked loop, voltage to frequency converter and frequency to voltage converter for various applications.

4. Apply the voltage to current converter, current to voltage converter, programmable gain amplifier, and charge amplifier in their relevant field of applications.

5. Understand the working of different types of spectrum analyzers and distortion meters.

6. Acquire the knowledge of electronic ohmmeter, multimeter, signal generators and virtual instrumentation.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: DESIGNING WITH PROCESSORS AND CONTROLLERS					
Paper Code: ECEN3222					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I [8L]:
Designing with microprocessors and microcontrollers- the issues and solutions, Embedded systems VS General computing systems, Purpose of Embedded systems, optimizing design metrics, prominent processor and controller technology, RISC vs CISC.

Module II [10L]:
Devices and Communication Buses: I/O types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols UART RS232/RS85, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth. Different types of I/O devices and interfacing: Keypad, LCD, VGA. Introduction to I/O interfaces: Interrupts, Interrupt hardware, Enabling and disabling interrupts, Concepts of handshaking, Polled I/O, Memory mapped I/O, Priorities, Stack and Queues. Vectored interrupts, Direct memory access, few types of Sensors and actuators.

Module III [10L]:
Memory: SRAM, DRAM, EEPROM, FLASH, CACHE memory organizations, (direct, associative, set associative mapping), Virtual memory, organization, mapping and management techniques, Fundamental issues in Hardware software co-design, Unified Modeling Language (UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system. Introduction to ARM architecture, Processor design, ARM organization and implementation.

Module IV [8L]:
Real Time Operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS. Resource Management/scheduling paradigms: static priorities, static schedules, dynamic scheduling, best effort current best practice in scheduling (e.g. Rate Monotonic vs. static schedules), Real-world issues: blocking, unpredictability, interrupts, caching, Examples of OSs for embedded systems - RT Linux, VRTX, Mobile phones, RFID.

Books:

1. Jack Ganssle, "The Art of Designing Embedded Systems", (Newnes), 1999.
2. David Simon, "An Embedded Software Primer", (Addison Wesley), 2000.
3. RTS: Real-Time Systems, by C.M. Krishna and Kang G. Shin, McGraw-Hill, 1997, ISBN 0-07-057043.
4. J. A. Stankovic and K. Ramamritham, Advances in Hard Real-Time Systems, IEEE Computer Society Press, Washington DC, September 1993, 777 pages.
5. Introduction to Embedded Systems :Shibu K. V. (TMH)
6. Embedded System Design – A unified hardware and software introduction: Frank

Vahid, Tony Givargis, (John Wiley)
7. Embedded Systems :Rajkamal (TMH)
8. Embedded Systems : L. B. Das (Pearson)
9. Embedded System design : S. Heath (Elsevier)
10. Embedded microcontroller and processor design: G. Osborn (Pearson)
11. ARM System-on-Chip Architecture, Steve Furber, (Pearson)

Course Outcomes:

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

1. Understand microprocessors and microcontrollers – their operation and programming.
2. Identify RISC processors from CISC processors and apply them in circuits.
3. Analyse operations of different serial and parallel buses and interrupts.
4. Evaluate different hardware designs and memory configurations.
5. Write RTOS for complex processor-based designs.
6. Design processor and controller based intelligent systems for real life problems.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: ANALOG AND DIGITAL COMMUNICATION					
Paper Code: ECEN3223					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I –[10L]
Introduction-Signal Analysis and Transmission: Overview of communication- base-band transmission, various types of signals, analog signal, digital signal, fundamental limitations in communication system- noise, power and bandwidth. Fourier series and Fourier Transformation representations; Modulation and its need and types; Time domain and frequency domain analysis.

AMPLITUDE MODULATION- Modulation principle and definitions, spectrum and power considerations, DSB, SSB, VSB and AM principles. Different type of modulator circuits.

DEMODULATOR- Basic principle of coherent detections, envelope detectors.

FREQUENCY AND PHASE MODULATION- Principles and definitions, Relationship between frequency and phase modulations. Phase and frequency deviations, Spectrum of FM signal, bandwidth considerations. Effect of modulation index on bandwidth, Narrow band and sideband FM and PM principles, RADIO RECEIVER Basic block diagram of TRF, Superhetrodyne principle,

Module II [10L]
Digital Transmission: Sampling theorem, sampling rate, aliasing and aperture effect; analog pulse modulation -PAM (ideal, natural & flat top sampling), PWM, PPM; basic concept of pulse code modulation, block diagram of PCM; quantizer; non-uniform quantizer, conceptual idea of A-law & μ-law companding; encoding, coding efficiency, source, line coding channel coding & properties, NRZ & RZ, AMI, Manchester coding PCM, DPCM, Delta modulation, adaptive delta modulation (basic concept and applications); baseband pulse transmission, matched filter (its importance and basic concept), error rate due to noise; Nyquist criterion for distortion-less transmission.

Module III [8L]
Digital Modulation Techniques: Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques, Bit rate, baud rate; information capacity generation and detection, digital carrier modulation techniques: ASK, PSK and FSK, DPSK. Concept of QAM and M-ary Communication, M-ary phase shift keying, (QPSK), Generation, detection, Offset Quadrature Phase shift Queuing (OQPSK), Minimum Shift Keying (MSK), Basic Concept of OFDM and Spread Spectrum Modulation.

Module IV [8L]
Multiplexing -TDM, FDM. Multiple Access Techniques and Radio Communication: Multiple access techniques, TDMA, FDMA and CDMA in wireless communication systems, advanced mobile phone system (AMPS), global system for mobile communications (GSM), cellular

concept and frequency reuse, channel assignment and handoff, Bluetooth, introduction to satellite communication.

Text Books:

1. Taub and Schilling , "Principles of Communication Systems", 2nd ed., Mc-Graw Hill
2. B.P.Lathi -Communication Systems- BS Publications
3. V Chandra Sekar – Analog Communication- Oxford University Press

References:

1. Carlson—Communication System, 4/e , Mc-Graw Hill
2. Proakis & Salehi - Fundamentals of Communication Systems- Pearson
3. Singh & Sapre—Communication Systems: 2/e, TMH
4. P K Ghosh- Principles of Electrical Communications- University Press
5. L. W. Couch Ii, "Digital and Analog Communication Systems", 2/e, Macmillan Publishing
6. Blake, Electronic Communication Systems- Cengage Learning
7. S Sharma, Analog Communication Systems- Katson Books

Course Outcomes:

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

1. Understand & apply the concepts of various types of signals, techniques for signal transmission and signal modulation from the knowledge gathered earlier.
2. Identify various parameters associated with amplitude and frequency modulation, time and frequency domain representations, side band frequencies etc., and apply these knowledge to solve numerical problems.
3. Apply sampling theorem to sample analog signal properly and differentiate among pulse modulation & demodulation techniques and understand PCM, DPCM.
4. Analyze performance of various digital modulation & demodulation techniques and understand concept of OFDM and Spread Spectrum Modulation system.
5. Analyze various multiplexing and Multiple access techniques and compare modern multiple access schemes, explain the concept of frequency reuse, channel assignment strategies and make use of wireless communication tools.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: INTRODUCTION TO E-COMMERCE					
Paper Code: INFO3221					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module – I [8]
Electronic Commerce: Overview, Definitions, Advantages & Disadvantages of E – Commerce, Drivers of E – Commerce, Myths, Dot Com Era,E-business. Technologies :Relationship Between E – Commerce & Networking, Different Types of Networking For E – Commerce, Internet, Intranet & Extranet, EDI Systems, Wireless Application Protocol: Defn. Hand Held Devices, Mobility &Commerce, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement For E – Commerce. Electronic Data Interchange (EDI): Meaning, Benefits, Concepts, Application, EDI Model, EDIFACT standard, Internet EDI.

Module – II [10]
Business Models of e – commerce:
Model Based On Transaction Party - B2B, B2C, C2B, C2C, E – Governance, m-commerce. E – strategy: Overview, Strategic Methods for developing E – commerce. B2B E-commerce: Collaborative Commerce Supply Chain Management: E – logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution (SCE), SCE - Framework, effect of different technologies on Supply Chain Mnagement.

Module – III [10]
E – Payment Mechanism: Payment through card system, E – Cheque, E – Cash, E – Payment Threats & Protections. E – Marketing: Home –shopping, E-Marketing, Tele-marketing
Risk of E – Commerce: Overview, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.

Module – IV [8]
Emerging technologies like Virtual/Augmented Reality, Blockchain, Internet of Things, AI and Machine Intelligence – how these technologies are influencing E-commerce.

Text Books:
1. E-commerce Business. Technology. Society by Kenneth C. Laudon, Carol G. Traver, Pearson Education
2. E-Commerce-Strategy, Technologies & Applications by David Whitley, TMH

Reference Book:
1. Electronic Commerce 2010 A Managerial Perspective by Efraim Turban, David King, Jae Lee, Ting-Peng Liang, Deborrah Turban

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Outcomes:

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

1. Understand the basics of E-commerce system.
2. Choose right kind of hardware and software platforms for the e-commerce system they are building.
3. Understand EDI, B2B, B2C, C2C, m-commerce, E-Governance – the varied aspects of E-commerce.
4. Understand the importance of security in E-commerce.
5. Understand E-commerce marketing concepts, dimensions and technologies.
6. Understand how different emerging technologies are reshaping E-commerce.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: WATER AND LIQUID WASTE MANAGEMENT					
Paper Code: CHEN3221					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I [10L]
Introduction to Water Quality and its Storage. Methodology of Water flow measurement. Classification and various Water and Wastewater Standards prevalent in India. Legislative aspects including Water Act. 1974 and its revisions. Consent to Establish and Consent to operate water intensive industries.
Water conservation methodologies in 1) Process industry, 2) Construction industry and 3) Service industry. Rainwater Harvesting and various recharge techniques. Principles of Water Audit.

Module II [10L]
Water pollution: Sources, sampling and classification of water pollutants, determination of basic parameters and computations associated with: BOD, COD, TS, TDS, SS; Waste water treatment: primary, secondary, tertiary and advanced; aerobic treatment with special reference to activated sludge, trickling filter, RBDC and RBRC, EA; non conventional: WSP, anaerobic treatment with special reference to AFFR, UASB, numerical problems associated with all topics sited here.

Module III [10L]
Preliminaries of Water treatment processes, Basic design consideration: Pre-design, Raw water intake, Screening and aeration, Water conveyance, Coagulation, Flocculation and Precipitation, Sedimentation, filtration, colour, taste and odor control, Disinfections and fluoridation, Water quality – Physico Chemical and Bacteriological quality. Water Treatment Plant with design criteria: Slow sand bed and Rapid sand bed filter, layout, Process control, Non conventional water treatment processes and its design, numerical problems associated with all topics sited here.

Module IV [10L]
Liquid Waste Management in selected process industries – fertilizer, refineries and petrochemical units, pulp and paper industries, Tanneries, Sugar industries, Dairy, Alcohol industries, Electroplating and metal finishing industries, Root Zone and Reed Bed Treatment for Effluents of small scale industries, Ranking of wastewater treatment alternatives. Case Studies.

Text Books:

1. Wendell P. Ela, Gilbert M. Masters, Introduction to Environmental Engineering and Science, PHI, Ed 3rd Edition,
2. Metcalf & Eddy, Wastewater Engineering, Tata Mc-Graw Hill – 2002.
3. Arceivala S.J., Wastewater treatment for pollution control, TMH, 2nd Edition.
4. Montogomery, J.M., Water Treatment Principles and Design, John Willey and Sons.

Books of Reference:

1. Mahajan, S.P., Pollution Control in Process Industries, Tata Mc Graw Hill, 2008.
2. Davis M., Cornwell, D, Introduction to Environmental Engineering, Tata Mc Graw Hill, 2012.
3. Standard Methods for Examination of Water and Wastewater, APHA /AWWA, 20th Edition.
4. Manual of Water Supply and Treatment: CPHEEO, Ministry of Urban Development, Govt. of India, 1999.
5. Water Treatment Plant Design, 5th Edition: ASCE and AWWA, 1912.
6. Design of Water treatment Plant - Part I, A G Bhole, Indian Water Works Association.

Course Outcomes:

The objective of this course is to provide approaches of Domestic/ Industrial Water and Liquid Waste Management for interdisciplinary B Tech students.

1. The students will be able to identify the importance of Legislative orders prevalent in India concerning Water and Liquid Waste Management
2. The students will be able to describe the methodology of Establishing and Operating Water and Liquid Waste intensive processes.
3. The students will be able to use the principles of Water Management in order to conserve water and solve water-shortage problems prevalent in India.
4. The students will be able to design the Water Treatment and Wastewater Treatment plants following the standard code of practice.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: INDUSTRIAL SAFETY AND HAZARDS					
Paper Code: CHEN3222					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I [10L]
Definition of safety, Hazard and Risk, Safety program, Engineering ethics, Inherent safety, Safety regulations, OSHA, Process safety management, Hazards due to fire, explosions and toxic chemicals, Distinction between fire and explosion, Upper Flammability limit and Lower Flammability Limit, Fire Triangle, BLEVE, Runaway reaction.

Module II [10L]
Tools for hazards identification: HAZOP, Fault Tree, Event Tree, FMEA, Dow Fire and Explosion Index, Mond Index. .

Module III [10L]
Risk analysis concept and methodology: Risk concept and measure of risk, Risk acceptance criteria, Quantitative risk analysis, Probit number.

Module IV [10L]
Control of chemical plant hazards, Intensification and attenuation of hazardous materials, Industrial plant layout, Ventilation, Fire prevention, Personnel protection devices, Laboratory safety, Emergency safety, Safety systems and disaster management. Case studies, Flixborough (England), Bhopal (India), Seveso (Italy), Pasadona (Texas).

Text Book:
1. Crowl D.A. and . Louvar J.F. Chemical Process Safety: Fundamentals with Applications:, Prentice Hall, 1990.

Books of Reference:
1. Kharbanda O.P.and Stallworthy E. ., Safety in Chemical Process Industries: Heinmann. Professional Publishing LTD.1988.
2. Wentz C.A. Hazardous Waste management: Mc-Graw Hill,
3. Cutter S.L. Environmental Risks & Hazards, Prentice Hall,1994.
4. Trevor A. Kletz, What went wrong? Case Histories of Process Plant Disasters and How They Could Have Been Avoided, 5th, Edition, Butterworth-Heinemann/IChemE.

Course Outcomes:
1. Ability to use important technical fundamentals of chemical process safety and to impart basic knowledge that allows the students to evaluate occupational safety and health hazards in the workplace.
2. Ability to analyze the effects of workplace exposures, injuries and illnesses, fatalities
3. Ability to use safety programs to prevent or mitigate damage or losses and to develop preventative measure to avoid accident.
4. Ability to use logic based quantitative risk analysis.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: COMPUTATIONAL MATHEMATICS					
Course Code: MATH3221					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Module I [9L]:
Sums: Sums and recurrences, manipulation of sums, multiple sums, general methods, finite and infinite calculus, infinite sums

Module II [9L]:
Binomial coefficients and special numbers: Basic identities involving binomial coefficients. Bernoulli numbers, Euler numbers, harmonic numbers, Fibonacci numbers, recurrence relations for these numbers.

Module III [9L]:
Integer functions and arithmetic: Floors and ceilings, the binary operation 'mod', divisibility, primes, relative primality, the congruence relation 'mod', residues, Euler phi function, Fermat's Little Theorem, Wilson Theorem, primitive roots, the law of quadratic reciprocity, (Statement only).

Module IV [9L]:
Generating functions: Basic manoeuvres, well-known sequences and their generating functions, using generating functions to solve recurrences, generating functions for special numbers.

References:

1. Ronald Graham, Donald Knuth, Oren Patashnik, 'Concrete Mathematics', Addison-Wesley
2. Douglas B. West, 'Introduction to Graph Theory', Pearson

Course Outcomes:

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

MATH3221**.1.** Identify patterns in data in the form of recurrences and using the latter to evaluate finite and infinite sums.

MATH3221**.2.** Explain combinatorial phenomena by using binomial coefficients, generating functions and special numbers.

MATH3221**.3.** Solve computational problems by applying number theoretic concepts such as primality, congruences, residues etc.

MATH3221**.4.** Analyze the properties of networks by invoking graph theoretic concepts such as connectivity, matchings, colouring etc.

MATH3221**.5.** Combine the concepts of recurrences, sums, combinatorics, arithmetic and graph theory in order to comprehend computational methods.

MATH3221**.6.** Interpret mathematically the algorithmic features of computational situations.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: ADVANCED PROBABILITY AND INFORMATION THEORY					
Course Code: MATH3222					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

MODULE-I: SINGLE AND BIVARIATE PROBABILITY DISTRIBUTIONS [9L]

- Review of basic probability : Axiomatic definition,Addition and Multiplication law, Conditional probability and Bayes' Theorem
- Expectation and Variance of single variable discrete and continuous distributions
- Covariance and variance of sums of random variables
- Moment generating functions
- Markov's inequality, Chebyshev's inequality and law of large numbers
- Joint distribution using joint probability mass/density function
- Finding marginal pmf/pdf from joint distribution
- Multiplicative property of joint pmf/pdf in case of independent random variables

MODULE-II: MARKOV CHAINS AND STATISTICAL METHODS [9L]

- Markov Chains: Introduction
- Chapman-Kolmogorov equations
- Classification of states
- Some applications: Gambler's Ruin Problem
- Measures of Central tendency: Moments, skewness and Kurtosis
- Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions
- Spearman's Rank Correlation coefficient
- Curve fitting: Straight line and parabolas

MODULE-III: CLASSICAL INFORMATION THEORY-I [9L]

- Motivation with some relevant examples
- Entropy : Definition with examples
- Joint Entropy and Conditional Entropy
- Relative Entropy and Mutual Information
- Relationship Between Entropy and Mutual Information
- Chain Rules for Entropy, Relative Entropy and Mutual Information
- Jensen's Inequality and Its Consequences
- Log Sum Inequality and Its Applications

MODULE-IV: CLASSICAL INFORMATION THEORY-II [9L]

- Data-Processing Inequality

- Sufficient Statistics
- Fano's Inequality
- Asymptotic Equipartition Property Theorem
- Consequences of the Asymptotic Equipartition Property Theorem: Data compression
- High probability sets and the Typical set

Suggested Books:

1. Introduction to Probability Models, *S.M.Ross*, Elsevier
2. Fundamentals of Mathematical Statistics, *S.C.Gupta and V.K.Kapoor*, Sultan Chand and Sons
3. An Introduction to Probability theory and its applications Vol-I, *W. Feller*, John Wiley and Sons
4. Elements of Information Theory, *Thomas M. Cover and Joy A. Thomas*, Wiley
5. Information Theory and Reliable Communication, *Robert G. Gallager*, John Wiley and Sons

Course Outcomes:

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

MATH3222.1: Articulate the axioms (laws) of probability.
MATH3222.2: Compare and contrast different interpretations of probability theory selecting the preferred one in a specific context.
MATH3222.3: Formulate predictive models to tackle situations where deterministic algorithms are intractable.
MATH3222.4: Quantifies the amount of uncertainty involved in the value of a random variable or the outcome of a random process.
MATH3222.5: Apply the data processing inequality to data science, machine learning and social science.
MATH3222.6: Develop the concept of data compression in the process of encoding information in signal processing.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: SCIENTIFIC COMPUTING					
Course Code: MATH3223					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Module I [9L]

***System of Linear Equations*:**

- Linear systems, solving linear systems
- Gauss elimination, pivoting and scaling, Gauss-Jordan method
- Symmetric positive define systems and indefinite systems, Cholesky factorization
- Iterative method: Gauss Jacobi and Gauss Seidel, Error prediction and acceleration

Module II [9L]

***Eigen Value problems*:**

- QR algorithm
- Power Method
- Linear least square data fitting
- Singular Value Decomposition

Module III [9L]

***Interpolation, Integration & Differentiation*:**

- Purpose of interpolation
- Choice of interpolating function, Polynomial interpolation
- Piecewise polynomial interpolation: cubic spline interpolation
- General form of quadrature rule; Newton-Cotes rule, Gaussian quadrature rule
- Numerical Differentiation: Methods Based on Finite Difference approximations

Module IV [9L]

***Initial Value & Boundary Value Problem*:**

- Multistep method to solve Initial Value Problem and its stability
- Predictor-corrector method: Adam Moulton method, Milne's Method
- Solving Boundary Value Problems: Finite Difference Method, Shooting Method

Books:

Text Book:

1. Trefethen L. N. and Bau D. *Numerical Linear Algebra*, SIAM
2. Watkins D. S. *Fundamentals of Matrix Computation*, Wiley

3. Smith G. D. *Numerical Solutions to Partial Differential Equations*, Oxford University Press
4. Jain M. K. and Iyengar S.R.K. *Numerical methods for scientific and engineering computation*
5. Conte S. D. and Boor C. D. *Elementary Numerical Analysis - An Algorithmic Approach*, McGraw Hill
6. Atkinson K. E. *Introduction to Numerical Analysis*,John Wiley

Reference Books:

1. Golub G. H. and Van Loan C.F. *Matrix Computation*, John Hopkins U. Press, Baltimore
2. Stewart G. W. *Introduction to Matrix Computations*, Academic Press
3. Demmel J.W. *Applied numerical linear algebra*, SIAM, Philadelphia
4. Jain M.K. *Numerical Solutions of Differential Equations*
5. Smith, *Numerical solutions of partial Differential Equations (Finite difference methods)*
6. Heath M. T., *Scientific Computing: An Introductory Survey*, McGraw Hill
7. Joe D. Hoffman, *Numerical Methods for Engineers and Scientists*, McGraw Hill
8. W. Layton and M. Sussman, *Numerical Linear Algebra.*

Course Outcomes:

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

MATH3223.1: Analyze certain algorithms, numerical techniques and iterative methods that are used for solving system of linear equations.
MATH3223.2: Implement appropriate numerical methods for solving advanced engineering problems dealing with interpolation, integration and differentiation.
MATH3223.3: Apply the knowledge of matrices for calculating eigenvalues and eigenvectors and their stability for reducing problems involving Science and Engineering
MATH3223.4: Develop an understanding to reduce a matrix to its constituent parts in order to make certain subsequent calculations simpler.
MATH3223.5: Develop the concept of predictor-corrector methods in solving Initial Value Problems numerically.
MATH3223.6: Apply numerical techniques in solving Boundary Value Problems where the analytical methods fail.