Department of Applied Electronics & Instrumentation Engineering

SYLLABUS FOR B.TECH. PROGRAMME

(Applicable for 2019, 2020, 2021, 2022 admitted batches)

Release date: July, 2018: Ver.1.0
July, 2019: Ver.1.1
July, 2020: Ver.1.2
July, 2021: Ver.1.3
May, 2023: Ver.1.4

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** (Applicable for 2019, 2020, 2021, 2022 admitted batches)	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**

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

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** (Applicable for 2019, 2020, 2021 admitted batches)	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
Department of Applied Electronics & Instrumentation Engineering

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** (Applicable for 2019, 2020, 2021 admitted batches)	AEIE2111	Material Science and Technology	4	0	0	4	4
			Total of Semester with Honours Course	**21**	**2**	**13**	**28**	**24.5**

Heritage Institute of Technology

Department of Applied Electronics & Instrumentation Engineering

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**

Heritage Institute of Technology

Department of Applied Electronics & Instrumentation Engineering

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** (Applicable for 2019, 2020 admitted batches)	AEIE3111	Introduction to Mechatronics	4	0	0	4	4
			Total of Semester with Honours Course	**21**	**0**	**7**	**28**	**24.5**

Heritage Institute of Technology

Department of Applied Electronics & Instrumentation Engineering

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	EmergingArea/Open Elective Courses- I		OE-01	3	0	0	3	3
6	MandatoryCourses	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
			Total Laboratory	**0**	**0**	**5**	**5**	**2.5**

Sessional

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Core Subject Courses	AEIE3295	Mini Project/Electronic Design Workshop	0	0	4	4	2
2	Seminar	AEIE3293	Term Paper and Seminar	0	0	4	4	2
			Total Sessional	**0**	**0**	**8**	**8**	**4**
			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
		INFO3221	Introduction to E-Commerce
		CHEN3221	Water and Liquid Waste Management
		MATH3222	Advanced Probability and Information Theory

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

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

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 (Applicable for 2019, 2020, 2021admitted batches)	AEIE4131/ AEIE4132/ AEIE4133	Analytical Instrumentation/ Soft Computing/ Non Destructive Testing	3	0	0	3	3
	Program Electives Courses – III (Applicable for 2022 admitted batches)	AEIE4131/ AEIE4132/ AEIE4133/ AEIE4134	Analytical Instrumentation/ Soft Computing/ Non Destructive Testing Material Science and Technology					
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**

Sessional

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 Sessional	**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 (Applicable for 2019 admitted batches)	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	BIOT4124	Biosensor
		CSEN4121	Fundamentals of Operating Systems
		INFO4121	Fundamentals of Cloud Computing
		ECEN4121	Software Defined Radio
		ECEN4123	Error Control Coding for Secure Data Transmission
Open Electives III	VII	CHEN4126	Industrial Total Quality Management
		CSEN4126	Intelligent Web and Big Data
		ECEN4127	Ad Hoc Wireless Networks
		MATH4126	Linear Algebra
		MECH4130	Ecology & Environmental Engineering

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

Heritage Institute of Technology

Department of Applied Electronics & Instrumentation Engineering

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 Techniques/ Machine Learning Techniques	3	0	0	3	3
2	Program Electives Courses-V (Applicable for 2019 admitted batches)	AEIE4241/ AEIE4242/ AEIE4243	Biomedical Instrumentation/ Digital Image Processing/ Principles of Robotics	3	0	0	3	3
	Program Electives Courses-V (Applicable for 2020, 2021 & 2022 admitted batches)	AEIE4241/ AEIE4242/ AEIE4243/ AEIE4244	Biomedical Instrumentation/ Digital Image Processing/ Principles of Robotics/ Introduction to MEMS					
3	Open Electives Courses–IV		OE-04	3	0	0	3	3
			Total Theory	**9**	**0**	**0**	**9**	**9**

Sessional

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 II	AEIE4295	Project II	0	0	16	16	8
			Total Sessional	**0**	**0**	**16**	**16**	**9**
			Total of Semester	**9**	**0**	**16**	**25**	**18**

Honours

Sl. No	Category	Code	Course Title	Contact hrs/wk				Credit Points
				L	T	P	Total	
1	Honours (Applicable for lateral students admitted in 2019)	HMTS 4011*	Disaster Response Services and Technologies	4	0	0	4	4

Open Electives basket IV for AEIE B. Tech students:

Open Electives	Semester	Paper Code	Paper Name
Open Electives IV	VIII	ECEN4222	Cellular and Mobile communication
		INFO4221	Fundamentals of Cryptography
		CHEN4222	Introduction to Solar and Wind Technology
		BIOT4221	Computational Biology
		BIOT4223	Biology for Engineers
		CSEN4221	Basics of Mobile Computing

Open Electives to be offered by Dept. of AEIE:

Heritage Institute of Technology

Department of Applied Electronics & Instrumentation Engineering

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

Honours Papers:

Sl. No.	Semester	Paper Code	Paper Name	Contact hrs/wk				Credit Points
				L	T	P	Total	
01	1st	HMTS1011	Communication for Professionals	3	0	0	3	3
		HMTS1061	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
08	8th	HMTS 4011*	Disaster Response Services and Technologies	4	0	0	4	4
Total			**For Regular Students**	18	0	4	22	**20**
			For Lateral Entry Students	16	0	0	16	**16**

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 for a regular students and 16 credits for a lateral entry students. These could be acquired through various Honours Courses offered by the respective departments.
- A part or all of the above additional credits should 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.

*** N.B. : HMTS4011 honours course is for the lateral entry students only.**

Heritage Institute of Technology

Department of Applied Electronics & Instrumentation Engineering

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 **&** 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	1			
AEIE2111	Material Science & Technology	4	Introduction to Materials Science and Engineering	IIT Delhi IIT Madras	NPTEL NPTEL
AEIE3111	Introduction to Mechatronics	4	Mechatronics and Manufacturing	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, (7^{th} Edition)
3. Organic Chemistry, Morrison & Boyd , (7^{th} Edition)
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, (4^{th} Edition)
5. Physical Chemistry, G. W. Castellan, (3^{rd} Edition)
6. Basic Stereo chemistry of Organic Molecules, Subrata Sen Gupta, (1^{st} 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 as follows:

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.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

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
Department of Applied Electronics & Instrumentation Engineering

Course Name: BASIC ELECTRICAL ENGINEERING					
Course Code: ELEC1001					
Contact	L	T	P	Total	Credit Points
Hours per week	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 KMnO4 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 to:

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 D imension), 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:

After successfully completing this course, the 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 maneuvers.

Non-intertial 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, polaroids and application of polarizations: Polarimeter

Laser & Fibre 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.

Fibre optics - principle of operation, numerical aperture, acceptance angle, Single mode, graded indexed fibre.

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: **Magnetostatics and Electromagnetic Induction: (6+3+3) = 12L**
Biot-Savart law, divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stoke's theorem; the equation for the 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 condition on $\vec{B}$ and $\vec{H}$. Solving for magnetic field due to simple magnet like a bar magnet; Magnetic susceptibility and 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 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. Understand and apply Vector Calculus as tool for solving different physical problems.
2. Analyze the nature of central forces and rotating frame phenomenon to understand basic space science and real world applications.
3. Interpret the different types of oscillatory motion and resonance.
4. Apply fundamental theories and technical aspect in the field of electricity and magnetism in solving real world problems in that domain.
5. Understand the Electrical and Magnetic properties of different types of materials for scientific and technological use.
6. Develop Analytical & Logical skill in handling problems in technology related domain.

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 per week	L	T	P	Total	Credit Points
	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. and Martin,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, series solution when $x = a$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, Brown Churchill, McGrawHill
2. Complex Variable, Murrey R. Spiegel, Schaum's Outline Series
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. Mathematical Methods, Potter, Merle C., Goldberg, Jack. PHI Learning
7. Ordinary and Partial Differential Equations, M. D. Raisinghania, S. Chand
8. Elements of Partial Differential Equation, Ian Naismith Sneddon, Dover Publications
9. Advanced Engineering Mathematics, Kreyszig, Willey
10. Higher Engineering Mathematics, B. V. Ramana, Tata McGraw-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. Choose appropriate circuit laws and analysis tools to analyze the dc and ac networks.
3. Create dc and ac circuit equations using network theorems.
4. Analyze the transient and steady state responses of dc circuits.
5. Analyze two-port networks with series, parallel, cascade connections and evaluate port parameters and conditions.
6. Design and analyze LP, HP, BP, BS passive and active filters.

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's theory (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 1^{st} & 2^{nd} 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 2^{nd} order system by appling different inputs
iv. Frequency response of 2^{nd} 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. List the properties and describe the structure of engineering materials.
2. Analyze defects in materials and their effect on engineering properties as well as limit their use in service.
3. Use phase diagrams to predict microstructures and also to understand precipitation hardening.
4. Determine the role of fracture mechanism on material life and performance.
5. Explain the processing of engineering materials.
6. Choose suitable material in product manufacturing and system design considering engineering, economic, environmental and societal aspect.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Data Structure and Basic Algorithms					
Course Code: CSEN2004					
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.

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

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.

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. Define and understand the static and dynamic characteristics of measuring instruments.
2. Compare among the operation of measuring instruments and choose the suitable one for measurement of electrical quantities.
3. Apply appropriate method/instrument for measurement of resistance, capacitance, inductance and quality factor of coil & capacitor.
4. Recognize suitable electronic instrument for measurement of voltage, current, frequency/phase.
5. Explain the construction and working principle of cathode ray tube, oscilloscope time base, CRO probes & dual trace oscilloscope and describe their applications.
6. Analyze the working principles of digital voltmeters, digital frequency meter and digital display units.

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 Algorithm Lab					
Course Code: CSEN2054					
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 with diaphragm, capsule, bellow, Bourdon tube, orifice plate, pitot tube, venture meter, control valve, control valve positioner, pneumatic relay, etc.
2. Study the characteristics of Flapper Nozzle system used in pneumatic instruments.
3. Calibration of pressure gauge and pressure transmitter using Dead Weight Tester with interfacing facility to LabVIEW software.
4. Case study of a real time industrial weighing system with automation built in LabVIEW software.
5. Study the characteristics of thermocouple and RTD.
6. Measurement of liquid flow through orifice meter/Venturi meter using manometer differential head, and comparison of the same with the reading of flow transmitter interfaced to the software.
7. Measurement of liquid flow rate using Rotameter, and comparison of the same the reading of flow transmitter interfaced to the LabVIEW software.
8. Measurement of liquid level using float type sensor and ultrasonic sensor.
9. Moisture measurement using moisture analyzer.
10. Data logging of different process signals using data acquisition card in LabVIEW software.
11. Calibration of Transmitters used for process parameter (Flow/level/ temperature/ pressure/ displacement) measurement in LabVIEW software.

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

1. Select proper sensing elements for the measurement of physical parameters like pressure, flow, level, temperature etc.
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. Understand characteristics of Flapper –Nozzle system.
5. Calculate load flow rate in conveyor belt using industrial weighing system.
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. Study of voltage to current and current to voltage converter circuits.
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 voltage to current and current to voltage converter circuits.
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 1st and 2nd 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 – [8L]

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 modulations, angle modulation, phase modulation, frequency modulation, narrowband FM, generation of FM, detection of FM, Phased locked Loop, frequency division multiplexing technique.

Module II – [8L]

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, 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 – [8L]

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. Interpret analog modulation and demodulation techniques and apply them in analog communication systems.
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. Analyze the performance of pulse modulation and coding techniques.

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.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

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.

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
Department of Applied Electronics & Instrumentation Engineering

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. Familiar 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 familiar 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. Analyze 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. Analyze 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: 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

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.

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, Nonconventional 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

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.

Department of Applied Electronics & Instrumentation Engineering

B.TECH in AEIE

Syllabus for 4th Year Courses

Detailed Syllabus of 4th Year 1st Semester Courses

Course Name: Principles of Management					
Course Code: HMTS4101					
Contact hrs per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Module I:
Introduction - [8L]
Management: Definition, nature, purpose and scope of management
Skills and roles of a Manager, functions, principles;
Evolution of Management Thought: Taylor Scientific Management, Behavioural Management, Administrative Management, Fayol's Principles of Management, Hawthorne Studies.
Types of Business organization -Sole proprietorship, partnership, company-public and private sector enterprises -Organization culture and Environment –Current trends and issues in Management.

Module II – [8L]
Planning: Types of plans, planning process, Characteristics of planning, Traditional objective setting, Strategic Management, premising and forecasting.
Organizing: Nature and Purpose-Formal and informal, organizational chart, organization structure-types-line and staff authority, departmentalization, delegation of authority, centralization and decentralization.
Controlling: Concept, planning-control relationship, process of control, Types of Control, Control Techniques
Human Resource Management-HR Planning, Recruitment, Selection, Training and Development, Performance Management, Career planning and management

Module III – [8L]
Directing: Foundations of individual and group behavior –motivation –motivation theories – motivational-Techniques –job satisfaction –job enrichment –leadership –types and theories of Leadership –Communication –process of communication –barrier in communication – effective communication –communication and IT
Decision-Making: Process, Simon's model of decision making, creative problem solving, group decision-making.
Coordinating: Concepts, issues and techniques.

Module IV - [8L]

Leading: Managing Communication: Nature & function of communication, methods of interpersonal communication, barriers of effective communication, direction of communication flow, role of technology in managerial communication

Motivating Employees: Define motivation, compare and contrast early theories of motivation, compare and contrast contemporary theories of motivation & current issues.
Being an Effective Leader Define leader/ leadership, compare and contrast early theories of leadership, understand three contingency theories, understand modern views on leadership. Motivation, Leadership, Communication, Teams and Teamwork.
Management by Objectives (MBO): Management by exception; Styles of management: (American, Japanese and Indian), McKinsey's 7-S Approach, Self-Management

Reference Books:

1. Stephen P. Robbins and Mary Coulter, "Management", Pearson Education, 2017, 13th edition
2. Koontz H. and Weihrich H., "Essentials of Management", Mcgraw Hill Int. Ed., 2015,10th edition
3. Bhat Aand Kumar A. "Management: Principles, Processes & Practices", Oxford University Press, 2016, 2ndedition
4. Robbins, Coulter, and DeCenzo, "Fundamentals of Management", Pearson Education, 2016, 9th edition
5. RichardL.Daft, "Management", Cengage Learning, 10thedition

Course Outcome:

Upon completion of the course, students will be able

1. To study the evolution of Management.
2. To understand various management functions and have some basic knowledge on different aspects of management.
3. To understand the planning process in an organization.
4. To understand the concept of organizational structure.
5. To demonstrate the ability to direct, lead and communicate effectively.
6. To analyze and isolate issues and formulate best control methods.

Course Name: Analytical Instrumentation					
Course Code: AEIE4131					
Contact hrs per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Module I – [8L]

Introduction to analytical instrumentation: classification, types of instrumental methods.
Gas analysis: thermal conductivity method, heat of reaction method.
Flue gas analyzers: Oxygen analysis- magneto dynamic instrument (Pauling cell), thermo magnetic type or hot wire type instrument, zirconia oxygen analyzer, NOx, Cox, SO_X analyzer.

Module II - [8L]

Liquid analysis: electrodes-ion selective, molecular selective types- their variations.
pH analysis: pH electrodes, circuit for pH measurement and applications; conductivity cells, TDS analyzer: standards, circuits and applications; voltametry and polarography: apparatus, circuits and techniques, applications.

Module III - [10L]

Spectrophotometry:
Electromagnetic radiation, Beer-Lambert law, colorimeters, UV-Visible spectrophotometers: single and double beam instruments, sources and detectors. IR spectrophotometers: types, FTIR spectrophotometers, flame photometer. Atomic spectrophotometers: absorption/emission type, sources, detectors applications; fluorescence spectrophotometer; X-ray diffractometer: working principle and applications; NMR: working principle and applications. Mass spectrometer: working principle and applications.

Module IV - [10L]

Separation methods: chromatography theory, instrumentation, gas chromatography (GC): basic parts, columns, temperature programming, detectors, techniques; liquid chromatography (LC): types, sources, detectors; high-pressure liquid chromatography (HPLC): sample injection system, column, detectors, applications; electrophoresis: theory, principle, instrumentation of horizontal and vertical electrophoresis; ion trap mass spectrometer; concept of scanning electron microscope (SEM).

References:

1. Principles of Instrumental Analysis- Skoog, Holler, Nieman, Publisher: Thomson Brooks/Cole

2. Handbook of Analytical Instruments- R.S. Khandpur, Publisher: Tata McGraw Hill
3. G.W. Ewing, 'Instrumental Methods of Analysis', McGraw Hill, 1992.
4. Introduction to Instrumental Analysis-Robert D. Braun, Publisher: Pharma Book Syndicate.

Course Outcomes:

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

1. Gain knowledge about gas analyzers.
2. Apply the liquid analysis techniques for analyzing liquids.
3. Acquire knowledge of UV, IR, X-ray and atomic mass spectroscopy.
4. Learn different chromatographic separation method used in industry and research purpose.
5. Select instrument for a particular analysis with some idea of its merits, demerits and limitations.
6. Learn operation of analytical tools that are used in hospitals for clinical analysis, drugs and pharmaceutical laboratories and above all for environmental pollution monitoring.

Subject Name: Soft Computing					
Paper Code: AEIE4132					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [9L]

Introduction to soft computing: fuzzy computing, neural computing, genetic algorithm and stochastic algorithm; introduction to different hybrid systems: fuzzy-conventional, neuro-fuzzy, neuro-genetic, genetic-fuzzy systems.

Introduction to fuzzy logic: benefits and application scope of fuzzy logic, distinguish fuzzy set and crisp set, fuzzy set theory, fuzzy set operations, membership functions, alpha-cuts, properties and operations of fuzzy relations.

Module II - [8L]

Fuzzy systems: different fuzzy implications, compositional rule of inference, normalization and de-normalization, fuzzification, fuzzy rule-base and approximate reasoning, defuzzification procedures, steps to design fuzzy PI/PD controllers.

Module III - [10L]

Neural network: biological neuron and evolution of neural network**,** model of artificial neuron, architectures, single-layer neural network, McCulloch-Pitts neural network, Hebb network; supervised, unsupervised and reinforce learning concepts, multilayer neural network, back propagation neural network, radial basis function network, introduction to deep learning.

Module IV - [9L]

Genetic algorithm: introduction, biological background, operators of genetic algorithm, simple genetic algorithm, stopping condition for genetic algorithm flow.
Hybrid soft computing techniques: neuro-fuzzy hybrid systems, genetic neuro hybrid system, genetic fuzzy and fuzzy genetic hybrid systems.

References:

1. J. S. R. Jang, C. T. Sun and E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI, 2004, Pearson Education 2004.
2. Dirankov, Hellendoorn and Reinfrank, *An Introduction to Fuzzy Control*, Narosa Publishing House.
3. Davis E. Goldberg, *Genetic Algorithms: Search, Optimization and Machine Learning*,Addison Wesley, N.Y., 1989.
4. S. Rajasekaran and G. A. Vijaylakshmi Pai, *Neural Networks Fuzzy Logic, and Genetic Algorithms*, Prentice Hall of India.

5. J. Yen and R. Langari, *Fuzzy Logic, Intelligence, Control and Information*, Pearson Education.
6. S. Haykin, *Neural Netowrks*, Prentice Hall of India.

Course Outcomes:

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

1. Classify the soft-computing into the different computing methods based on their application, knowledge-base, mode of operation, construction, etc.
2. Explain the functions and properties of different fuzzy sets and compare with crisp set, explain different fuzzy relations and implications.
3. Design and analyze the different components of fuzzy controller appropriately to develop the best possible fuzzy controller that can be applied to any process control systems.
4. Identify different component of biological and artificial neural network, and acquire knowledge of different ANN terminologies to apply in solving control problems.
5. Analyze and design algorithms for different supervised and unsupervised learning networks.
6. Illustrate the biological background and give idea about the basics of genetic algorithm and its application in optimizing system parameters.

Subject Name: Non-Destructive Testing					
Paper Code: AEIE4133					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [8L]

Introduction to NDT, NDT versus Mechanical testing, Overview of the Non Destructive Testing methods for the detection of manufacturing defects as well as material characterization, Relative merits and limitations, Classification of various sensors for NDT.

Module II - [10L]

Liquid Penetrant Testing – principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, testing procedure, interpretation of results, Magnetic particle testing- basic theory of magnetism, magnetization methods, field indicators, particle application, inspection.

Module III - [10L]

Eddy Current Testing - generation of eddy currents, properties of eddy currents, eddy current sensing elements, probes, instrumentation, types of arrangement, advantages, limitations, interpretation/evaluation;

Electrical resistivity; Ultrasonic-longitudinal and shear wave methods, acoustic emission methods, Case studies: pipeline leakage testing.

Module IV - [8L]

X-rays - refraction/diffraction and fluorescence, Gamma rays – radiography, IQI (image quality indicator), Xerography, Image intensification methods, Electron microscopic techniques, ISO specifications and certifications, Case studies: sonar, radar.

Books: -

1. Krantkramer - Ultrasonic Testing of materials, Springer 2005
2. Handbook of Nondestructive Testing, Mc Graw Hill, 1998
3. U. Schnars, W. Jeuptner - Digital Holograpy, Springer, 2005
4. W. J. Price – Nuclear radiation Detection, Mc Graw Hill, New York, 1958
5. B. Raj, T.Jayakumar, M.Thavasimuthu -Practical Non-Destructive Testing, Narosa Publishing House, 2014.

Course Outcomes:

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

1. Understand the fundamental concepts of NDT and differentiate NDT and mechanical testing.
2. Discuss the different methods of NDE, their applications, merits and demerits.
3. Explain the principle and testing procedure of Liquid Penetrant testing and Magnetic particle testing.
4. Realize the concept of and Eddy current testing and its application in NDT.
5. Explain the concept of Ultrasonic testing and Acoustic emission methods.
6. Demonstrate the concept of Radiography and Electron microscopic techniques.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Material Science and Technology					
Course Code: AEIE4134					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

(*Applicable for 2022 admitted batch*)

Module I: [11L]

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

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.

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

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

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

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

Module II: [9L]

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

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.

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

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.

Module III: [8L]

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.

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.

Module IV: [8L]

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

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

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

Particle reinforced composites, fiber reinforced composites, structural composites.

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

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

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. List the properties and describe the structure of engineering materials.
2. Analyze defects in materials and their effect on engineering properties as well as limit their usein service.
3. Use phase diagrams to predict microstructures and also to understand precipitation hardening.
4. Determine the role of fracture mechanism on material life and performance.
5. Explain the processing of engineering materials.
6. Choose suitable material in product manufacturing and system design considering engineering,economic, environmental and societal aspect.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name : Biosensor					
Course Code: BIOT4124					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I: Introduction to biological system and Biosensors [10L]
Biosensor: principle, general characteristics; Proteins and enzymes: basic properties, denaturation and renaturation, immbobilization of enzymes; Advantages and limitations of biosensors; Classification of biosensors based on bioreceptor; Immobilization and coupling of bioreceptors.

Module II: Bio-recognition based sensors [10L]
Principle, operation and limitation of: Microbial sensor, Immunological sensor, Nucleic acid sensor. Other bioreceptors (e.g. animal, plant tissue); Different types of inhibitors: principles, operations, applications and limitations.

Module III: Biosensor based on transducer [10L]
Classification of biosensor based on transducer; Calorimetric, Electrochemical (potentiometric, amperometric), Optical, Piezoelectric, Semiconductor biosensor: principle, construction, calibration and limitations.

Module IV: Application of biosensor [10L]
Clinical and diagnostics sector, Industrial sector: Food, Environmental, defense sector; Commercially available biosensor.

Reference books:

1. Biosensors by Tran Minh Canh. London. Chapman and Hall, 1993.
2. Biosensors Fundamentals and applications, Turner, A.P.F, Karube.I.,and Wilson, G.S, Oxford Univ. Press.
3. Engineering Biosensors, kinetics and design applications by Ajit Sadana..San Diego, Academic Press, 2002.
4. D.Thomas and J.M. Laval – Enzyme Technology in concepts in Biotechnology by Balasubramaniam et al, Univ. Press, 1996.

Course Outcomes:
At the end of this course students will be able to
1. State types of bio-recognition elements and describe the fundamental components required to make a viable biosensor.
2. Illustrate types of enzyme immobilization methods used to make a biosensor and immobilize it to a transducer for the construction of biosensor.
3. Describe each types of biosensing element in relation to their uses in biosensors.
4. Understand the classification, construction and working principle of various transducers.

5. Understand the concepts, types, working principles and practical applications of important biosensors.
6. Explain the working principle of different types of inhibition based biosensors.

Course Title : Fundamentals of Operating Systems					
Course Code : CSEN 4121					
Contact hours per week :	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module I: [8L]

- **Introduction of General Operating System [5L]**

  Introduction: What do OS do? Computer System Organization, Interrupt Driven System, Storage Structure, I/O Structure**,** Operating System Functions, OS Services, Dual Mode Operations ,Kernel, System Calls, Types of System Calls

- **Types of Operating Systems [3L]**

  Computer System Architecture (Monolithic, Microkernel, Layered, Hybrid), Different types of O.S.(Batch, Multi-programmed, Time-sharing, Real-time, Distributed, Parallel, for Mobile Unit, Single Processor System, Multiprocessor Systems)
  Virtual Machines, System Boot

Module II: [10L]

- **Process Concept [3L]**

  What is process, Operations on Process (Process States), Process Control Block, Process Scheduling, Scheduling Queues,

- **Cooperating Process [2L]**

  Co-operating Processes, Inter-process Communication. IPC,
  Examples in IPC, Communication in Client-Server Systems

- **Threads [2L]**

  Threads, Benefits of Threads, User and Kernel Threads.

- **CPU Scheduling [3]** Scheduling Criteria, Pre-emptive & Non-pre-emptive Scheduling, Scheduling Algorithms (FCFS, SJF, RR, priority).

.

Module III [11L]

- **Process Synchronization [7L]**

  Critical Section Problem, Critical Region, Synchronization Hardware.
  Petersons Solution, Classical Problems of Synchronization,
  Semaphores, Monitors, Synchronization examples, Atomic Transactions.

- **Deadlock[4L]**

Deadlocks: System model, Deadlock characterization, Method of handling Deadlock, Deadlock Prevention, Avoidance, Detection, Recovery from deadlock

Module IV [11L]

- **Memory Management Strategies[7]**
  Contiguous Memory Allocation, Paging, Structure of Page Table, Segmentation, Demand Paging, Copy-on-Write, Swapping, Page Replacement, Allocation of Frames, Thrashing, Memory Mapped Files, Allocating Kernel Memory, Operating System examples

- **File Management [4]**

  File System: File Concept, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection

Text Books:

1. A. Silberschatz, P B Galvin, G Gagne, Operating systems, 9th edition/10th edition, John Wiley and sons.

Reference Books:

1. William Stalling, "Operating Systems: Internals and Design Principles", Pearson Education, 1st Edition, 2018.
2. Andrew S Tanenbaum, Herbert BOS, "Modern Operating Systems", Pearson Education, 4th Edition, 2016.

Course Outcome:

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

1. Apply knowledge of mathematics, science and engineering in the areas of process management, memory management and storage management.
2. Understand the underlying technologies and features of memory management and storage management.
3. Understand the various design issues in process management.
4. Learn operating system operation, structures.
5. Be familiar with various types of operating systems.
6. Identify the concepts learned here which are used in their own field of work.

Course Name: Fundamentals of Cloud Computing					
Course Code: INFO4121					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module-I: [7L]

Overview of Computing Paradigm: Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing

Introduction to Cloud Computing: Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Properties, Characteristics, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing

Module-II: [11L]

Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services
Service Models (XaaS): Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS)
Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud
Infrastructure as a Service (IaaS): Introduction to IaaS, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine (VM)
Resource Virtualization: Server, Storage, Network, Virtual Machine (resource) provisioning and manageability, storage as a service, Data storage in cloud computing (storage as a service)
Examples: Amazon EC2, Renting, EC2 Compute Unit, Platform and Storage, pricing, customers

Module-III:[11L]

Platform as a Service (PaaS): Introduction to PaaS, Service Oriented Architecture (SOA)
Cloud Platform and Management: Computation, Storage
Examples: Google App Engine, Microsoft Azure
Software as a Service (SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS

Module-IV: [12L]

Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously,

Managing Data: Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing
Cloud Security: Infrastructure Security, Network level security, Host level security, Application level security, Data security and Storage, Data privacy and security Issues, Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations

Reference Books

1. *Cloud Computing Bible*, Barrie Sosinsky, *Wiley-India*, 2010

2. *Cloud Computing: Principles and Paradigms, Editors:* Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, *Wile, 2011*

3. *Cloud Computing: Principles, Systems and Applications, Editors:* Nikos Antonopoulos, Lee Gillam, *Springer*, 2012

4. *Cloud Security: A Comprehensive Guide to Secure Cloud Computing*, Ronald L. Krutz, Russell Dean Vines, *Wiley-India*, 2010

Course Outcomes:

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

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing
2. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
3. Explain the core issues of cloud computing such as security, privacy, and interoperability.
4. Discuss system, network and storage virtualization and outline their role in enabling the cloud computing system model.
5. Explain AWS, Google App Engine, and Microsoft Azure.
6. Understand different web services techniques to provide SaaS.

Course Title: Software Defined Radio					
Course Code : ECEN4121					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Module – I [10 L]

Introduction to SDR, Brief history of development of SDR, RF architectures applied in SDR, Processing architectures suitable for SDR, Software environment for SDR. SDR-benefits, problems, GNU radio design.

Module – II [12 L]

Signals and Systems in relation to SDR, Probability in Communications- the effects on reliability, Understanding SDR hardware, Timing and Carrier synchronization, Frame synchronization, Channel coding.

Receive techniques for SDR, Transmit Power, Bandwidth, Spectral Efficiency, Interference.

Module – III [8 L]

OFDM, introduction and implementation of the general model, Channel estimation, Equalization, Power allocation techniques for bits.

Module – IV [6 L]

SDR – some applications, future directions.

SDR-3000 series Software Defined Radio Transceiver Systems

Smart Antenna API for SDR

Networking and SDR- some case histories, Vehicular networking.

Text Books:

1) Software Defined Radio for Engineers , T.Collins, Robin Getz, Di Pu, and Alexander M. Wyglinski, Artech House, 2015.
2) Cognitive Radio Techniques : Spectrum Sensing, Interference Mitigation and Localization-Sithamparanathan, Kandeepan; Giorgetti, Andrea, Artech House, 2012

Reference Books:

1) Cognitive Radio Technology, Bates, Martin; Fettee, Bruce A, Elsevier Science & Technology
2) Software Defined Radios : From Smart(er) to Cognitive, Liesbet Van Der Perre, Michael Timmers and SofiePollin, Springer

Course Outcomes:

The students after studying this course will be able to:

1. Understand the technological differences between families of radios.
2. Explain the function of reconfigurable hardware.
3. Analyze the processing techniques required for software defined radio.
4. Evaluate the effects of probability in communication reliability.
5. Analyze the synchronization requirements in SDR and SDR based networks.
6. Analyze functioning of different families of radios.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name : Error Control Coding for Secure Data Transmission					
Course Code : ECEN 4123					
Contact	**L**	**T**	**P**	**Total**	**Credit Points**
Hours per week	**3**	**0**	**0**	**3**	**3**

Module 1 [10L]

Information theory : Uncertainty and information, measure of information, Self and conditional Information, mutual information and entropy, Fixed length code, Variable length code, Prefix code, Instantaneous code, Kraft Inequality.

Source Code: Source coding theorem, Huffman codes, Shanon- Fano coding, Arithmetic code, Lempel-Ziv algorithm.

Channels: Discrete memory less channel, Channel matrix for different channel models- Lossless channel, Deterministic channel, Noise-less channel, Deterministic channel capacity, channel coding, information capacity theorem, The Shannon limit.

Module 2 [7L]

Block code: Hamming codes Minimum distance, Error detecting and Error-correcting capabilities of block code.

Linear Block Code: Definition & properties of linear block codes, Generator and parity check matrices, Encoding of a linear block code, Decoding of a linear block code, Syndrome and error detection, Minimum distance considerations, Error detecting and error correcting capabilities.

Module 3 [10L]

Cyclic Code: Definition & properties of cyclic codes, Code Polynomials, Generator Polynomials, Division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Syndrome computing and error detection, Decoding of cyclic codes.

Galois Field: Introduction to Linear Algebra: Groups, Fields, binary field arithmetic, Introduction to Galois Field, Primitive elements, generator polynomials in terms of minimal polynomials, Calculation of minimal polynomial.

BCH Code: Concept of BCH Codes, Encoding and Decoding, Reed Solomon Codes.

Module4 [8L]

Convolution code: Polynomial description of convolution codes, Distance notions for convolution codes and the generating function. Encoding of convolution codes: Systematic and Non-systematic convolution Codes. Decoding of convolution codes: Viterbi decoder, distance and performance bounds for convolution codes. Structural properties of convolution codes: state diagram, state table, state transition table, tree diagram, and trellis diagram.

Text Books:

1. Introduction to Error Control Codes - S Gravano; Oxford Press.
2. Information theory, coding and cryptography - Ranjan Bose; TMH.
3. Information and Coding - N Abramson; McGraw Hill.

References:

1. Introduction to Information Theory - M Mansurpur; McGraw Hill.
2. Information Theory - R B Ash; Prentice Hall.
3. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

Course outcomes:

After completing the course the student will be able to:

1. Find the equations for entropy, mutual information and channel capacity for all types of channels, utilizing their knowledge on the elements.
2. Analyse a discrete memory less channel, given the source and transition probabilities.
3. Demonstrate encoder and decoders for Linear Block Codes, Cyclic codes, etc.
4. Apply the concept of modern linear algebra for the error control coding technique.
5. Select decoding algorithms for efficient decoding of Block codes and Convolution codes.
6. Develop overall understanding about different types of codes applied to both source and channel end during data transmission.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Industrial Total Quality Management					
Course Code: CHEN 4126					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	0	0	0	3

Pre-Requisites: Mathematics I, Mathematics II

Module I: 10L
Basic concepts– Three paradigms of management and evolution of concept of quality management, Organization: its basic objectives and goal, Mission and Vision, customer and secondary customer, Deming's wheel, bottom line: profit vs quality, historical developments with contribution of different scientists Basic statistical concepts associated with quality management, measurement of central tendency and dispersion, range versus variance, Random variables and expected value calculations, quality and process capability, probability distributions, concept of statistical quality control.

Module II : 10L
Tools and techniques for improvement in TQM: type A and type B techniques with a special reference to SWOT Analysis, brainstorming, stratification, Pareto Analysis, Ischikawa diagram, check sheet.
Use of control charts and process engineering techniques for implementing the quality plan: X—R chart, moving average chart, p-chart and c-chart.

Module III: 10L
Principles of Acceptance sampling: single–double and multiple sampling, AOQ, AQL, LTPD, Chain sampling plan, Dodge-Romig plan

Philosophy and concept of quality circle: formation, steering committee, power and functions of leader, dy. Leader, coordinator, facilitator, case studies.

Module IV: 10L
Principles of Kaizen and Gemba principles. Concept of Six Sigma standards, case studies.

Different standards: ISO, BS and Bureau of Indian Standards, details of ISO 9000 series, ISO 14000 series and SA 8000, OSHAS 18000 and the certification authorities.

Text Books:

1. Grant, Eugene and Leavenworth, Richard, Statistical Quality Control, TMH, 7th Edition 2012.
2. Udpa, S R , Quality Circles: Progress through Participation, TMH, 1992
3. Bedi, Kanishka, Quality Management, Oxford University Press,

References:

1. H. Lal Total Quality Management- A Practical Approach (1st Edition): New Age International, 1990
2. Sundararaju, S. M., Total Quality Management – A Primer: TMH, 1995
3. Mitra, Amitava, Fundamentals of Quality Control and Improvement, 2nd Edition. Prentice-Hall of India, 1998.
4. Subburaj Ramasamy, Total Quality management, Mc-Graw Hill Education (India) Pvt. Ltd, 2012.

Course Outcomes:

1. Identify and control the quality of processes and hence that of products or goods & services by applying basic statistical tools.
2. Draw various types of Control Charts and analyze to ascertain the state of the process of.
3. Develop different sampling plans to evaluate the quality of various types of defects.
4. Apply the techniques of Quality Circles and Kaizen in order to enhance work culture and Total Quality status in an organization.

Course Title : Ad Hoc Wireless Networks					
Course Code : ECEN4127					
Contact hours per week :	L	T	P	Total	Credit Points
	3	0	0	3	3

Module I: [10L]

- **Introduction [2L]**

Ad hoc wireless networks, Applications of Ad hoc wireless networks. Issues in Ad hoc wireless networks, Static and mobile Ad hoc network, Indoor Outdoor network model.

- **MAC Protocols [8L]**

Issues in designing a MAC protocol for Ad hoc wireless Networks, Hidden and Exposed terminal problem, Contention based protocols with reservation mechanisms and scheduling mechanisms, MAC protocols using directional antennas, IEEE802.11 in Ad hoc mode.

Module II: [8L]

- **Routing Protocols [8L]**

Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Proactive & Reactive routing protocol, Unicast & Multicast routing algorithm. Location aided routing, Link reversal routing, Hybrid routing algorithm, Energy aware routing algorithm, Hierarchical routing, QoS aware routing.

Module III [6L]

- **Transport Layer Protocols [6L]**

Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks, Classification of transport layer solutions, TCP over Ad hoc wireless Networks.

Module IV [12L]

- **QoS in Ad hoc wireless network [8L]**

Issues and challenges in providing QoS in Ad hoc wireless networks, Classification of QoS solutions, QoS in wireless ad hoc network – analysis of degradation of receiver sensitivity, practical solutions.

- **Energy Management Schemes [4L]**

Battery management, transmission power management, System power management schemes.

Text Books:

1."Ad Hoc Wireless Networks – Architectures and Protocols" - C. Siva Ram Murthy and B.S. Manoj –Pearson Education.

Reference Books:

1. "Ad Hoc Mobile Wireless Networks – Protocols and Systems" - Chai K. Toh – Prentice Hall.
2. "Ad hoc wireless Networking", Xiuzhen Cheng, Xiao Hung, DingZhu Du, Kluwer Academic publishers.
3. "Mobile Ad Hoc Networking" – Stefano Basagni, Marco Conti, Silvia Giardano, Ivan Stojmenovic –Wiley India

Course Outcome:

After this course, the following results are expected.

1. The students will understand the under lying technologies of wireless communication networks.
2. They will be able to analyze the various design issues and challenges of Ad hoc Networks.
3. Different routing protocols and their operations will be clear to them.
4. The students will learn about the contention in MAC layer and ways to solve them.
5. Students will be familiar with the network design strategies to assure adequate QoS.
6. The students will be able to apply their knowledge to develop new and improved application

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Paper Name: Linear Algebra					
Paper Code: MATH4122					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module I: [9L]

Characteristic equations, Eigen Values and Eigen vectors, Diagonalization, Applications to differential equations, Symmetric matrices, Positive definite matrices, similar matrices, Singular Value Decomposition, Generalized Inverses.

Module II: [9L]

Definition of Field, Vector Spaces, Elementary Properties in Vector Spaces, Subspaces, Linear Sum of Subspaces, Spanning Sets, Linear Dependence and Independence, Basis and Dimension. Application to matrices and system of linear equations.

Module III: [9L]

Inner Product Spaces, Concept of Norms, Orthogonality, Projections and subspaces, Orthogonal Complementary Subspaces, Orthogonal Projections, Gram-Schmidt Orthogonalization Process, Least square approximations, QR decomposition.

Module IV: [9L]

Linear Transformations, kernels and images, The Rank-Nullity-Dimension Theorem.Matrix representation of a Linear Transformation, Change of Basis, Linear space of linear mappings.

Text Book

1. Linear Algebra and its Applications: Gilbert Strang (Thomson Brooks/Cole CengageLearning)

Reference Books

2. Matrix Computations : Gene H. Golub, Charles F. Van Loan (JHU Press)
3. Linear Algebra : Kenneth M. Hoffman, Ray Kunze (Prentice-Hall)
4. Linear Algebra A Geometric Approach: S. Kumaresan(PHI)

Course Outcome:

1. MATH4122. 1. Explain concepts of diagonalization, orthogonal diagonalization and Singular Value Decomposition (SVD).

2. MATH4122. 2. Discuss basis, dimension and spanning sets.
3. MATH4122. 3. Design Gram-Schmidt Orthogonalization Process and QR decomposition using concepts of inner product spaces.
4. MATH4122. 4. Analyze Least squares solutions to find the closest line by understanding projections.
5. MATH4122. 5. Define linear transformations and change of basis.
6. MATH4122. 6. Illustrate applications of SVD such as, Image processing and EOF analysis, applications of Linear algebra in engineering with graphs and networks, Markov matrices, Fourier matrix, Fast Fourier Transform and linear programming.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Industrial Training Evaluation					
Course Code: AEIE4191					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**0**	**0**	**2**

This course has been designed for the students to gain real life working experience by visiting a Process Plant / Industry for a specified period. Thus, each & every student of AEIE should undergo industrial training for 4 weeks, during 6th – 7th Semester break in reputed Private / Public Sector / Government organization / companies. After completion of this course each student has to submit a report based on their industrial training and give a presentation on the same topic.

Course Outcomes:

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

1. Correlate their theoretical understanding with practical implementation.
2. Communicate effectively with other professional and non-professional groups in an industry/organization.
3. Identify, formulate and model problems; and find engineering solution based on a systems approach.
4. Become a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills.
5. Aware of the social, cultural, global and environmental responsibility as an engineer.
6. Develop capability and enthusiasm for self-improvement through continuous professional development and life-long learning.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Project I					
Course Code: AEIE4195					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**8**	**8**	**4**

Project should be on any topic having relevance with Electronics, Instrumentation, Electrical or inter-disciplinary field of engineering. The same should be decided by the student and concerned supervisor. Project should consist of research work done by the student in the selected topic with comprehensive and significant review of recent developments in the same field.

Course Outcomes:

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

1. Demonstrate ability to identify and formulate real world engineering problems relevant to society needs; study its feasibility and methodology for implementation.
2. Apply knowledge of circuit design, sensor selection, signal processing, control system, embedded system and programming, etc., to implement the project work with proper time frame.
3. Implement hardware model along with its relevant software programming, conduct experiments, analyze and interpret data and explain them.
4. Prepare project report properly and demonstrate presentation confidently.
5. Develop regularity, engage in enduring learning, ability to work in a group and deal with existing project ethically.
6. Develop interpersonal communication skill and demonstrate sound technical knowledge of their project work.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Introduction to MEMS					
Course Code: AEIE4111					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module 1 - [**8L**]
Introduction and Historical Background, Scaling Effects.
Micro/Nano Sensors,
Actuators and Systems overview: Case studies.

Module 2 - [10L]
Review of Basic MEMS fabrication modules: Different types of Deposition Techniques, Oxidation, Ion implantation, CVD, PVD, Photo Lithography and Dry and wet Etching. Reactive Ion Etching. Isotropic Etching and Anisotropic Etching

Module 3 - [9L]
Micromachining: Bulk Micromachining and Surface Micromachining, Issues related to Bulk and surface micro-manufacturing. Introduction to LIGA process. Concept of Wafer Bonding.

Module 4 - [9L]
Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Text/Reference Book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Identify the fabrication procedure like deposition, lithography and etching.
3. Understand the issues related to deposition and etching
4. Learn different types of micro-manufacturing techniques
5. Acquire knowledge regarding mechanics of micro and nano devices.
6. Design and model of MEMS devices.

Course Name: Instrumentation and Telemetry					
Course Code: AEIE4121					
Contact hrs per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Module I – [8L]

Generalized measurement system.

Introduction to telemetry principles: Basic systems, classifications, non electrical telemetry systems, voltage and current telemetry systems.

Sensors and transducers: resistive, capacitive, inductive, magnetostrictive, piezoelectric, hall sensor, optical, and applications.

Module II – [10L]

Measurement of pressure and vacuum: Introduction, diaphragm, capsule, bellows, bourdon tube, DP transmitters, Mcleod gauge, pirani gauge.

Flow rate measurement: head type flow meters – orifice, pitot tube, venturimeter; electromagnetic flow meters; ultrasonic flow meters.

Level measurement: float and displacers type instruments, resistive and capacitive type level instrument; D/P type sensors; ultrasonic level instruments.

Temperature measurement: thermocouple, RTD, thermistors, pyrometer.

Module III – [10L]

Data handling system: signal conditioning circuits, instrumentation amplifiers, ADC, DAC.

Basic classification of telemetry systems: voltage, current, position, frequency and time, components of telemetry and remote control systems, sampling theorem, sample and hold, quantization error, data conversion, coding, introduction to fiber optic communication system.

Module IV – [8L]

Multiplexing; time division multiplexers and de-multiplexer theory, scanning procedures, frequency division multiplexers with constant and proportional bandwidth, de-multiplexers. Fundamentals of radio-telemetry system, RF link system design, pipeline telemetry; power system telemetry, PSK, QPSK , FSK,

IEEE 802.11, Introduction to IoT.

References:

1. D. Patranabis, Telemetry principles, TMH, New Delhi
2. E. L. Gruenberg, Handbook of Telemetry and Remote control, Mc Graw Hill
3. B. P. Lathi, Modern Digital and Analog Communication Systems, Oxford University Press

4. Ginz Beng "Fundamentals of Automation and Remote Control".
5. Feng Zhao and Leonidas. J. Guibas, Wireless Sensor Networks: An Information Processing Approach, Morgan Kaufmann.
6. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press.

Course Outcomes:

After the completion of the course students will be able to

1. Understand different blocks of generalized measurement system.
2. Clarify operation of indigenous sensors and transducers.
3. Gain knowledge of measurement system for industrial parameters like pressure, flow, level and temperature.
4. Design various signal conditioning circuits for sensors.
5. Select telemetry system required for a given application.
6. Justify the need of process data multiplexing and de-multiplexing in telemetry.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: Linear Control Systems and Applications					
Paper Code: AEIE 4122					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module-I [9L]
Concepts of control systems: open loop and closed loop control systems, effect of feedback in control system; mathematical model of physical system: differential equation representation of physical systems, transfer function, block diagram representation and reduction, signal flow graphs.

Module-II [8L]
Standard test signals, time response analysis: transient an d steady state response of first or de r and second order processes, steady state error coefficients, performance indices, effect of pole–zero addition in system response.

Module- III [10L]
Stability analysis: characteristic equation and concept of stability; Routh stability criterion; root locus technique and stability analysis from root locus plot.
Introduction to frequency domain analysis; Bode plot for stability analysis: minimum and non- minimum phase system, concept of phase margin and gain margin.

Module –IV [9L]
Control elements: dc servomotors, ac servomotors, dc motor speed and position control.
Basic control actions: P, PI, PD and PID controller and applications. Case study: Level and flow control.

References:

1. Nagrath I. J. and Gopal M., *Control System Engineering,* 5th Ed., New Age International Private Ltd. Publishers.
2. Kuo B. C., A*utomatic 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., C*ontrol Systems Engineering,* 4th Ed., Wiley India.
6. B.W. Bequette, *Process Control Modeling, Design and Simulation,* Prentice Hall of India, New Delhi.

Course Outcomes:

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

1. Derive mathematical model of physical and simulated systems.

2. Execute block diagram reduction and signal flow graph to calculate overall system gain.
3. Investigate the time response of systems and calculate performance indices.
4. Analyze the stability of linear systems using Routh stability criterion and root locus method.
5. Explain frequency response of a process and determine stability using Bode plot.
6. Understand the concept and utility of control actions and its usages.

Subject Name: Optical Instrumentation					
Paper Code: AEIE4126					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I –
[9L]

Optical detectors: PIN photodiode, avalanche photo diode, phototransistor, LDR, photo voltaic cell.

LED: Power and efficiency calculation, structure of LED and its characteristics, hetero-junction LED.

Module II - [9L]

Optical Fibers and their Performances: Propagation of light through fiber, different types of fibers and their properties and characteristics, different types of losses in optical fiber communications, dispersions, optical fiber connectors and splices.

Module III - [9L]

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.

Industrial applications of LASER: Laser for measurement of distance, length, velocity, acceleration, current,voltage and atmospheric effect- Material processing -Laser Heating, Welding, Melting and trimming of material-Removal and vaporization.

Module IV - [9L]

Optical Fiber sensors : Fiber optic sensors-fiber optic Instrumentation system-Different types of modulators- Inferometric method of measurement of length-Moire fringes-Measurement of pressure, temperature, current, voltage, liquid level and strain.

References:

1. J.M. Senior, Optical Fiber 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. SterlingJr, Technicians Guide to Fiber Optics, 3rd Edition, Vikas Publishing House, 2000.
4. M. Arumugam, Optical Fiber Communication and Sensors, 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 Fiber Communication, McGraw Hill, 1995.
8. Mr. Gupta, Fiber Optics Communication, Prentice Hall of India, 2004.

Course Outcome:

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

1. Learn the techniques of communications using optical fiber.
2. Learn the difference between direct and indirect band gap semiconductors.
3. Characterize structures and performance of LEDs and lasers.
4. Learn the structures and performance of photo detectors (like photo diode, PIN diode, APD etc).
5. Explain the techniques of measurement of distance, length, velocity, acceleration, current, voltage using laser. Formulate the structure of generalized measurement system.
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 : Introduction To Embedded Systems					
Paper Code : AEIE 4127					
Contact hrs per week :	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module I- [10L]

Introduction to an embedded system : 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. Introduction to AVR, PIC, ARM and Arduino based systems.

Module II- [10L]

Overview of AVR microcontroller: Introduction to AVR (ATmega328p-pu) microcontroller, pin layout, architecture, program memory, Data Direction register (DDRx), Port Registers (PORTx), PWM registers (8-bit), ADC registers, interrupts, basics of communication, overview and interfacing I/O devices with I^2C Bus, UART and Serial Peripheral Interchange (SPI) bus.

Module III- [8L]

Embedded operating systems: Operating system basics, types of operating systems, 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, how to choose an RTOS.

Module IV- [8L]

Hardware Interfacing and Programming with ATmega 328p: Interfacing of LCD, interfacing with analog sensors (i.e. LM35, ADXL 335 accelerometer), interfacing of stepper motor, interfacing with a keyboard and MPU6050 (MEMS Accelerometer and Gyroscope) using I^2C bus.

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. Elliot Williams, AVR Programming: Learning to Write Software for Hardware, Maker Media, Incorporated, 2014.
4. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, "The AVR Microcontroller and Embedded Systems: Using Assembly and C"; Pearson, 2014.

5. Dhananjay Gadre, "Programming and Customizing the AVR Microcontroller";McGraw Hill Education, 2014.
6. Silberschatz Galvin Gagne, "Operating System Concepts", WILEY, 2014.

Course Outcomes:

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

1. Explain the definitions, components and requirements of the Embedded System.
2. Acquire knowledge in the area of embedded system using AVR microcontroller.
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.

Detailed Syllabus of 4th Year 2nd Semester Courses

Course Name: Power Plant Instrumentation					
Course Code: AEIE4231					
Contact hrs per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Module I – [6L]
Fundamental of power plant: Introduction, classification of power plants, resources for power generation, review of thermodynamics cycles related to power plants, main equipments: boiler, prime mover, condensers and cooling towers, coal handling system, ash and dust handling system, draught system, feed water purification plant, pumping system, air pre-heater, economizer, super heater, feed heaters, fossil fueled power plant circuits, steam turbines, fans and pumps, components of turbo generators and auxiliaries.

Module II – [12L]
Instrumentation and control: Burner management system, drum level measurement-DP cell type, hydra step, boiler drum level control, load demand control, combustion control, furnace draft control, steam temperature control, steam pressure control, dearator storage tank and condenser hot-well level control.

Module III – [10L]
Instrumentation for safety interlocks, interlocking types, emergency shutdown/tripping conditions. Turbine supervisory instrumentation system: measurement of vibration, eccentricity, rotor & casing movement, temperature of metal and lubricating oil, speed etc. Turbine control systems: speed, lube oil pressure/flow, temperature, tank level etc.

Module IV – [8L]
Water treatment plant: water sources, water quality (impurities), effects of impurities, measurement of impurities, feed water treatment, blow down control. Pollution measurement and environmental regulations: NOx, SOx and COx and particulate measurement. Introduction to hydro-electric power plant, Introduction to nuclear power plant.

References:
1. K Krishnaswamy, M Ponni Bala, *Power Plant Instrumentation*, PHI, 2011.
2. Black & Veatch, *Power plant engineering*, Springer Science &Business Media, Inc. 1996.
3. L. L. Grigsby, *Electric Power Engineering Handbook*, CRC Press, 2001.
4. A.K. Raja, A.P. Srivastava, M. Dwivedi, *Power Plant Engineering*, New Age International (P) Ltd., 2006.

Course Outcomes:

After completion of the course students will be able to

1. Describe the main equipments of a power plant.
2. Explain the thermodynamic cycles used thermal power plant.
3. Give details of instrumentation and control loops in thermal power plant.
4. Include safety interlocks necessary for safe operation of thermal power plant.
5. Describe the turbine supervisory instrumentation system.
6. Gain knowledge about water treatment system and Pollution measurement and regulation of NOx, SOx and COx.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: Digital Control Techniques					
Paper Code: AEIE 4232					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I – [8L]

Introduction to digital control, basic elements of discrete data control systems, advantages of discrete data control systems, examples, discrete time system representation, sampling process and its mathematical modeling, signal reconstruction; zero order and first order sample and hold circuits.

Module II - [9L]

Introduction to z-transforms: properties of z-transform, application of z-transform to difference equations, mapping of s-plane to z-plane; pulse transfer function, pulse transfer function of ZOH, pulse transfer of discrete data systems with cascaded elements, pulse transfer function of closed loop system.

Module III - [10L]

Block diagram and sampled signal flow graph; time response of discrete time systems; stability analysis of closed loop system in z-plane, Jury stability criterion, stability analysis using bilinear transformation and Routh stability criterion.

Module IV - [9L]

Design of sampled data control systems: root locus method, root locus based controller design, Bode plot, compensator design using bode plot, lag-lead compensator design, design of digital control systems with dead beat response.

References:

1. Ogata, *Discrete Time control systems* ; 2nd ed. (PHI)
2. Kuo, *Digital control systems*; (Second Edition) Oxford University Press
3. M. Gopal, *Digital Control Engineering*; New Age Publ.
4. John Dorsey, *Continuous &Discrete Control Systems* ; MGH

Course Outcomes:

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

1. Acquire knowledge about fundamental concepts and techniques used in digital control system.
2. Understand and formulate the mathematical models of linear discrete time control systems.
3. Apply knowledge of z-transform and explain the concept of pulse transfer function.
4. Deduce signal flow graph and determine the transient and steady state behavior of process model.
5. Analyze the stability of the process model using different methods.
6. Design compensator and digital controllers by applying different design procedures.

Subject Name: Machine Learning Techniques					
Paper Code : AEIE 4233					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [8L]

Introduction:

Introduction to ML-Well posed learning problems, Designing a learning system, Perspectives and Issues in Machine Learning, Modelling concepts, Applications of ML.

Descriptive Statistics: Data exploration - histograms, bar chart, box plot, line graph, scatter plot; Qualitative and Quantitative Data; Measure of Central Tendency - Mean, Median and Mode; Measure of Positions - Quartiles, Deciles, Percentiles and Quartiles; Measure of Dispersion - Range, Median, Absolute deviation about median, Variance and Standard deviation.

Learning: Inductive learning and deductive learning; Supervised, Unsupervised and Reinforcement learning; Learning decision trees; Choosing attribute tests; Generalization and over fitting, Significance test, Test of Hypothesis, t-test, Cross validation, Model selection: Complexity versus goodness of fit, Loss function, Regularization, Feature selection.

Module II – [8L]

Learning and deterministic models:

Regression Analysis: Relationship between attributes using Covariance and Correlation, Relationship between multiple variables: Regression (Linear, Multivariate) in prediction, R-square and goodness of fit.

Linear Regression- Least square method, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Partial Least squares, Polynomial Regression, Regularization methods, Lasso, Ridge and Elastic nets, Examples: Applications of Time Series in financial markets.

Implementation- In Python with Scikit Learn.

Module III – [10 L]

ML Techniques:

Clustering-Distance measures Different clustering methods (Distance, Density, Hierarchical), Iterative distance-based clustering.

Classification: Linear discriminant analysis (LDA); Naïve Bayes Classifier; K-Nearest Neighbour (KNN) classifier*;* Logistic regression for classification; Support Vector Machine (SVM) for classification and regression - Linear and nonlinear models, Kernel methods; Decision trees; Dimensionality reduction byPrincipal components analysis (PCA). *Implementation*- In Python with Scikit Learn.

Module IV – [10L]

Neural Networks & Deep Learning:

Introduction- Basic models of artificial neurons, activation functions, Simple perceptron, multilayer perceptron, Adaline and Madaline, LMS learning rule, Back propagation learning algorithm, weight updating methods, accelerated methods of learning; Radial basis function neural networks; Advantages and disadvantages of neural networks.

Deep learning- Concept, improvement of the deep neural network, deep learning algorithms, deep networks, training of deep networks, applications of deep learning; Convolutional neural network- Introduction, architecture of CNN, convolution layers, stride and padding in convolutional layers, pooling layers, improving the performances of CNN.

Implementation- In Python with TensorFlow.

References:

1. Duda, Richard O., Hart, Peter E., Stork, David G., ***Pattern Classification***. Wiley Interscience, 2nd Ed., 2000.
2. K. Fukunaga, ***Introduction to Statistical Pattern Recognition***. 2nd Ed, Academic Press, 1990.
3. Neapolitan, Richard E., and Xia Jiang. ***Artificial intelligence: With an introduction to machine learning***. CRC Press, 2018.
4. I. Goodfellow, Y. Bengio and A. Courville, ***Deep Learning***, MIT Press, 2016.
5. François Chollet, ***Deep Learning with Python***, Manning Publications, 2017.
6. Géron, Aurélien. ***Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems***. O'Reilly Media, 2019.
7. Pete Warden "***TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers***", Publisher: Shroff/O'Reilly; First edition (20 January 2020)
8. Margaret A. Boden. ***Artificial Intelligence. Handbook of Perception and Cognition,*** Academic Press, 2019.
9. Bishop, Christopher M. ***Pattern recognition and machine learning***. Springer, 2006.
10. Murphy, Kevin P. ***Machine learning: a probabilistic perspective***. MIT press, 2012.
11. Mitchel, Tom M. ***Machine Learning***, McGraw Hill, 1997.

Course Outcome:

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

1. Familiarize with the basic concepts and techniques of machine learning and integrate multiple facets of practical machine learning in a single system: data preprocessing, learning, regularization, model selection, data analysis, and hypothesis testing.
2. Develop linear and multivariate regression models on given data and analyze their performance by calculation of R-square and goodness of fit.
3. Implement and analyze existing learning algorithms, including well-studied methods for development of classifier models such as LDA, Bayes, KNN, SVM and logistic regression.
4. Learn data clustering techniques and dimensionality reduction of data by principal component analysis method and apply them on practical problems.
5. Gain knowledge on artificial neural network, convolution neural network and deep learning and implement them with python.
6. Apply basic principles of AI in real world problems that require solving, inference, perception, knowledge representation, and learning

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: Biomedical Instrumentation					
Paper Code: AEIE4241					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**0**	**0**	**3**	**3**

Module I–[8L]

Biomedical transducers: Body Temperature transducers- thermoresistive, thermoelectric, semiconductor, chemical thermometry and operating specifications; Blood Pressure transducer- Strain gauge type, variable capacitance type, LVDT and operating specifications; Blood flow transducers- based on Piezoelectric effects, electromagnetic effects, operating specifications.

Module II-[8L]

Biopotentials and electrodes: Bio-potentials- origin, types and electrical activity of cells, resting and action potentials of cells, refractory periods; Electrodes- Electrode theory and half-cell potential, electrode-electrolyte interface, off-set potentials, motion artifact, polarization and effects, types of electrodes: surface, needle and micro electrodes and their equivalent circuits; Electrode impedance, electrical conductivity of electrode jellies and creams.

Module III-[12L]

Biomedical signal processing: Biosignal characteristics, frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system and signal conditioning, electrical pathways, ECG waves and interpretation, EEG 10-20 electrode system, and signal conditioning, average mode, frequency and amplitude ranges; EMG: unipolar and bipolar modes, invasive and noninvasive measurements of muscle activities, frequency and amplitude ranges; Plethysmography.
Biomedical image processing techniques: X-Ray imaging, Ultrasonic imaging, CAT, MRI; Biotelemetry and patient monitoring.

Module IV-[8L]

Assisting and therapeutic instruments: Pacemakers, defibrillators, hearing aids. ventilators, heart-lung machine, diathermy.
Electrical safety: Model of electrical danger, micro and macro electric shocks, Physiological effects of current, Ground shock hazards, earthing scheme. Schemes of accident prevention: Ground Fault Circuit Interrupt (GFCI), elements of electrical safety.

References:

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Second edition, Prentice-Hall India, 1997.
2. R.S. Khandpur, Handbook of Biomedical Instrumentation, 2 Edition, Tata McGraw Hill New Delhi, 1987.
3. John G. Webster, Medical Instrumentation application and design, Third edition, Wiley, 1997.
4. S. K. Venkata Ram, Biomedical Electronics and Instrumentation, Galgotia Publication Pvt. Ltd., New Delhi.
5. Geddes L.A and Baker L.E, Principles of Applied Biomedical Instrumentation, Third edition, Wiley-Interscience, 1989.

Course Outcomes:

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

1. Explain the fundamental principles and applications of different transducers used for body parameter measurements.
2. Understand the physiology of biomedical systems and different methods in the design of biomedical instruments.
3. Learn the different methods of medical imaging systems, concepts related to the operations and analysis of biomedical instruments.
4. Design signal processing hardware circuits.
5. Learn various therapeutic devices.
6. Aware of the importance of electrical safety and apply it in the design of different assisting, therapeutic and diagnostic medical devices.

SUBJECT NAME: Digital Image Processing					
Paper Code: AEIE4242					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [9L]

Introduction to Digital Image Processing &Image Transforms:

Digital Image Processing Systems: Digital image, Components of Image processing system, Image sensing and acquisition, storage, Processing, Communication, Display, Image Sampling and quantization, Basic relationships between pixels, Elements of visual perception, Image formation in the human eye, Brightness adaptation and discrimination, Application of digital image processing, 2D signals and systems- convolution.

Colour Image Processing: Color image fundamentals - Colour models, The Chromaticity diagram, Conversion of colour models, Pseudo colour image processing, Full colour processing.

Image Transforms: Need for image transforms, DFT and FFT, DCT, Walsh, Hadamard, Haar, KLT and Wavelet transforms.

Module II - [10L]

Image Enhancement, Restoration and Morphological Processing:

Image Enhancement: Spatial Domain methods- Point operations, Histogram equalization, Gray level transformation- linear and nonlinear; Local or neighbourhood processing- Mean filter, Max filter, Min filter, Median filter, Gaussian filter, High pass filter, High boost filter, Bit plane slicing, Smoothing, sharpening filters– Laplacian filters; Frequency domain filters: Smoothing – Sharpening filters – Homomorphic filtering; Image arithmatics.

Image Restoration: Introduction, Image degradation, Types of image blur, Classification of image-restoration techniques, Image restoration model, Linear image restoration technique-Inverse filtering, Least mean square filtering, Constrained least square filtering, Wiener filtering.

Morphological Operations: Dilation and Erosion, Opening and Closing, Boundary extraction, Region filling, Convex hull, Thinning, Thickening, Skeletons, Pruning.

Module III - [8L]

Image Compression:

Introduction, Need for data compression, Coding redundancy, Interpixel redundancy, Psycho visual redundancy, Image compression models, Error free compression, Huffman coding, Run Length coding, Shift coding, Arithmetic coding, Vector Quantization, Block truncation coding, Lossless

predictive coding, Lossy predictive coding, Transform coding, Wavelet coding, Basics of Image compression standards: JPEG, MPEG.

Module IV - [9L]

Image Segmentation, Representation, Description and Recognition:

Introduction, Classification of image segmentation techniques, Segmentation based on thresholding, Discontinuity based segmentation- Line detection, Edge detection, Region based segmentation; Image Representation schemes, Boundary descriptors, and Regional descriptors. Object Recognition – Need for an object recognition system, Automated object recognition systems, Patterns and pattern classes, Feature extraction, Feature selection techniques, Introduction to classification- supervised and unsupervised learning, Template matching, Bayes classifier.

References:

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, 3rd Edition, Prentice Hall, 2008.
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall of India, 2002.
3. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, *Digital Image Processing using MATLAB*, Pearson Education, Inc., 2004.
4. William K. Pratt, *Digital Image Processing*, John Wiley, NewYork, 2002.
5. Milman Sonka,Vaclav Hlavac, Roger Boyle, *Image Processing, Analysis and Machine Vision*, Brooks/Cole, Vikas Publishing House, II ed., 1999.
6. S. Jayaraman, S. Esakkirajan, T. Veerakumar, *Digital Image Processing*, McGraw Hill Education (India) Private Limited, New Delhi, 2009.

Course Outcomes:

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

1. Understand how gray level and colour images are formed, sampled, quantized and represented digitally and processed by discrete, linear, time-invariant systems.
2. Apply transformation algorithms such as DFT, DCT, Walsh, Hadamard, Haar, KLT and Wavelet transform to any given image.
3. Perform image enhancement, restoration and morphological operations on images.
4. Compress a given image by applying lossy and loss less image coding techniques.
5. Evaluate the methodologies of image segmentation, representation and description.
6. Learn feature extraction techniques for image analysis and recognition.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Paper Name: Principles of Robotics					
Paper Code: AEIE4243					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module I [9L]

Introduction to robotics, applications, elements of robots:

Introduction–progressive advancement in robots, laws of robotics, robot anatomy-links, joints, degree of freedom, manipulator and end effectors.

Industrial applications-material handling, processing, assembly, inspection; robot safety, non-industrial applications.

Module II [9L]

Direct and inverse kinematic model of robots:

Direct kinematic-description and structure of components, direct kinematic modeling of the manipulator, kinematic relationship between adjacent links and manipulator transformation matrix, kinematic model examples.

Inverse kinematic-inverse kinematic technique, solvability of inverse kinematic model, inverse kinematic model examples.

Module III [9L]

Static and dynamic analysis of robot manipulators:

Manipulator differential motion and statistics-linear and angular velocity of a rigid body, relationship between transformation matrix and angular velocity, mapping of velocity vector and velocity propagation along links.

Dynamic modeling-dynamic model of two degree of freedom manipulator.

Module IV [9L]

Robotic sensors and control of manipulators:

Robotic sensors-kinds of sensors used in robotics, industrial applications of vision–controlled robotic systems.

Control of manipulators-linear control schemes, characteristics of second order linear systems, partitioned PD control scheme, PID control, applications.

References:

1. A. Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2nd reprint, 2008.

2. K. Fu, R. Gonzalez and C.S. G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.
3. R. D. Klafter, T. A. Chimielewski and M. Negin, Robotic Engineering–An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. Nagrath and Mittal, Robotics and Control, Tata McGraw-Hill, 2003.
5. Spong and Vidhyasagar, Robot Dynamics and Control , John Wiley and sons, 2008.

Course Outcomes:

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

1. Explain robot anatomy by identifying its different components.
2. Know the potential area of application of robot.
3. Formulate direct and inverse kinematics model of robots for different degree of freedom robot manipulators.
4. Perform static and dynamic model analysis of robot manipulator.
5. Understand the applications of vision-controlled robotic systems and find the proper sensors used in robotics.
6. Choose and apply a proper control strategy for second order linear systems model.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Introduction to MEMS					
Course Code: AEIE4244					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

(*Applicable for 2020, 2021 & 2022 admitted batches*)

Module 1 - [**8L**]
Introduction and Historical Background, Scaling Effects.
Micro/Nano Sensors,
Actuators and Systems overview: Case studies.

Module 2 - [10L]
Review of Basic MEMS fabrication modules: Different types of Deposition Techniques, Oxidation, Ion implantation, CVD, PVD, Photo Lithography and Dry and wet Etching. Reactive Ion Etching. Isotropic Etching and Anisotropic Etching

Module 3 - [9L]
Micromachining: Bulk Micromachining and Surface Micromachining, Issues related to Bulk and surface micro-manufacturing. Introduction to LIGA process. Concept of Wafer Bonding.

Module 4 - [9L]
Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Text/Reference Book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Identify the fabrication procedure like deposition, lithography and etching.
3. Understand the issues related to deposition and etching
4. Learn different types of micro-manufacturing techniques
5. Acquire knowledge regarding mechanics of micro and nano devices.
6. Design and model of MEMS devices.

Course Title : Cellular and Mobile Communication					
Course Code : ECEN 4222					
Contact hours per week :	L	T	P	Total	Credit Points
	3	0	0	3	3

Module I: [11L]

- **Introduction [2L]**

Brief introduction to wireless communication and systems, Evolution of wireless/mobile standards - 1G, 2G, 3G and 4G and related networks, Brief introduction to 5G network, Potential challenges.

- **Cellular Networks: Design Fundamentals [4L]**

Principle of cellular communication, Description of cellular system- Cellular Structure, Cell clustering, and Capacity enhancement techniques for cellular networks, Frequency Reuse- Co-channel and Adjacent channel interferences, Channel Assignment Strategy, Handoff Schemes, Mobility Management- Location, Radio Resource and Power management.

- **Radio Propagation Path Loss Models :Large Scale and Small Scale [5L]**

Introduction to Radio Wave Propagation, Multipath Propagation mechanism and effects on Wireless Communication, Propagation models for Wireless networks- Free space propagation model, Ground reflection (Two-Ray) model, Log distance path loss model, Log normal shadowing model, Small-Scale Multipath Propagation- Influencing factors and Doppler shift, Types of Small Scale Fading, Introduction to antenna systems in mobile radio.

Module II: [8L]

- **Multiple Access Techniques for Wireless Communications [3L]**

Introduction to multiple access techniques, Narrow band channelized systems- Frequency Division Duplex and Time Division Duplex Systems, Frequency Division Multiple Access, Time Division Multiple Access, Wideband Systems- Principles of WDM, Spread Spectrum Multiple Access, Space Division Multiple Access, Orthogonal Frequency Division Multiple Access.

- **GSM& GPRS: Architecture and Protocols- 2G & 2.5G [5L]**

Introduction, GSM subsystems, GSM subsystems entities, GSM Air Interface, GSM frequency bands and allocation strategies, GSM channel structure, GSM call set-up procedure, GPRS (2.5G) network architecture, GPRS Attachment and Detachment procedure.

Module III [9L]

- **Overview of CDMA Systems- 2G [3L]**

CDMA Evolution-An overview, CDMA IS-95 systems, CDMA channel concept-Forward and Reverse, Transmission power control- Near Far problem and Multipath Phenomenon, Handoff process.

- **The Universal Mobile Telecommunication System-3G [2L]**

UMTS Network architecture, Frequency allocation strategy, UMTS channels.

- **LTE 4G [4L]**

Introduction to LTE network architecture, Uplink and Downlink frequency bands and allocation strategies, Channel Structure of LTE, Channel dependent multiuser resource scheduling.

Module IV [8L]

- **Key Enablers for LTE 4G[5L]**

Multicarrier concepts, Basics of OFDM, SC-FDE and SC-FDMA, OFDM in LTE, Timing and Frequency synchronization, Multiple Access for OFDM systems, OFDMA and SC-FDMA in LTE, OFDMA system design considerations.

- **Mobile Internet Protocol [3L]**

Basic Mobile IP, Mobile IP Type-MIPv4 and MIPv6, Basic Entities of MIPv4, MIPv4 Operations, Registration, Tunneling and Reverse Tunneling, Triangular Routing.

Text Books:

1. Wireless Communications: Principles and Practice, T.S. Rappaport, Pearson Education
2. Wireless Communication and Networks: 3G and Beyond, I.SahaMisra, TMH Education.
3. Fundamentals of LTE, Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, Pearson Education, ISBN-13: 978-0-13-703311-9.

Reference Books:

1. Wireless Digital Communications: Modulations and Spread Spectrum Applications, K. Feher, Prentice Hall.
2. Wireless Communications and Networking, J. W. Mark and W. Zhuang, PHI.

Course Outcome:

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

1. Learn about the evolution of radio communication and fundamental design strategies of cellular network.
2. Appreciate the challenges of RF communication.
3. Understand the concepts of propagation over wireless channels.
4. Learn about the both physical and networking of LTE-4G systems.
5. Understand the functioning of IP technology.
6. Apply their knowledge for research work in communication domain.

Course Name: Fundamentals of Cryptography					
Course Code: INFO4221					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

MODULE – I [8L]

Network Security and Cryptography- Concepts and Techniques

Need for Security, Security approaches, Principles of Security, Types of Active attack and Passive attack. Introduction to cryptography, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Types of Cipher, Cryptanalysis and Brute-force attack, Type of attacks on encrypted text, Symmetric & Asymmetric key Cryptography.

MODULE – II [10L]

Symmetric Key Algorithms

Algorithm types & Modes, Overview of Symmetric Key Cryptography, Diffie-Hellman key exchange algorithm, Digital Envelope, DES (Data Encryption Standard) algorithm & its variant and IDEA (International Data Encryption Algorithm) algorithm.

MODULE – III [11L]

Asymmetric Key Algorithms, Digital Signature and User Authentication

Overview of Asymmetric key Cryptography, RSA algorithm, Digital Signature, Basic concepts of Message Authentication code, Message Digest and Hash Function. HMAC algorithm. Authentication Basics, Password, Authentication Token, Certificate based Authentication and Biometric Authentication.

MODULE – IV [11L]

Electronic mail security, SSL and Firewall

Basics of e-mail security, PEM, PGP, Secure Socket Layer (SSL) protocol. Introduction to Firewall, Characteristics of Firewall, Packet filtering router, Application-level gateway, Circuit-level gateway, Bastion Host, Firewall Configurations and DMZ Network.

Text Books

1. "Cryptography and Network Security", William Stallings, 3rd Edition, Pearson Education Asia

2. "Cryptography & Network Security", Atul Kahate, TMH.

Reference Books

1. "Cryptography and Network Security", Behrouz A. Forouzan, Special Indian Edition, 2007, TMH

2. "Network Security Essentials: Applications and Standards" by William Stallings, Pearson.

3. "Cryptography and Security", C K Shyamala, N Harini and Dr T R Padmanabhan, Wiley India

4. "Network Security private communication in a public world", C. Kaufman, R. Perlman and M. Speciner, Pearson.

Course Outcome:

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

1. Define the concepts of network security. Classify different types of attack on network security. Recall the principles of security.
2. Classify different kinds of substitution techniques and transposition techniques and describe the concepts of symmetric key cryptography and asymmetric key cryptography. Discuss in detail DES, RSA and IDEA algorithm.
3. Solve numerical based on DES and RSA. Analyze the concept of SSL, PEM and PGP. Compare MAC, Message Digest and Hash function.
4. Analyze HMAC algorithm. Describe Digital Signature.
5. Explain authentication token and classify between different types of authentication tokens. Compare certificate based authentication and biometric authentication
6. Explain the concepts of firewall and DMZ network. Compare between packet filtering router, Application-level gateway and circuit-level gateway. Classify between different Firewall configurations.

Course Name: Introduction to Solar and Wind Technology					
Course Code: CHEN4222					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	0	0	3	3

Module 1: [10L]

Introduction to Radiation heat transfer: Blackbody radiation, Stefan-Boltzman Law, Wien's Dispalcement Law, emissivity, absorptivity, radiation view factor, radiation shield. **Solar radiation**: sun earth geometric relationship, solar angles, sun's trajectories in different seasons, zenith solar time, air mass, solar beam, total solar radiation & diffuse radiation, solar radiation on different surfaces at different angles, extraterrestrial radiation. Attenuation of solar radiation by the atmosphere, beam and diffuse components of hourly and daily radiation, clearness index.

Module 2: [10L]

Solar Thermal Collector: Flat plate collector, Unglazed, Single and double glazed solar collectors, Optical losses and thermal losses, thermal analysis and performance characteristics. Concentrating solar collectors: General description; concentrators, receivers, Orienting/tracking requirements, Parabolloid dish collectors, Scheffler dish, Linear Fresnnel Reflector Collector.

Introduction to Solar PV: Crystal structure, band theory, energy band diagrams, Fermi level, intrinsic and extrinsic semiconductor, Standard solar cell structure, I-V characteristics, FF, Voc, Isc, Pmax, conversion efficiency, losses in solar cell, Rs, Rsh, impact of radiation and temperature; Silicon wafer based solar PV technology, Single and poly crystalline silicon solar cells; Thin film technology of solar cell, Merits and demerits of thin film technologies.

Module 3: [10 L]

Basics of Wind Energy Conversion: Power available in the wind spectra, Wind turbine power and torque, Classification of wind turbines: Horizontal axis and Vertical axis, Characteristics of wind rotors, Aerodynamics of wind turbines (Airfoil, Aerodynamic theories, Axial momentum theory, Blade element theory, Strip theory), Rotor design, Rotor performance.

Analysis of wind regimes: The wind (Local effects, Wind shear, Turbulence, Acceleration effect, Time variation), Measurement of wind (Ecological indicators, Anemometers, Cup anemometer, Propeller anemometer, Pressure plate anemometer, Pressure tube anemometers, Sonic anemometer, Wind direction), Analysis of wind data (Average wind speed, Distribution of wind velocity, Statistical models for wind data analysis; Weibull distribution, Rayleigh distribution),Energy estimation of wind regimes (Weibull based approach, Rayleigh based approach).

Module 4: [10L]

Wind energy conversion systems: Wind electric generators (Tower, Rotor, Gear box, Power regulation, Safety brakes, Generator; Induction generator, Synchronous generator. Fixed and variable speed operations, Grid integration), Wind farms, Offshore wind farms, Wind pumps (Wind powered piston pumps, Limitations of wind driven piston pumps; The hysteresis effect, Mismatch between the rotor and pump characteristics, Dynamic loading of the pump's lift rod, Double acting pump, Wind driven roto-dynamic pumps, Wind electric pumps).

Performance of wind energy conversion systems: Power curve of the wind turbine, Energy generated by the wind turbine (Weibull based approach, Rayleigh based approach), Capacity 26 factor, Matching the turbine with wind regime, Performance of wind powered pumping systems (Wind driven piston pumps, Wind driven roto-dynamic pumps, Wind electric pumping systems).

Text Books:

1. Sukhatme S. & Nayak J., Solar Energy: Principles of Thermal Collection and Storage, Third Edition, Tata McGraw Hill, 2008.
2. Solanki C.S.; Solar Photovotaics – Fundamentals, Technologies and Applications; PHI Learning, 3rd edition, 2015.
3. Efstathios E. (Stathis) Michaelides, Renewable Energy Sources, Springer, 2012.
4. Sathyajith Mathew, Wind Energy: Fundamentals, Resource Analysis and Economics, Springer, 2006.

Reference Books:

1. Goswami D.Y., Kreith F.&Kreider J.F.; Principles of solar Engineering, Tyalor and Francis, Philadelphia, 2000.
2. N.K. Bansal and M.K. Kleeman, Renewable Sources of Energy and Conversion Systems, Tata McGraw-Hill, 1984

Course outcome:

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

1. Understand different technologies used for solar collectors.
2. Students will be able to evaluate the performance and efficiency of different devices that extract power from solar energy.
3. Students will be able to understand the main components of wind energy system and its functions.
4. Understand the different types of wind turbines

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name : Computational Biology					
Course Code: BIOT4221					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module-I: Introduction to Biomolecules [10L]
Introduction to biochemistry and molecular biology; Biomolecules: structure, function and metabolic pathways.

Module-II: Scope of Computational Biology [10L]
Definition of computational biology; origin and development of computational biology; Nature and Types of biological data; Data Structures: Sequences (GENbank files), Secondary structures, Super-secondary structures (Motifs), Tertiary structures (Pubchem and PDB structure files); Interaction Networks, Photographic Data: Fingerprints (DNA and MS), Microarray data; Biological databases.

Module-III: Preferred Algorithms, Programming languages and Operating systems [10L]
Principles of Pattern recognition: Use of Hidden Markov Model and Artificial Neural Networks in computational biology; Significance of Python and C/C++; Operating system: Bio-Linux (Selected Bioinformatics packages)

Module-IV: Applications of Computational biology [10L]
Molecular Modeling and Dynamics: introduction to Open MM library; GROMACS as an example of GUI in the public domain; computer based drug design (public domain and proprietary); Mathematical modeling of cell growth kinetics; Embedded systems for computational biology: High throughput data collection, processing and analysis; LC-MS, DNA microarrays and other applications (e.g. mobile microscopy and high throughput micro-PCR); Systems biology and Metabolic Engineering.

Text books:

1. Introduction to Bioinformatics, by Arthur M. Lesk (International Fourth Edition) (2014), Oxford University Press.
2. Essential Bioinformatics, by Jin Xiong, Cambridge University Press (2006).

Reference books:

1. Biochemistry: Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 7th edition, Academic Press.
2. Introduction to Bioinformatics: T K Attwood, D J Parry-Smith and S. Phukan (2008) Pearson.
3. Fundamentals of Database Systems, 5th Edition, R. Elmasri and S.B. Navathe (2009)
4. Bioinformatics-A Machine Learning Approach- By Baldi and Brunak, 2nd Edition (2006), John Wiley Inc.
5. Dynamics of Proteins and Nucleic Acids: J. Andrew McCammon and Stephen C. Harvey, Cambridge University Press (1998).

6. Molecular Modelling: Principles and Applications-2nd Edition, Andrew R. Leach-Pearson (2016)
7. Molecular Modelling and Drug Design-K. Anand Solomon-1st edition (2011)-MJP Publishers.

Course outcomes:

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

1. Acquire basic understanding of structures and functions of different biomolecules.
2. Obtain knowledge about the different metabolic pathways.
3. Explain different biological data and biological databases.
4. Understand classification of databases and how the biological data are stored in those databases.
5. Obtain the knowledge of different algorithms and programming languages to manage biological data.
6. Apply different tools and software for analysis of biological data.

Course Name : Biology for Engineers					
Course Code: BIOT4223					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

MODULE-I: BASIC CELL BIOLOGY [9L]

Prokaryotic and Eukaryotic cells, Cell theory; Cell structure and function, Cell organelles, Structure and function of DNA and RNA, Central Dogma; Genetic code and protein synthesis, differences between eukaryotic and prokaryotic protein synthesis

MODULE-II: BIOCHEMISTRY AND CELLULAR ASPECTS OF LIFE [9L]

Biochemistry of carbohydrates, proteins and lipids; Cell metabolism – Glycolysis, TCA cycle, Fermentation; Cell cycle and cell death; Stem cells and their applications, Basics of Mendelian Genetics

MODULE-III: ENZYMES AND INDUSTRIAL APPLICATIONS [9L]

Enzymes – significance, co-factors and co-enzymes, classification of enzymes; Enzyme kinetics, enzyme inhibition, models for enzyme action; Restriction enzymes; industrial applications of enzymes; enzymes in human gene therapy and disease diagnostics

MODULE-IV: BIODIVERSITY AND BIOENGINEERING INNOVATIONS [8L]

Molecular motors, Basics of neural networks; Tissue Engineering; Basic concepts of environmental biosafety, bioresources, biodiversity, bioprospecting, bioremediation, biosensors; recent advances in engineering designs inspired by examples in biology.

TEXT BOOKS:

1. Wiley Editorial, "*Biology for Engineers: As per Latest AICTE Curriculum*," Wiley-India, 2018.
2. S. ThyagaRajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, "*Biology for Engineers*," Tata McGraw-Hill, New Delhi, 2012.

REFERENCES:

1. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, "*Biochemistry*," W.H. Freeman and Co. Ltd., 6th Ed., 2006.
2. Robert Weaver, "*Molecular Biology*," MCGraw-Hill, 5th Edition, 2012.
3. Jon Cooper, "*Biosensors A Practical Approach*" Bellwether Books**,** 2004.
4. Martin Alexander, "*Biodegradation and Bioremediation,"* Academic Press, 1994.
5. Kenneth Murphy, "*Janeway's Immunobiology*," Garland Science; 8th edition, 2011.

Course Outcomes:

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

1. Understand the basic structure and function of cells and cellular organelles.
2. Understand the fundamental concepts of cellular reproduction and cell metabolism.
3. Characterize the different types of proteins, lipids and carbohydrates.
4. Analyze the mechanism of inheritance of characters through generations.
5. Understand and implement the working principles of enzymes and their applications in biological systems and industry.
6. Design and evaluate different environmental engineering projects with respect to background knowledge about bioresources, biosafety and bioremediation.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Basics of Mobile Computing					
Course Code: CSEN4221					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module 1: Introduction to Mobile Communication
Introduction to Mobile Computing, Cellular Mobile Wireless Networks:-Systems and Design Fundamentals, Frequency Reuse, Cochannel and Adjacent channel interference [3L]

First Generation Wireless Networks - AMPS, Second Generation (2G) Wireless Cellular Networks – GSM, 2.5G Wireless Networks-GPRS, CDMA (IS 95), Third Generation 3G Wireless Networks-UMTS, Fourth Generation 4G Wireless Networks-LTE Advanced [4L]

Fifth Generation 5G Wireless Networks: Architecture, Main features. MIMO concept. Convex Optimization based treatment of channel allocation. [4L]

Module 2: Wireless Media Access Control (MAC)
Wireless LAN – IEEE 802.11 [3L]

PAN-Bluetooth- Piconet, Scatternet, Connection Establishment, Protocol Stack [3L]

WiMax – IEEE 802.16. Physical layer, Modulation: OFDM; MIMO; Duplexing;

Protocol stack; MAC Layer; Network Architecture. [3L]

Module 3: Network Layering and Mobile Network Layer
Basics of Computer Networking – Layering & OSI.
Challenges from Mobile Environment. [4L]

Mobile IP: Goals, Entities, Agent Advertisement and Discovery, Registration. Tunnelling and Encapsulation, Reverse Tunnelling, [3L]

Cognitive Radio and Internet of Things. SDR: User and Control plane. [3L]

Module 4: Mobile Transport Layer
Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, routing and various routing algorithms- DSR, DSDV, AODV [4L]

Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP**,** ATCP, Transmission / Timeout Freezing Selective Retransmission, Transaction oriented TCP. [4L]

References:-

1. Mobile Communications, Jochen Schiller, 2nd Edition, Pearson Education, India.
2. Mobile Communication Systems, Krzysztof Wesolowski, Wiley
3. Wireless Communications: Principles & Practice, 2nd edition, Theodore S. Rappaport, Prentice Hall.
4. Wireless Communication: Stallings, Pearson

5. NPTEL materials on 5G from Aditya P Jagannath's lectures

6. A Survey of 5G Network: Architecture and Emerging Technologies by AKHIL GUPTA AND RAKESH KUMAR JHA, IEEE Access, 28 July, 2015

Course Outcome:

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

1. Understand the infrastructure to develop mobile communication system.
2. Analyze the measures taken to increase the capacity in mobile systems as well as in the entire protocol architecture.
3. Describe different inter-networking challenges and solutions in wireless mobile networks.
4. Analyze the modifications necessary in normal IP and TCP protocols to make them mobility enabled.
5. Learn the basics of Ad Hoc Networking Protocols.
6. Motivate the students to pursue research in the area of wireless communication and mobile computing field.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Comprehensive Viva Voce					
Course Code: AEIE4297					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**0**	**0**	**1**

Every student should appear before a panel duly constituted by the members of faculties of the department in order to evaluate his/her knowledge in various subjects learned during the four years of study of the B. Tech AEIE course.

Course Outcomes:
After the completion of the course, the students will be able to:
1. Answer questions from all the courses studied.
2. Attain oral presentation skills by answering questions in precise and concise manner.
3. Appear interview elegantly and confidently.
4. Judge themselves about their domain knowledge.
5. Develop habits of learning.
6. Gain confidence and inter-personal skills.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Project II					
Course Code: AEIE4295					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**16**	**16**	**8**

The student has to continue the project work done in seventh semester. At the end of eighth semester, the student has to appear in examination (viva-voce & demonstration) before the panel of examiners (both external and internal) to defense his/her work done in project. The candidate shall submit the project report in the prescribed format to the Head of the department, duly certified that the work has been satisfactorily completed.

Course Outcomes:

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

1. Demonstrate ability to identify and formulate real world engineering problems relevant to society needs; study its feasibility and methodology for implementation.
2. Apply knowledge of circuit design, sensor selection, signal processing, control system, embedded system and programming, etc., to implement the project work with proper time frame.
3. Implement hardware model along with its relevant software programming, conduct experiments, analyze and interpret data and explain them.
4. Prepare project report properly and demonstrate presentation confidently.
5. Develop regularity, engage in enduring learning, ability to work in a group and deal with existing project ethically.
6. Develop interpersonal communication skill and demonstrate sound technical knowledge of their project work.

Subject Name: Process Instrumentation					
Paper Code: AEIE4221					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [9L]

Introduction to process and instrumentation, static and dynamic characteristics of instruments, active and passive transducers; measurement methods and applications: displacement, strain, pressure, temperature, flow and level measurement.

Module II - [9L]

Introduction to process control, open and closed loop process, mathematical model and transfer function, dynamic behavior of first and second order processes; feedback controllers: on-off controllers, basic control modes, PID controllers.

Module III - [9L]

Control system instrumentation: transducers and transmitters, two wire and four wire transmitters, smart transmitters, final control elements; feedforward, ratio and cascade control; basic concept of stability.

Module IV- [9L]

Introduction to process automation, brief idea and application of PLC, DCS and SCADA; case study: boiler drum level control/ distillation column control.

References:

1. B. G. Liptak, *Instrumentation Engineers Handbook (Measurement),* Chilton Book Co.; 1994
2. John P. Bentley, *Principles of Measurement Systems,* Third edition, Addison Wesley Longman Ltd., UK, 2000.
3. E.O. Doebelin, *Measurement Systems - Application and Design,* Fourth edition, McGraw-Hill International Edition, New York, 1992.
4. U. A. Bakshi, A.V.Bakshi; *Instrumentation Engineering*; Technical Publications; 2009.
5. Harold E. Soisson; Instrumentation in Industry; John Wiley & Sons Canada, Limited, 1975.
6. B.E. Noltingk, *Instrumentation Reference Book,* 2nd Edition, Butterworth Heinemann, 1995.
7. L.D. Goettsche, *Maintenance of Instruments and Systems – Practical guides for measurements and control,* ISA, 1995.

Course Outcome:

Upon completing this course the student will be able to

1. Acquire knowledge about the characteristics of different process instruments.
2. Explain the working principle and functions of displacement, strain, pressure, temperature, flow and level measuring instruments.
3. Formulate the mathematical equation of the linear processes and derive their response.
4. Apply their knowledge of controllers and final control element in various control schemes for effective process control.
5. Gain knowledge of industrial signal transmission and transmitters.
6. Choose proper automation system for specific application.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: Medical Instrumentation					
Paper Code: AEIE4222					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**0**	**0**	**3**	**3**

Module I–[8L]

Transduction Principles: Transducers- Definition, principles of sensing and transduction, characteristics, classification, concept of signal conditioning; Body Temperature transducers- thermoresistive, thermoelectric, semiconductor, chemical thermometry and operating specifications; Blood Pressure transducer- Strain gauge type, variable capacitance type, LVDT and operating specifications; Blood Flow transducers- based on piezoelectric effects, electromagnetic effects, operating specifications; Acoustic Transducers- Heart sound.

Module II-[10L]

Bio-potentials and electrodes: Bio-potentials- Origin and electrical activity of cells, resting and action potentials of cells; Electrodes- Electrode theory and half-cell potential, Electrode-Electrolyte interface, types of electrodes: surface, needle and micro electrodes and respective applications. Electrode impedance, electrode jellies and creams; Measurement of electrical activities in Cardiovascular system- ECG, Einthoven's triangle, electrodes, amplifiers, cardiac pace-maker, defibrillator, Measurement of electrical activities in muscles and brain: EMG, EEG.

Module III-[10L]

Biomedical imaging: ultrasound imaging, radiography, CT scan, MRI and applications, Plethysmography;
Assisting and therapeutic instruments: Pacemakers, defibrillators, Hearing aids. Ventilators, Heart-lung machine, Diathermy;

Module IV-[8L]

Philosophy of biotelemetry and patient safety: transmission and reception aspects of biological signals via long distances; electrical safety of patients;
Measurements of blood pH, pCO_2, pO_2.

References:

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Second edition, Prentice-Hall India, 1997.

2. R.S. Khandpur, Handbook of Biomedical Instrumentation, 2 Edition, Tata McGraw Hill New Delhi, 1987.
3. John G. Webster, Medical Instrumentation application and design, Third edition, Wiley, 1997.
4. S. K. Venkata Ram, Biomedical Electronics and Instrumentation, Galgotia Publication Pvt. Ltd., New Delhi.
5. Geddes L.A and Baker L.E, Principles of Applied Biomedical Instrumentation, Third edition, Wiley-Interscience, 1989.

Course Outcomes:

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

1. Explain the fundamental principles and applications of different transducers used for body parameter measurements.
2. Understand the physiology of biomedical systems and different methods in the design of biomedical instruments.
3. Learn the different methods of medical imaging systems, concepts related to the operations and analysis of biomedical instruments.
4. Learn various therapeutic devices.
5. Design various type bio-telemetry system.
6. Aware of the importance of electrical safety and apply it in the design of different assisting.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: Disaster Response Services and Technologies					
Paper Code: HMTS4011					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	4	**0**	**0**	**4**	**4**

Module-I [10L]: Introduction

Definition of disaster, types of disasters, phases of disasters, factors contributing to disaster impact and severity, disaster profile of India, definition of disaster management, disaster management cycle, Disaster Management Act 2005, organizations involved in disaster management.

Module -II [10L]: Pre Disaster Services for Risk Reduction

Disaster Preparedness:

Disaster risk assessment, disaster risk reduction, preparedness plans, community preparedness, and emergency resource networks.

Disaster Mitigation:

Concepts of hazard, hazid, hazan and hazop as part of safety and risk management; types of vulnerabilities, vulnerability assessment, strategies for disaster mitigation, structural mitigation and non-structural mitigation, disaster mitigation initiatives in India.

Module-III [10L]: Post Disaster Services for Recovery

Disaster Response

Need for coordinated disaster response, SPHERE standards in disaster response, role of government, international agencies and NGOs, post disaster situation awareness, post disaster damage and need assessment.

Disaster Recovery and Reconstruction

Post disaster effects and remedial measures, creation of livelihood options, disaster resistant house construction, sanitation and hygiene, education and awareness, dealing with victims' psychology, long-term counter disaster planning.

Module-IV [10L]: Disaster Management Technologies

Emergency communication infrastructures; emerging technologies for disaster resilience - drones, VR/AR, social media technologies, real-time mapping system; examples of disaster management information systems; examples of smartphone/ web based applications for disaster management.

References

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies”, NewRoyal book Company.
2. Bhattacharjee Suman, Roy Siuli, Das Bit Sipra, "Post-disaster Navigation and Allied Services over Opportunistic Networks", Springer Verlag, Singapore.
3. Basu Souvik, Roy Siuli, Das Bit Sipra, "Reliable Post Disaster Services over Smartphone Based DTN: An End-to-End Framework", Springer, Singapore.
4. Sahni, Pardeepet.al. (Eds.),” Disaster Mitigation Experiences and Reflections”, Prentice Hall ofIndia, New Delhi.
5. Goel S. L., "Disaster Administration And Management Text and Case Studies", Deep &DeepPublication Pvt. Ltd., New Delhi.
6. Liu Zhi, Ota Kaoru, "Smart Technologies for Emergency Response and Disaster Management", IGI Global.
7. Rajib Shaw, "Disaster Risk Reduction - Methods, Approaches and Practices", Springer Verlag, Singapore.

Course Outcomes:

After the completion of this course, student will be able to

CO1: Recall the basic concepts and terminologies of disaster and disaster management.
CO2: Understand disaster risk assessment, risk reduction and community preparedness plans.
CO3: Interpret and characterize hazards, vulnerabilities and strategies for disaster mitigation.
CO4: Examine techniques for post disaster situation awareness, damage and need assessment.
CO5: Evaluate post disaster remedial measures and long-term recovery planning.
CO6: Design emergency communication infrastructures, technologies and services.