JSS MAHAVIDYAPEETHA

JSS SCIENCE AND TECHNOLOGY UNIVERSITY

SRI JAYACHAMARAJENDRA COLLEGE OF ENGINEERING, MYSURU

Scheme of Teaching and Examination 2020-21

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2020-21)

SCHEME OF TEACHING AND EXAMINATION FOR B.E IN ELECTRONICS AND INSTRUMENTATION ENGINEERING

Scheme of Teaching & Examination

Bachelor of Engineering
in
Electronics and Instrumentation Engineering

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION

2020 onwards

B.E in Electronics and Instrumentation Engineering

Scheme of Teaching

Sl. No.	Semester	Credits
1	I	20
2	II	20
3	III	25
4	IV	25
5	V	25
6	VI	25
7	VII	19
8	VIII	16
Total		175

Vision and Mission of the Department

VISION

To produce professionally competent engineers to face the global challenges in the field of Electronics, Instrumentation and Health care Engineering.

MISSION

1. To impart quality education based on in-depth and thorough understanding of fundamentals.

2. To provide practical exposure for students to face global challenges.

3. To facilitate R&D activities in the areas related to Electronics, Instrumentation, Signal Processing, Health care and Rehabilitation Engineering.

4. To encourage students to become Entrepreneurs.

5. To develop both personal and technical skills of young engineers who will contribute to the development of society.

Program Educational Objectives (PEOs)

1. Excel in professional career in Electronics, Instrumentation and allied Engineering disciplines.

2. Upgrade knowledge for technological advancement to use modern tools.

3. Exhibit leadership, team spirit and communication skills with commitment towards requirements of the society.

Program Specific Outcomes (PSOs)

The graduates of Electronics and Instrumentation Engineering program will be

1. Empowered with the knowledge of design and analysis of Electronics and Instrumentation systems required for industry, higher education and research.

2. Able to apply the concepts of design and development in Automation, Control and transmission by selecting suitable hardware and software tools for providing industrial solutions.

3. Having the knowledge of acquisition, processing and analysis of physical and physiological parameters for industrial and health care applications.

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SCHEME OF TEACHING AND EXAMINATION FOR B.E IN ELECTRONICS AND INSTRUMENTATION ENGINEERING

SEMESTER: III

Sl. No.	Course code	Course title	Category Code	Teaching Department	QP Setting Dept.	Contact Hours				Credits	Marks			SEE Duration in hrs.
						L	T	P	Total		CIE	SEE	Total	
1	**20MA310**	Mathematics III	BSC	Mathematics	Mathematics	3	0	0	3	3	50	50	100	03
2	**20EI310**	Circuit Theory and Analysis	PCC	EI	EI	3	2	0	5	4	50	50	100	03
3	**20EI320**	C++ and Data Structures	PCC	EI	EI	3	0	2	5	4	50	50	100	03
4	**20EI330**	Transducers and Instrumentation – I	PCC	EI	EI	3	0	0	3	3	50	50	100	03
5	**20EI340**	Analog Electronic Circuits	PCC	EI	EI	3	0	0	3	3	50	50	100	03
6	**20EI350**	Logic Design	PCC	EI	EI	3	0	0	3	3	50	50	100	03
7	**20HU311**	Universal Human Values (UHV)	HSMC	EI	EI	2	0	0	2	2	25	25	50	1.5
8	**20EI37L**	Analog Electronic Circuits Lab	PCC	EI	--	0	0	3	3	1.5	50	50	100	03
9	**20EI38L**	Logic Design Lab	PCC	EI	--	0	0	3	3	1.5	50	50	100	03
						Total contact hours			30	25		**Total marks**	850	

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SCHEME OF TEACHING AND EXAMINATION FOR B.E IN ELECTRONICS AND INSTRUMENTATION ENGINEERING

SEMESTER: IV

Sl. No.	Course code	Course title	Category Code	Teaching department	QP Setting Dept.	Contact Hours				Credits	Marks			SEE Duration in hrs.
						L	T	P	Total		CIE	SEE	Total	
1	**20MA410**	Mathematics IV	BSC	Mathematics	Mathematics	3	0	0	3	3	50	50	100	03
2	**20EI410**	Biomedical Instrumentation	PCC	EI	EI	4	0	0	4	4	50	50	100	03
3	**20EI420**	Signal Conditioning Circuits	PCC	EI	EI	4	0	0	4	4	50	50	100	03
4	**20EI430**	System Design Using HDL	PCC	EI	EI	3	0	2	5	4	50	50	100	03
5	**20EI440**	Signals and Systems	PCC	EI	EI	3	2	0	5	4	50	50	100	03
6	**20EI450**	Transducers and Instrumentation – II	PCC	EI	EI	3	0	0	3	3	50	50	100	03
7	**20EI47L**	Transducers and Instrumentation Lab	PCC	EI	EI	0	0	3	3	1.5	50	50	100	03
8	**20EI48L**	Signal Conditioning Circuits Lab	PCC	EI	EI	0	0	3	3	1.5	50	50	100	03
9	**20HU412**	Environmental studies	HSMC	Environmental Engineering	--	2	0	0	2	0	50	-	50	-
Total credits										25	**Total marks**		850	

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SCHEME OF TEACHING AND EXAMINATION FOR B.E IN ELECTRONICS AND INSTRUMENTATION ENGINEERING

SEMESTER: V

Sl. No.	Course code	Course title	Category Code	Teaching department	QP Setting Dept.	Contact Hours				Credits	Marks			SEE Duration in hrs.
						L	T	P	Total		CIE	SEE	Total	
1	**20EI510**	Process Control	PCC	EI	EI	4	0	0	4	4	50	50	100	03
2	**20EI520**	Control Systems	PCC	EI	EI	3	2	0	5	4	50	50	100	03
3	**20EI530**	Microcontrollers and Applications	PCC	EI	EI	4	0	0	4	4	50	50	100	03
4	**20EI540**	Digital Signal Processing	PCC	EI	EI	4	0	0	4	4	50	50	100	03
5	**20EI55x**	Professional Elective-I	PEC	EI	EI	3	0	0	3	3	50	50	100	03
6	**20EI56x**	Open Elective-I	OEC	EI	EI	3	0	0	3	3	50	50	100	03
7	**20EI57L**	Microcontrollers Lab	PCC	EI	EI	0	0	3	3	1.5	50	50	100	03
8	**20EI58L**	Digital Signal Processing Lab	PCC	EI	EI	0	0	3	3	1.5	50	50	100	03
9	**20HU511**	Essence of Indian Traditional Knowledge	HSMC	Humanities	--	2	0	0	2	0	50	-	50	-
									Total credits	25	**Total marks**		850	

course code	Professional Elective-I
20EI551	Industrial Communication
20EI552	Aeronautical Instrumentation
20EI553	Operating Systems

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SCHEME OF TEACHING AND EXAMINATION FOR B.E IN ELECTRONICS AND INSTRUMENTATION ENGINEERING

SEMESTER: VI

Sl. No	Course code	Course title	Category Code	Teaching department	QP Setting Dept.	Contact Hours				Credits	Marks			SEE Duration in hrs.
						L	T	P	Total		CIE	SEE	Total	
1	**20EI610**	Mathematics for Signal Analysis	PCC	EI	EI	3	2	0	5	4	50	50	100	03
2	**20EI620**	Automation in Process Control	PCC	EI	EI	4	0	0	4	4	50	50	100	03
3	**20EI630**	Python Programming and Raspberry Pi	PCC	EI	EI	3	0	0	3	3	50	50	100	03
4	**20EI64x**	Professional Elective-II	PEC	EI	EI	3	0	0	3	3	50	50	100	03
5	**20EI65x**	Open Elective-II	OEC	EI	EI	3	0	0	3	3	50	50	100	03
6	**20EI66x**	Open Elective-III	OEC	EI	EI	3	0	0	3	3	50	50	100	03
7	**20EI67L**	Process Control and Automation Lab	PCC	EI	EI	0	0	3	3	1.5	50	50	100	03
8	**20EI68L**	Python Programming and Raspberry Pi Lab	PCC	EI	EI	0	0	3	3	1.5	50	50	100	03
9	**20EI69P**	Mini Project	PWC	EI	--	--	--	--	--	2	50	--	50	--
10	**20HU612**	Constitution of India and Professional Ethics	HSMC	Humanities		2	0	0	0	--	50	--	50	--
									Total credits	25		**Total marks**	900	

Course code	Professional Elective-II
20EI641	Automobile Instrumentation
20EI642	Digital Image Processing
20EI643	Computer Networks

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SCHEME OF TEACHING AND EXAMINATION FOR B.E IN ELECTRONICS AND INSTRUMENTATION ENGINEERING

SEMESTER: VII

Sl. No.	Course code	Course title	Category Code	Teaching Department	QP Setting Dept.	Contact Hours				Credits	Marks			SEE Duration in hrs.
						L	T	P	Total		CIE	SEE	Total	
1	**20EI710**	Management course	HSMC	EI	EI	4	0	0	4	4	50	50	100	03
2	**20EI72x**	Professional Elective-III	PEC	EI	EI	3	0	0	3	3	50	50	100	03
3	**20EI73x**	Professional Elective-IV	PEC	EI	EI	3	0	0	3	3	50	50	100	03
4	**20EI74x**	Open Elective-IV	OEC	EI	EI	3	0	0	3	3	50	50	100	03
5	**20EI75x**	Open Elective-V	OEC	EI	EI	3	0	0	3	3	50	50	100	03
6	**20EI76P**	Project Work Phase - 1	PWC	EI	--	--	--	--	--	2	50	--	50	--
7	**20EI77P**	Industrial training /Internship	PWC	--	--	-	-	-	-	1	50	--	50	--
									Total credits	19	**Total marks**		600	

Course code	Professional Elective-III	Course code	Professional elective-IV*
20EI721	Analytical Instrumentation	**20EI731**	Industrial Instrumentation
20EI722	CMOS Integrated Circuit Design	**20EI732**	Medical Imaging Systems
20EI723	Robotics	**20EI733**	Micro and Smart Systems Technology

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SCHEME OF TEACHING AND EXAMINATION FOR B.E IN ELECTRONICS AND INSTRUMENTATION ENGINEERING

SEMESTER: VIII

Sl. No	Course code	Course title	Category Code	Teaching department	QP Setting Dept.	Contact Hours				Credits	Marks			SEE Duration in hrs
						L	T	P	Total		CIE	SEE	Total	
1	**20EI81x**	Professional Elective-V	PEC	EI	EI	3	0	0	3	3	50	50	100	03
2	**20EI82x**	Professional Elective-VI	PEC	EI	EI	3	0	0	3	3	50	50	100	03
3	**20EI83P**	Project work Phase - 2	PWC	EI	--	--	--	--	--	10	70	30	100	03
									Total credits	16	**Total marks**		300	

Course code	Professional Elective-V	Course code	Professional Elective-VI
20EI811	IoT and Smart Sensors	**20EI821**	Photovoltaic Theory and Design
20EI812	Lasers and Optical Instrumentation	**20EI822**	Fuzzy Logic and Applications
20EI813	Biomedical Signal Processing	**20EI823**	Rehabilitation Engineering

List of SWAYAM Courses (for Professional Elective – IV)

Sl. No.	Course title	No. of weeks
1	Innovation by Design	4
2	Cognition, Emotion and Transformation	
3	Design Thinking - A Primer	
4	Product Design and Development	
5	Stress Management	
6	Python for Data science	
7	Ergonomics Work Place Analysis	
8	Body language : Key to Professional Success	
9	Design, Technology and Innovation	8
10	Developing Soft Skills and Personality	
11	Introduction to Basic Cognitive Processes	
12	Corporate Social Responsibility	
13	Introduction to R Software	
14	Data science for Engineers	
15	Solar Energy Engineering and Technology	12
16	Introduction to Industry 4.0 and Industrial Internet of Things	
17	Enclosure Design of Electronic Equipment	
18	Design of Mechatronics	
19	Essential Mathematics for Machine Learning	
20	Soft Skills	

(Students can complete 12 Weeks of SWAYAM course/s from 3rd to 6th Semester to claim exemption of Elective - IV)

List of open electives

Sl. No.	Semester	Elective	Course Code	Course Title
1	**5**	**Open Elective – 1**	**20EI561**	Transducers and Applications
2			**20EI562**	Fundamentals of Biomedical Instrumentation
3			**20EI563**	Aircraft Instrumentation
4	**6**	**Open Elective – 2**	**20EI651**	Automotive Instrumentation
5			**20EI652**	Physiological Signal Processing
6			**20EI653**	Ergonomics for Engineers
7		**Open Elective – 3**	**20EI661**	Introduction to Lasers and Optical Instrumentation
8			**20EI662**	Healthcare Data Analytics
9			**20EI663**	Process Control and Automation
10	**7**	**Open Elective – 4**	**20EI741**	Robotics and Industrial Automation
11			**20EI742**	Medical Imaging Systems
12			**20EI743**	Rehabilitation Engineering
13		**Open Elective - 5**	**20EI751**	Industrial Instrumentation – Case Studies
14			**20EI752**	Machine Learning in Health Care
15			**20EI753**	MEMS and their Applications

Course Title: Engineering Mathematics -III	***Course Code: 20MA310***
Credits (L:T:P): 3:0:0	***Total Contact Hours: 39:0:0***
Type of Course: Lecture	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Engineering Mathematics-I and Engineering Mathematics-II

Course Outcomes: After completing this course, students should be able to

CO1	Apply numerical techniques to solve Engineering problems and fit a least squares curve to the given data.
CO2	Test the system of linear equations for consistency and solve system of ODE's using matrix method
CO3	Examine and construct the analytic functions.
CO4	Classify singularities of complex functions and evaluate complex integrals.
CO5	Construct the Fourier series expansion of a function/tabulated data.

Unit No.	Course Content	No. of Hours
1	**Numerical solution of Ordinary differential equations:** Taylor's series method, Euler's and modified Euler's method, fourth order Runge-Kutta method. **Statistics:** Curve fitting by the method of least squares, fitting linear, quadratic and geometric curves. Correlation and Regression.	8
2	**Linear Algebra:** System of linear equations, Row operations, Echelon form Reduced Echelon form, Solution of Homogeneous and Nonhomogeneous equations, vector equations, Linear combinations, Linear independent/dependent vectors, Eigen values, Eigen vectors, Diagonalizations, Solving a system of differential equations using diagonalization.	8
3	**Complex Variables-I:** Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Consequences of Cauchy-Riemann equations, Construction of analytic functions. **Transformations:** Conformal transformation, Discussion of the transformations: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$, $w=\cosh z$. Bilinear transformation	8
4	**Complex Variables-II:** Complex integration, Cauchy theorem, Cauchy integral formula, Taylor and Laurent series (statements only), Singularities, Poles and residues, Cauchy residue theorem.	8
5	**Fourier Series:** Periodic functions, Fourier Expansions, Half Range Expansions, Complex form of Fourier series, Practical Harmonic Analysis.	7

Text Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley publication, 10th edition, 2015.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th edition, 2017.

Reference Books:

1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th edition, 2010.
2. Dennis G. Zill, Michael R. Cullen, "Advanced Engineering Mathematics", Jones and Barlett Publishers Inc., 3rdedition, 2009.
3. Dennis G. Zill and Patric D. Shanahan, "A first course in complex analysis with applications", Jones and Bartlett publisher, Second edition, 2009.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	2	2	0	0	0	0	0	0	0	0	0	0	2	0	1
CO2	2	2	0	0	0	0	0	0	0	0	0	0	2	0	2
CO3	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0
CO4	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0
CO5	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Circuit theory and analysis	***Course Code: 20EI310***
Credits (L:T:P): 3:1:0	***Total Contact Hours: 39:26:0***
Type of Course: Lecture + Tutorial	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Elements of Electrical and Electronics Engineering.

Course Outcomes: After completing this course, students should be able to

CO1	Recall the fundamentals of electrical circuits and simplify any given circuit.
CO2	Solve for the circuit parameters by reducing the given circuit.
CO3	Illustrate the behavior of circuit elements and analyze the behavior of the circuits.
CO4	Analyze the given circuits using different methods.
CO5	Determine the performance parameters of the given circuits.

Unit No.	Course Content	No. of Hours
1	**Basic concepts:** Introduction, Network terminologies, Review of KVL & KCL, Energy sources – ideal & practical, Source Transformations, Mesh Analysis of DC & AC circuits, Nodal analysis of DC & AC circuits, Star – Delta transformations.	10
2	**Network Theorems:** Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.	06
3	Transient behavior and initial conditions: Behavior of circuit elements under switching condition and their representation, evaluation of initial and final conditions using differential equations of circuits with AC and DC excitation.	08
4	**Circuit Analysis using Laplace Transforms:** Step response of RL, RC & RLC circuits, Circuit analysis with LT using partial fraction expansion.	06
5	**Resonance and Two port parameters:** Series resonance: resonant frequency, reactance curves, voltage & current variation with frequency, Selectivity & bandwidth, Q – factor, circuit magnification factor Selectivity with variable C & variable L. Parallel resonance: resonant frequency, impedance, selectivity, bandwidth Maximum impedance conditions with C, L, & f variable, current & Q – factor. Two Port parameters: Short circuit admittance parameters, Open circuit impedance parameters, Transmission parameters, Hybrid parameters, relationships between parameters.	09

Text Book:

1. J. David Irwin, R. Mark Nelms, "Basic Engineering Circuit Analysis", 8th edition, John Wiley & Sons, 2006.

Reference Books:

1. William H.Hayt, Jr, Jack E.Kimmerly, Steven M.Durbin, "Engineering Circuit Analysis",6th edition, Tata McGraw-Hill, 2002.
2. D. Roy Choudhury, "Networks and Systems", New Age International, Reprint 2005.
3. M.E.VanValkenburg,"Network Analysis", 3rd edition, PHI, Reprint 2006.

Web Resources:

http://nptel.ac.in/courses/108102042/

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	3	0	0	1	0	0	0	1	0	0	1	0	0	0
CO2	3	1	0	0	1	0	0	0	1	0	0	0	1	0	0
CO3	3	3	0	0	3	0	0	0	1	0	0	1`	1	0	1
CO4	3	3	0	1	3	0	0	0	1	0	0	2	2	0	1
CO5	3	3	0	1	3	0	0	0	1	0	0	1	1	0	0

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: C++ and Data Structures	*Course Code: 20EI320*
Credits (L:T:P): 3:0:1	*Total Contact Hours: 39:0:26*
Type of Course: Lecture + Practical	*Category: Professional Core Course*
CIE Marks: 50	*SEE Marks: 100*

Pre-requisite: Problem solving using C.

Course Outcomes: After completing this course, students should be able to:

CO1	Recall procedural systems and describe the object-oriented programming (OOPs) approach in connection with C++.
CO2	Demonstrate the use of various OOPs concepts with the help of programs.
CO3	Develop programs based on the concepts of operator overloading, polymorphism, inheritance and pointers.
CO4	Explain different types of data structures, operations, algorithms and implement them using C++ .
CO5	Demonstrate the use of various OOPs concepts with the help of programs.

Unit No.	Course Content	No. of Hours
1	**C++ programming Basics**: Need of object oriented programming, procedural languages, characteristics of OOPs, preprocessor directives, data types, manipulators, Type Conversion. Structures: Structures, enumerated data types, Boolean type, Functions: passing arguments, returning values, reference arguments, overloaded functions, inline functions, Default Arguments variable and storage classes.	08
2	**Objects and classes**: objects as data types, constructors, destructors, Objects as Function Arguments, Returning Objects from Function. Arrays: Arrays as class member data types, passing arrays, arrays as objects, strings, arrays of strings.	07
3	**Operator overloading and Inheritance**: overloading of unary operators, binary operators, Data conversion. Inheritance, derived class and base class, derived class constructors, overriding member functions, scope resolution, inheritance in the English distance class, class hierarchies, public and private inheritance, levels of inheritance, multiple inheritance, ambiguity in multiple inheritance.	08
4	**Pointers**: pointers to objects, virtual functions, static functions, files and streams, Linked List, input/output operations.	08
5	**Data structures**: Linear List - Array representation, Linear List – Linked representation, Arrays and matrices and their applications. Stacks: Array representation, linked representation, queues array representation, linked representation, skip lists and hashing, binary trees and their applications.	08

LIST OF EXPERIMENTS:

Write C++ programs,

1. On Basics of OOPs and functions
   a) Count the number of words in a phrase typed in by the user.
   b) Implement Different Function Call Mechanisms,
      i) Call by reference. ii) Call by value

c) Implement
i) Function overloading ii) Default arguments
d) Show the effect of declaring a variable as automatic external and static.

2. On Classes and Objects
   a) Constructor and destructor.
   b) Pass and Return an object from function.
3. On Arrays and String
   a) Software stack.
   b) String functions.
4. On Operator overloading
   a) Overload Unary operators.
   b) Overload Binary Operators.
5. Data conversion
   a) Conversion between basic type and user defined type.
   b) Conversion between objects of two different classes.
6. On Inheritance
   a) Inheritance and Function Overriding.
   b) Multiple inheritances.
   c) Multilevel inheritance.
   d) Access Specifiers.
7 On Pointers
   a) **S**ort an array of integer using pointers
   b) Implement pointer to an object using 'New' and 'delete' operator.
   c) Show the effect of declaring a function as static.
   d) Show the effect of declaring a function as Virtual.
   e) Read/Write data from/to a file.
   f) Implement Linked List.
8. To implement
   a) Linear List
   b) Stack
9. To implement
   a) Queue
   b) Skip list
10. To implement
   a) Hash Table
   b) Binary tree

Text Books:

1. RobertLafore,"Object oriented programming in TURBO C++",4th edition, Galgotia Publications, 2014.
2. SartajSahni, "Data Structures, Algorithms and Applications in C++", 2nd edition, Tata Mc Graw Hill Publications, 2009.

Reference Books:

1. E Balaguruswamy, "Object Oriented Programming with C++", 3rd edition, TMH, 2006.
2. Herbert Schildt, "C++ the complete reference", 4thedition, TMH, 2003.
3. D.S.Malik, "Data Structures using C++", 2nd editionThomson learning, 2003.
4. Tanenbaum A. M, "Data Structures Using C and C++", 2nd edition, Pearson Education, 2007.

Web Resources:

1. http://nptel.ac.in/courses/106106127/
2. http://nptel.ac.in/courses/106103069/

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0
CO2	0	2	2	0	0	0	0	0	0	0	0	0	0	2	0
CO3	0	2	2	0	0	0	0	0	0	0	0	0	0	3	0
CO4	0	2	3	0	0	0	0	0	0	0	0	0	0	3	0
CO5	3	2	3	0	0	0	0	0	0	0	0	0	0	3	0

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Transducers and Instrumentation - I	*Course Code: 20EI330*
Credits (L:T:P): 3:0:0	*Total Contact Hours: 39:0:0*
Type of Course: Lecture	*Category: Professional Core Course*
CIE Marks: 50	*SEE Marks: 100*

Pre-requisite: Engineering Physics, Elements of Electronic Engineering.

Course Outcomes: After completing this course, students should be able to

CO1	Identify the fundamental elements of a system, errors associated with measurement and methods of minimization of errors.
CO2	To find static and dynamic characteristics of a measuring system.
CO3	Analyze the bridge used for measurement of passive parameter.
CO4	Discuss the working principle, characteristics and applications of a transducer.
CO5	Identify the appropriate transducer for the measurement of physical parameter.

Unit No.	Course Content	No. of Hours
1	**Generalized configurations & functional descriptions of measuring instruments:** Functional elements of an instrument, I/O configuration of measuring instruments & instrument system, Methods of correction for interfering & modifying inputs. **Generalized performance characteristics of instruments:** Static characteristics and Dynamic characteristics, Generalized static stiffness & input impedance, Measurement Errors- Gross errors, Systematic errors and Absolute errors.	10
2	**Measurement of Resistance, Inductance, Capacitance and Q factor**: Wheatstone bridge, sensitivity analysis, limitations, Kelvin double bridge, Maxwell bridge, Schering bridge, Sources and detectors.	07
3	**Measurement of displacement:** Principle of measurement of displacement, Resistive potentiometers, Resistance strain gages, Variable inductance & variable reluctance pickups, LVDT, Capacitance pickup.	06
4	**Force, torque & shaft power Measurement:** Principle of measurement of force, Torque, Shaft power standards and calibration, Basic methods of force measurement, Characteristics of elastic force transducer- Bonded strain gauge, Piezo-electric transducer, Torque measurement on rotating shafts, Shaft power measurement (Dynamometers).	06
5	**Contact type Temperature measurement:** Standards & calibration, Thermal expansion methods - Bimetallic thermometers, Liquid-in-glass thermometers, Pressure thermometers, Thermoelectric sensor (Thermocouple) - Common thermocouples, Reference junction consideration, Electrical resistance sensors - Conductive sensor (Resistance thermometers), Bulk semiconductors sensors, Thermistor, Junction semiconductor sensors (AD590) and Digital thermometers. **Non- contact type Temperature measurement:** Radiation methods- Radiation fundamentals, Radiation detectors, Automatic null balance radiation thermometers, Optical pyrometers, Two color radiation thermometers, Black body tipped fiber optic radiation thermometer, IR imaging systems, Fluro-optic temperature measurement.	10

Text Books:

1. Ernest O Doebelin, "Measurement Systems", 6th Edition,TMH, 2007
2. A.K.Sawhney, "Electrical &Electronic Measurement and Instrumentation", 10th Edition, DhanpatRai & sons, Delhi.

Reference Books:

1. B G Liptak, "Instrument Engineers Hand book (Process Measurement.)", 3rd Edition, Chilton book, 1995.
2. Rangan Sharma Mani, "Instrumentation Devices and Systems", 2nd Edition, TMH.
3. Murthy.D.V.S. , "Transducers and Instrumentation" , 2nd Edition, PHI, 2008.
4. H. S. Kalsi, "Electronic Instrumentation" , McGraw Hill, 3rd Edition, 2012,

Web Resources:

1. https://nptel.ac.in/courses/108/105/108105064/
2. https://nptel.ac.in/courses/108/108/108108147/

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	1	1	0	0	0	0	3	0	0	1
CO2	3	2	1	0	0	1	2	0	0	0	0	3	0	1	0
CO3	3	3	3	1	0	1	2	0	0	0	2	3	2	1	3
CO4	3	3	3	2	2	1	3	0	2	0	2	3	3	3	3
CO5	3	2	2	1	1	1	1	0	0	0	3	3	3	2	3

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Analog Electronic Circuits	***Course Code: 20EI340***
Credits (L:T:P): 3:0:0	***Total Contact Hours: 39:0:0***
Type of Course: Lecture	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Elements of Electronic Engineering

Course Outcomes: After completing this course, students should be able to

CO1	Understand the concepts of DC and AC analysis of BJT and MOSFET circuits
CO2	Illustrate the working principles of various amplifiers and oscillators
CO3	Evaluate the performance parameters of amplifier and oscillator circuits
CO4	Design amplifiers and oscillators
CO5	Explain the concepts of feedback amplifiers and power amplifiers

Unit No.	Course Content	No. of Hours
1	**Transistor biasing** - Fixed bias, emitter bias and voltage divider bias, bias stabilization, stability factor, thermal runaway. **BJT AC analysis**- r_e model and hybrid equivalent model for CE,CC and CB configurations, cascaded systems, Darlington connection. **Frequency response of BJT amplifiers** - Low frequency response of BJT amplifier, Miller effect capacitance, high frequency response of BJT amplifier.	09
2	**MOS Field-Effect Transistor (MOSFETs):** Device structure and physical operation, current voltage characteristics, MOSFET circuits at DC, MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits. **MOSFET AC Analysis:** Small signal operation and models, single stage MOS amplifiers, MOSFET internal capacitances and high frequency model, frequency response of CS amplifier.	08
3	**Differential amplifiers**: Operation with a Common-Mode Input Voltage and Differential Input voltage. Small-Signal Operation of the MOS Differential Pair: Differential Gain and Common Mode Rejection Ration (CMRR). Non-ideal Characteristics of the Differential Amplifier: Input Offset Voltage of the Differential Pair, Input Common-Mode Range.	08
4	**Power Amplifiers**: Types of amplifiers, series fed class A amplifier, transformer coupled class A amplifier, class B push pull amplifier and class AB amplifiers, amplifier distortion.	07
5	**Feedback Amplifiers and Oscillators**: Concepts of feedback, types of feedback, practical feedback circuits. Oscillator operation, Phase shift, Wien Bridge, Tuned and Crystal oscillators.	07

Text Books:

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory",11th Edition, Pearson, 2015.
2. Adel S. Sedra Kenneth C. Smith, "Microelectronic Circuits, Theory and Applications", 7th Edition, Oxford University Press, 2017.
3. Donald A Neamen, "Microelectronics: Circuit Analysis and Design", Fourth edition, Mc Graw Hill, 2021.

Reference Books:

1. Behzad Razavi, "Fundamentals of Microelectronics", 2nd Edition, Wiley, 2013.
2. M.H Rashid, " Microelectronics circuits Analysis and Design", 2nd Edition, 2011,Thomson.

Web Resources:

3. https://nptel.ac.in/courses/117101106
4. https://nptel.ac.in/courses/108102095

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	3	3	2	0	0	0	0	0	0	0	1	3	0	1
CO2	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0
CO3	3	2	3	3	3	0	0	0	0	0	0	2	3	2	2
CO4	3	0	3	3	3	0	0	2	0	0	0	2	3	2	0
CO5	3	3	3	0	0	0	0	0	0	0	0	1	1	0	1

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Logic Design	*Course Code: 20EI350*
Credits (L:T:P): 3:0:0	*Total Contact Hours: 39:0:0*
Type of Course: Lecture	*Category: Professional Core Course*
CIE Marks: 50	*SEE Marks: 100*

Pre-requisite: Elements of Electronic Engineering.

Course Outcomes: After completing this course, students will be able to,

CO1	Recall the fundamentals of Boolean algebra to simplify and realize digital circuits using universal gates.
CO2	Construct truth table and Boolean expression for an application, and propose a cost effective circuit.
CO3	Design circuits using MSI components.
CO4	Learn the operation of a basic memory unit (Flip flop) and design shift registers and counters.
CO5	Design and analyze simple sequential circuits.

Unit No.	Course Content	No. of Hours
1	**Boolean Algebra and Combinational Networks:** Min/Maxterms, Canonical formula, Complements of equations, Combinational network, Circuit realization using universal gates. **Simplification of Boolean Expressions:** Prime implicants, Prime Implicates, Essential prime implicants, Essential prime implicates, Three, four variables Karnaugh Maps, Sum of Products, Product of Sums, Code converters: Binary to BCD, BCD to Binary, BCD to Excess-3, Excess-3 to BCD, Binary to Gray, Gray to Binary, The Variable Entered Maps.	09
2	**Logic Design with MSI Components**: Binary parallel adders and Subtractors, Design of BCD to Excess-3 and Excess-3 to BCD using parallel adders, Lookahead carry adder, Decimal adders, Design of one bit and 2 bits magnitude comparators, study of 4 bit comparator, Encoders, Priority encoders, Decoders, Multiplexers, Realization of Boolean expression/Canonical expressions using Decoders, Multiplixers.	08
3	**Flip Flops and Applications:** SR Flip Flop, RS Flip Flop, Switch debouncer, Gated SR, Gated D Flip Flops, JK Flip Flops, Master Slave Flip Flops, Race around condition, Shift Registers, Universal shift register,	08
4	**Design of Counters:** Shift register based counters, Mod N Binary ripple counters using clocked T, JK, D Flip Flops, Synchronous Binary counters using clocked T, SR, JK, and D Flip Flops.	08
5	**Synchronous Sequential Networks:** The excitation and Transition equations, the excitation and transition tables, state tables, state diagrams.	06

Text Books:

1. Donald D.Givone, “Digital Principles and Design”, TMH, 2002.
2. John M Yarborgh, “Digital Logic Applications & Design”, Thomson learning, 2006.

Reference Books:

1. Charles H Roth Jr, "Fundamental of Logic design", Thomson learning, 2004
2. Ronald J Tocci, "Digital Systems Principles and Applications", PHI, 2001.

Web Resources:

1. http://nptel.ac.in/courses/117106086/1
2. https://swayam.gov.in/course/1392-digital-circuits-and-systems

Course Outcomes	Program Outcomes (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	3	3	0	3	0	0	0	0	0	0	1	0	1	0
CO2	3	3	3	2	3	0	0	1	0	0	0	2	1	3	2
CO3	3	0	3	2	3	0	0	1	0	0	0	2	2	3	2
CO4	3	1	3	3	3	0	0	1	0	0	0	2	3	3	2
CO5	3	3	3	3	3	0	0	1	0	0	0	2	3	3	2

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Universal Human Values	***Course Code: 20HU311***
Credits (L:T:P): 2:0:0	***Total Contact Hours: 26:0:0***
Type of Course: Lecture	***Category: Professional Core Course***
CIE Marks: 25	***SEE Marks: 25***

Pre-requisites: Students Induction Program (desirable).

Course Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes (COs): After the completion of the course a student will –

1. **CO1:** Become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, keeping human relationships and human nature in mind.
2. **CO2:** Have better critical ability and also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

Syllabus:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Health.

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
14. Understanding the meaning of Trust; Difference between intention and competence
15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all pervasive space
21. Holistic perception of harmony at all levels of existence.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
26. Case studies of typical holistic technologies, management models and production systems
27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
28. Sum up.

Text Books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

References:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal

9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Weblinks:

1. https://onlineethics.org/

CO-PO Mapping (Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	0	0	0	0	0	1	2	2	0	0	0	0
CO2	0	0	0	0	0	1	1	1	0	0	0	0

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Analog Electronic Circuits Laboratory	*Course Code: 20EI37L*
Credits (L:T:P): 0:0:1.5	*Total Contact Hours: 0:0:39*
Type of Course: Practical	*Category: Professional Core Course*
CIE Marks: 50	*SEE Marks: 50*

Pre-requisite: Elements of Electronic Engineering

Course Outcomes: After completing this course, students should be able to

CO1	Apply the fundamental knowledge of basic electronics and design the various circuits.
CO2	Test the designed circuits and observe the outcomes.
CO3	Analyze and draw inference/ conclusion on the results obtained.
CO4	Express/demonstrate the importance and applications of various circuits.

List of experiments

1. Low pass and High pass RC circuits
2. Clipping circuits
3. Clamping circuits
4. Rectifier circuits
5. RC coupled amplifier
6. Darlington emitter follower
7. FET amplifier
8. RC phase shift oscillator
9. FET Colpitts oscillator
10. Crystal oscillator
11. Class B push pull amplifier
12. Voltage regulator

Course Outcomes	**Program Outcomes**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	2	3	0	0	0	0	2	3	0	0	3	1	0	0
CO2	3	2	2	0	0	0	0	2	3	0	0	1	1	0	0
CO3	3	3	0	0	0	0	0	2	3	0	0	2	1	0	0
CO4	3	0	0	0	0	0	0	2	3	0	3	0	0	0	0

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Logic Design Lab	***Course Code: 20EI38L***
Credits (L:T:P): 0:0:1.5	***Total Contact Hours: 0:0:39***
Type of Course: Practical	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 50***

Pre-requisite: Elements of Electronic Engineering.

Course Outcomes: After completing this course, students will be able to,

CO1	Apply the fundamental knowledge of Boolean algebra to simplify and realize using logic gates.
CO2	Design various circuits using MSI chips.
CO3	Test the various circuits which have been designed & draw the inference on the result obtained.
CO4	Demonstrate the importance & application of the circuit individually & in a team effectively.

LIST OF EXPERIMENTS:

1. Realization of a given Boolean expression using universal gates (Simplification of the expression using K Map).
2. Realization of half/full adder and half/full subtractor using logic gates .
3. Realization of parallel adder/ subtractor and Excess-3 code and Excess -3 to BCD
4. Realization of Binary to Gray code converter and vice versa.
5. Realization of Arithmetic circuits and code converters using Multiplexer IC.
6. Realization of Arithmetic circuits and code converters circuits using Decoder IC.
7. Realization of one bit comparators and study of 4 bit magnitude comparator (7485).
8. Use of decoder chip to drive LED display and Priority encoder.
9. Demonstration of clocked SR, T, D, JK, JK master slave Flip Flops using logic gates.
10. Study of 7490,74192,74193 ICs and realization of MOD N counter.
11. Study of Shift Register 7495 and realization of Johnson and ring counter using 7495 IC.
12. Design of Sequence Counters using 7476 IC.

Course Outcomes	**Program Outcomes**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	2	3	0	0	0	0	2	3	0	0	3	0	0	0
CO2	3	2	3	0	0	0	0	2	3	0	0	1	1	0	0
CO3	3	1	3	0	0	0	0	2	3	2	0	2	1	0	0
CO4	3	0	0	0	0	0	0	2	3	0	3	0	1	0	0

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Syllabus
IV
Semester

Course Title: Engineering Mathematics -IV	***Course Code: 20MA410***
Credits (L:T:P): 3:0:0	***Total Contact Hours: 39:0:0***
Type of Course: Lecture	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Engineering Mathematics-I and Engineering Mathematics-II

Course Outcomes: After completing this course, students should be able to

CO1	Find functional values, derivatives, areas and volumes numerically from a given data
CO2	Evaluate Fourier transforms and use Z-transforms to solve difference equations
CO3	Analyze the given random data and its probability distributions
CO4	Determine the parameters of stationary random processes and use Markov chain in prediction of future events
CO5	Obtain the series solution of ordinary differential equations.

Unit No.	Course Content	No. of Hours
1	**Numerical Differentiation and Numerical Integration**: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's1/3rd rule and Simpson's 3/8th rule. Applications to Engineering problems.	8
2	**Fourier Transforms:** Finite and Infinite Fourier transform, basic properties, convolution theorem; inverse transforms; applications to solution of ordinary and partial differential equations. **Z-transforms:** z-transforms and inverse z-transforms; solution of difference equations.	8
3	**Random Variables:** Random variables (discrete and continuous), Probability density function, Cumulative distribution function, Mean, Variance and Moment generating function. **Probability Distributions:** Binomial and Poisson distributions, Exponential distribution and Normal distribution. Applications to Engineering problems.	8
4	**Joint probability distribution:** Joint probability distribution, Discrete and independent random variables, Expectation, Covariance, Correlation coefficient. Probability vectors, stochastic matrices, fixed point matrices, Regular stochastic matrices, Markov chains, Higher transition-probabilities, stationary distribution of regular markov chains and absorbing states.	8
5	**Series Solution of ODEs and Special Functions:** Series solution, Frobenius method, Series solution of Bessel differential equation leading to Bessel function of first kind, Orthogonality of Bessel functions, Series solution of Legendre differential equation leading to Legendre polynomials, Orthogonality of Legendre Polynomials, Rodrigue's formula**.**	7

Text Books:

1. R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Delhi, 9th edition, 2012.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th edition, 2017.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley publication, 10th edition, 2015.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th edition, 2010.
3. Kishor S. Trivedi, "Probability & Statistics with reliability, Queuing and Computer Science Applications", John Wiley & Sons, 2nd edition, 2008.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0
CO2	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0
CO3	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0
CO4	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0
CO5	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0

0 -- No association, 1---Low association, 2--- Moderate association, 3---High association

Course Title: Biomedical Instrumentation	***Course Code: 20EI410***
Credits (L:T:P): 4:0:0	***Total Contact Hours: 52:0:0***
Type of Course: Lecture	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Transducers and Instrumentation-I

Course Outcomes: After completing this course, students should be able to

CO1	Explain the origin of various biological signals that are useful for diagnostic purpose.
CO2	Express the importance of the arrangement of electrodes used for acquisition of biological signals.
CO3	Explain the importance of invasive and non-invasive techniques used for measuring biomedical signals
CO4	Describe the methods and instrumentation needed to measure pressure and flow in the human body.
CO5	Explain the working of life saving devices and safety measures taken during design and use of biomedical instruments

Unit No.	Course Content	No. of Hours
1	**Fundamentals:** Sources of biomedical signals, Basic medical instrumentation system, Consumer and portable medical equipment, Implantable medical devices, General constraints in design of biomedical instrumentation systems. **Bioelectric Signals and Electrodes:** Origin of bioelectric signals-ECG EEG EMG, Recording electrode-Electrode-Tissue interface, Polarization, Skin contact impedance, Motion artifacts, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG.	10
2	**Biomedical Recorders:** Electrocardiograph : Block diagram of an ECG machine, Block diagram of an isolation preamplifier commonly used in modern ECG machine, ECG Leads, Multi-channel ECG machine. Electroencephalograph: Block diagram description of an Electroencephalograph, 10-20 electrode system, Electromyograph, other biomedical recorders .	10
3	**Patient Monitoring System:** bedside patient monitoring systems, central monitors, measurement of heart rate – instantaneous heart rate meter (cardio tachometer), measurement of pulse rate, measurement of blood pressure – direct & indirect method, oscillometric method, ultrasonic doppler shift method, measurement of respiration rate – impedance pnuemography, CO_2 method, apnea detectors, pulseoximeters.	12
4	**Blood Flow and Cardiac Output Measurement:** Electromagnetic blood flow meters, Square wave electromagnetic blood flow meters, Ultrasonic blood flow meters – Doppler shift flow velocity meters, Range gated pulsed Doppler flow meters, Cardiac Output Measurement: Dye dilution method and Thermal dilution method. Measurement of continuous cardiac output derived from the aortic pressure waveform.	10
5	**Therapeutic equipments:** Cardiac Pacemakers, Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemaker, Rate-responsive pacemakers,	10

	Defibrillators: DC defibrillators. Ventilators: Artificial ventilation, , Patient Safety: Electric shock hazards, Leakage currents.	

Text Books:

1. R. S. Khandpur, "Handbook of Biomedical Instrumentation", 3rdEdition, Tata McGraw-Hill Publishing Company Limited, 2014.

Reference Books:

1. J. G. Webster, "Encyclopedia of Medical Devices and Instrumentation", John Wiley, 1999.
2. S. K. Venkata Ram, "Biomedical Electronics & Instrumentation", 3rd Edition, Galgotia Publications Pvt. Ltd., 2009.
3. Lesely Cromwell & others, "Principles of Applied Biomedical Instrumentation", 2ndEdition, John Wiley and sons,

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	1	0	0	0	0	3	0	0	0	0	0	0	0	0	3
CO2	1	0	0	0	0	3	0	0	0	0	0	0	0	0	3
CO3	1	0	0	0	0	3	0	3	0	0	0	0	0	0	3
CO4	1	0	0	0	0	3	0	3	0	0	0	0	0	0	3
CO5	1	0	0	0	0	3	0	3	0	0	0	0	0	0	3

0 -- No association, 1---Low association, 2--- Moderate association, 3---High association

Course Title: Signal Conditioning Circuits	*Course Code: 20EI420*
Credits (L:T:P): 4:0:0	*Total Contact Hours: 52:0:0*
Type of Course: Lecture	*Category: Professional Core Course*
CIE Marks: 50	*SEE Marks: 100*

Pre-requisite: Analog Electronic Circuits, Circuit theory and Analysis.

Course Outcomes: After completing this course, students should be able to

CO1	Explain the basic principles and configuration of op-amp, timer and phase locked loop (PLL).
CO2	Analyze the working of negative and positive feedback amplifiers, timer and PLL.
CO3	Construct different types of linear and nonlinear circuits using op-amp, timer and PLL.
CO4	Develop and analyze the higher level applications using op-amp, timer and PLL.
CO5	Explain the working of data acquisition systems and design signal conditioning circuits.

Unit No.	Course Content	No. of Hours
1	**Unit-1 Operational amplifier Basics & negative feedback amplifiers:** Introduction to differential amplifiers, equivalent circuit of op-amp, Ideal and practical parameters of operational amplifiers, measurement of op-amp parameters. Inverting amplifier, non-inverting amplifier, Summing amplifier, Differential amplifier, instrumentation amplifier, Log and anti log amplifiers, Current to voltage and voltage to current converters, problems.	12
2	**Applications of Negative feedback amplifiers:** Integrating and Differentiating circuits with frequency response, Precision rectifiers, Peak detectors, active filters I and II order butter worth filter, Waveform generators**:** principle, phase shift and Wien bridge oscillator, problems.	10
3	**Comparators & Positive feedback amplifiers and its applications:** Inverting and non inverting comparators, ZCD, window detector, Schmitt trigger, monostable and astable multivibrators, triangular and saw tooth wave generator, problems. .	10
4	**Phase locked loop & Timers:** Operating principles lock range, capture range, working of NE565, PLL as frequency multiplier, frequency synthesizer, frequency translation, 555 timers: astable, monostable multivibrators and elementary design of specific applications.	10
5	**Signal conditioning and Data acquisition:** Signal conditioning and linearizing circuit for thermocouple, RTD, AD590, thermistor and strain gage, Data acquisition system, Sample and Hold circuits, Binary weighted DAC, R-2R DAC, Successive approximation ADC, Dual slope ADC, problems.	10

Text Books:

1. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th Edition, Pearson 2015
2. Hnatek, Eugene R A "User's handbook of D/A and A/D converters", Wiley, 1976.

Reference Books:

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd edition, McGraw Hill, 2002.
2. Pearson, 2015 OPAMP and applications, Coughlin and Driscoll, 4th edition, PHI, 2000.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	3	2	2	0	0	0	0	3	1	0	3	3	3	3
CO2	3	3	3	2	0	0	0	0	3	1	0	3	3	3	3
CO3	3	3	3	3	0	0	0	0	3	1	0	3	3	3	3
CO4	3	3	3	3	0	0	0	0	3	1	0	3	3	3	3
CO5	3	3	3	3	0	0	0	0	3	1	0	3	3	3	3

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: System Design using HDL	***Course Code: 20EI430***
Credits (L:T:P): 3:0:1	***Total Contact Hours: 39:0:26***
Type of Course: Lecture + Practical	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Logic Design

Course Outcomes: After completing this course, students should be able to:

CO1:	Explain the concept of HDL as a software tool and analyze dataflow in circuits
CO2:	Develop circuits in behavioral and structural description styles
CO3:	Make use of programming skills for structured, modular designs
CO4:	Inculcate skills to develop packages and used defined data types
CO5:	Demonstrate skills to program FPGA and interface

Unit No.	Course Content	No. of Hours
1	**Introduction and data type descriptions: S**tructure of HDL module, operators, data types, types of descriptions, simulation and synthesis, software for synthesis and simulation, brief comparison of VHDL and Verilog. Circuit design using FPGA, data flow descriptions, highlights of data-flow descriptions, structure of data-flow description, examples	08
2	**Behavioral and structural descriptions** Behavioral description highlights, structure of HDL behavioral description, VHDL variable assignment, signal assignment statement, sequential statements, examples, Structural descriptions, highlights of structural description, organization of the structural descriptions, binding, examples.	08
3	**Advanced HDL descriptions and file processing** Highlights of procedures, tasks, and functions, procedures and tasks examples, functions examples, generate generic, and parameter statements. Advanced HDL descriptions, procedures of file processing and tasks, examples of file processing.	08
4	**Mixed type and mixed Language Descriptions:** VHDL user-defined data types, VHDL packages, mixed type description examples, two dimensional array and matrix algebra in HDL, mixed language descriptions, highlights of mixed-language description, how to invoke one language from the other, mixed-language description examples, limitations of mixed-language description.	08
5	**FPGA Interfacing:** Development of simple applications using FPGA, Interface of switches and LEDs to FPGA, Interface of matrix keyboard and display units to FPGA, Interface of actuators to FPGA, stepper motor, DC motor, interface of DAC.	07

LIST OF EXPERIMENTS:

1. Synthesis and simulation of logic gates, half adder
2. Synthesis and simulation of multiplexer, comparator and priority encoder
3. Synthesis and simulation of fulladder and 3 bit ripple carry adder
4. Synthesis and simulation of 4 bit ALU
5. Synthesis and simulation of flip flops(D,T, JK)
6. Synthesis and simulation of binary counters(binary, BCD)
7. Interfacing of switches and LEDs to FPGA
8. Interfacing of seven segment display units to FPGA
9. Interface of matrix keyboard, and LCD display to FPGA
10. Interface of stepper motor to FPGA and control its operations
11. Interface of DC motor to FPGA and control its operations
12. Interface of DAC unit to FPGA and generation of waveforms

Text Books:

1. Nazeih M. Botros, "HDL Programming VHDL and Verilog", Thomson Learning, 2007.
2. Charles H. Roth, Lizy Kurian John, **"**Principles of Digital Systems Design using VHDL", Cengage Learning, 2009.

Reference Books:

1. Volnei A Pedroni **,** **"**Digital Electronics and Design with VHDL**"**, Elsevier, 2008.
2. Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital logic Design with VHDL", second edition, 2007.

Web Resources:

http://nptel.ac.in/courses/117108040/1

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	1	2	2	3	3	0	0	0	1	1	0	0	3	2	1
CO2	1	2	2	3	3	0	0	0	1	1	0	0	3	2	1
CO3	1	2	2	3	3	0	0	0	1	1	0	0	3	2	1
CO4	1	2	2	3	3	0	0	0	1	1	0	0	3	2	1
CO5	1	2	2	3	3	0	0	0	1	1	0	0	3	2	1

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Signals and Systems	*Course Code: 20EI440*
Credits (L:T:P): 3:1:0	*Total Contact Hours: 39:26:0*
Type of Course: Lecture +Tutorial	*Category: Professional Core Course*
CIE Marks: 50	*SEE Marks: 100*

Pre-requisite: Engineering Mathematics

Course Outcomes: After completing this course, students should be able to

CO1	Understand the concepts of signals and systems
CO2	Interpret the properties of the system
CO3	Analyze the system in time domain
CO4	Apply the knowledge of Z transform to analyze discrete time systems
CO5	Analyze the system using Fourier representation

Unit No.	Course Content	No. of Hours
1	**Introduction**: Definition of signals and systems, classification of signals, basic operations on signals, elementary signals, properties of systems.	08
2	**Time domain representation of LTI systems**: Convolution sum, interconnection of systems, differential equation representation of LTI systems, solution of differential equation, difference equation representation of LTI systems, solution of difference equation.	07
3	**Fourier representation of signals**: Fourier series for discrete time periodic signals (DTFS), properties of DTFS, Fourier transform of discrete time non periodic signal, properties of DTFT, DTFT of periodic signals, analysis of LTI discrete time system using DTFT.	08
4	**Z-Transform**: Introduction, Z-transform, Properties of Z-transform, Region of convergence, Inversion of Z-transforms, Analysis of LTI discrete time system using Z transform, stability and causality analysis.	07
5	**Discrete Fourier Transform**: Frequency domain Sampling and Reconstruction of Discrete time signals, properties of DFT and IDFT. **Computation of DFT**: Radix 2 - decimation in time and decimation in frequency FFT, inverse FFT.	09

Text Books:

1. Simon Haykin and Barry Van Veen, "Signals and Systems", John Wiley & Sons, 2nd Edition, 2018.
2. Alan V. Oppenheim, Alan S Willsky and S Hamid Nawab, "Signals and Systems", Pearson India, 2nd Edition, 2015.

Reference Books:

1. Proakis G & Dimitris G. Manolakis, Pearson, "Digital Signal Processing",4th Edition, 2007.
2. Emmanuel C. Ifeachor, Barrie E. Jervis, Pearson Education, "Digital Signal Processing A Practical Approach", 2nd Edition, 2003.

Web Resources:

1. http://nptel.ac.in/courses/117104074/

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	2	0	1	0	0	0	0	0	0	0	0	0	1	0	0
CO2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
CO3	0	3	0	0	0	0	0	0	0	0	0	0	2	1	0
CO4	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0
CO5	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Transducers and Instrumentation-II	***Course Code: 20EI450***
Credits (L:T:P): 3:0:0	***Total Contact Hours: 39:0:0***
Type of Course: Lecture	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Transducers and Instrumentation-I.

Course Outcomes: After completing this course, students should be able to:

CO1	Understand the fundamentals of physical quantities.
CO2	Discuss the construction and working of the transducer used for measurement.
CO3	Illustrate the characteristics of a transducer.
CO4	Identify a suitable transducer for measurement of the physical quantity.
CO5	Evaluate the output or input variables of measuring instruments for a given condition.

Unit No.	Course Content	No. of Hours
1	**Pressure Measurement:** Standards & calibration; basic methods of pressure measurement; dead weight gauges & manometer, manometer dynamics; elastic transducers, high pressure measurement; low pressure (vacuum) measurement- McLeod gage, Knudsen gage, momentum-transfer (viscosity) gages, thermal conductivity gages, ionization gages.	7
2	**Flow Measurement**: Local flow velocity, magnitude and direction, Flow visualization, Velocity magnitude from pitot static tube, Velocity direction from yaw tube, dynamic wind vector indicator. Hot wire and hot film anemometer, Hot film shock-tube velocity sensors, Laser Doppler velocimeter.	8
3	**Gross flow rate and level Measurement:** Gross volume flow rate; Constant-area, variable-pressure-drop meters (Obstruction meters). Averaging pitot tubes. Constant pressure-drop, variable area meters (Rotameters), turbine meters, positive displacement meters, Electromagnetic flow meters. Drag force flow meters. Ultrasonic flowmeters, vortex-shedding flow meters. **Level Measurement**: Capacitance probe; conductivity probes; diaphragm level detector, deferential pressure level detector, radiation level sensors, level transmitter, ultrasonic level detector.	8
4	**Density and viscosity Measurement** : Definition & units of density and specific gravity, Liquid density measurement – Ball type, capacitance type, displacement type, hydrometers, radiation type, sound velocity type. Gas density measurement – displacement type, electromagnetic suspension type. **Viscosity Measurement:** Definition and units, selection of viscometer, Laboratory Viscometers – Capillary, capillary extrusion, Saybolt viscometer, Rotational viscometer-Cone & plate viscometer. Industrial Viscometers - differential pressure continuous capillary viscometer, falling piston viscometer, single and two float viscometer, cone and plate plastometer.	8
5	**Humidity and moisture Measurement:** Definition and terminologies, dry and wet bulb psychrometers (Sling psychrometer), hair hygrometers, dew-point hygrometers.	8

	Moisture Measurement: Definition and terminologies, Electrolytic hygrometer, capacitance hygrometer, impendence hygrometer, piezoelectric hygrometer, infrared absorption hygrometer. Measurement of moisture in solids – Nuclear moisture gauge, infrared absorption moisture gauge, capacitance moisture gauge.	

Text Books:

1. Ernest O Doebelin, "Measurement Systems Application and Design" 6th Edition,TMH, 2007.
2. B G Liptak, "Instrument Engineers Hand book (Process Measurement.)", 3rdEdition, Chilton book, 1995.

Reference Books:

1. C. S. Rangan, G. R. Sarma, V. S. V. Mani, "Instrumentation: Devices and Systems", 2nd Edition, McGraw Hill Education (India), 2014.
2. K. Krishnaswamy and S. Vijayachitra, "Industrial Instrumentation", New Age International Pub., 2005.
3. D.V.S.Murty, "Transducers and Instrumentation" 2nd Edition, PHI, 2009.
4. A. K. Ghosh, "Introduction to Measurements and Instrumentation", 2nd Edition, PHI, 2007.
5. B.C.Nakra and K.K.Choudhry, "Instrumentation Measurement and Analysis" 3rd Edition, Mc Graw Hill Education (India) Pvt.Ltd. 2009.

Web Resources:

1. http://nptel.ac.in/courses/108105064/
2. http://nptel.ac.in/courses/112103174/10
3. https://swayam.gov.in/courses/4523-mechanical-measurement-system
4. https://swayam.gov.in/course/3764-industrial-instrumentation

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	0	0	0	0	0	1	0	2	3	0	3	3	0	3
CO2	3	0	0	0	0	2	1	0	2	3	0	3	3	0	3
CO3	3	2	1	0	0	0	0	0	0	3	0	3	3	0	3
CO4	3	0	1	0	2	2	1	2	3	3	1	3	3	0	3
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Transducers and Instrumentation Lab	***Course Code: 20EI47L***
Credits (L:T:P): 0:0:1.5	***Total Contact Hours: 0:0:39***
Type of Course: Practical	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 50***

Pre-requisite: Transducers and instrumentation

Course Outcomes: After completing this course, students should be able to:

CO1	Apply the fundamental knowledge of transducers and measurement systems.
CO2	Test the different circuits, modules and observe the output.
CO3	Analyze the result and draw the characteristics.
CO4	Express the importance of various circuits & modules

List of Experiments

1. Measurement of sensitivity of Wheatstone bridge.
2. Measurement of Low resistance by Kelvin double Bridge
3. Measurement of Self- inductance by Maxwell Bridge, Anderson's bridge.
4. Measurement of unknown capacitance by Desauty's and Schering's bridge
5. Characteristic of Resistance transducer: Potentiometer and Strain gauge
6. Characteristics of LVDT.
7. Characteristics of Capacitive transducer for variable area & variable distance
8. Characteristics of Thermocouple
9. Characteristics of Thermistor & RTD
10. Pressure indicator using piezoelectric transducer
11. Level indication based on conduction method
12. Humidity/Moisture Measurement

Course Outcomes	**Program Outcomes**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	3	1	0	0	0	0	3	2	3	0	3	3	0	3
CO2	3	3	3	0	0	0	0	3	3	3	0	3	3	0	3
CO3	3	2	3	0	0	0	0	3	2	3	0	3	3	0	3
CO4	3	3	3	0	0	0	0	3	2	3	0	3	3	0	3

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Signal Conditioning Circuits Lab	***Course Code: 20EI48L***
Credits (L:T:P): 0:0:1.5	***Total Contact Hours: 0:0:39***
Type of Course: Practical	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 50***

Pre-requisite: Analog Electronic Circuits, Circuit theory and Analysis.

Course Outcomes: After completing this course, students should be able to

CO1	Apply the fundamental knowledge of an amplifier and design using an opamp.
CO2	Test the designed circuit using an opamp & Timer and observe the output.
CO3	Analyze and draw conclusion on the result.
CO4	Demonstrate the application of various circuits using IC's

List of Experiments:

1. Inverting and non-inverting amplifiers
2. Differential amplifiers & Instrumentation amplifiers for different gains.
3. Integrator and differentiator.
4. Precision half wave and full wave rectifiers.
5. II order Low pass and High pass filters.
6. Comparators and Schmitt triggers.
7. Astable and monostablemultivibrators using op-amp.
8. Astable and monostablemultivibrators using 555 Timer.
9. Signal conditioning circuit for RTD
10. Design of linearizing circuit for Thermistor
11. Digital to analog converter using DAC 0800
12. Analog to Digital converter using ADC 0804

Course Outcomes	**Program Outcomes**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	3	3	3	0	2	0	2	3	3	2	3	3	3	3
CO2	3	3	3	3	0	2	0	2	3	3	2	3	3	3	3
CO3	3	3	3	3	0	2	0	2	3	3	2	3	3	3	3
CO4	3	3	3	3	0	2	0	2	3	3	2	3	3	3	3

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: **Environmental Studies**	***Course Code:*** **20HU412**
Credits (L:T:P): 0:0:0	***Total Contact Hours: 26:0:0***
Type of Course: Lecture	***Category: HSMC***
CIE Marks: 50	***SEE Marks: -***

Course Objective

The student gains knowledge on basic concepts on Environmental aspects and understands its importance in various disciplines for safeguarding the environment.

Course Outcomes (COs) and Learning Outcomes (LOs)

At the end of the course the students are able to:

CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water attributes at regional and global scale.
CO2	Develop critical thinking/observation skills - apply them to identify and analyze Environmental issues.
CO3	Understand the complex ecological relationship between biotic and abiotic components.
CO4	Apply ecological knowledge to illustrate and address environmental problems for better management.
CO5	Understand the recent technologies and legal aspects related to the environment.

Unit No.	Course Content	No. of Hours
1	Introduction: Environment - Components of Environment Ecosystem: Types & Structure of Ecosystem, Balanced ecosystem Human Activities – Food, Shelter, And Economic & Social Security. Impacts of Agriculture & Housing Impacts of Industry, Mining & Transportation Environmental Impact Assessment, Sustainable Development.	5
2	Natural Resources, Water resources – Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water Mineral resources, Forest Wealth Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle. Energy – Different types of energy, Conventional sources & Non-Conventional sources of energy Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy.	7
3	Environmental Pollution – Water Pollution, Noise pollution, Land Pollution, Public Health Aspects. Global Environmental Issues: Population Growth, Urbanization, Land Management, Water & Waste Water Management.	5
4	Air Pollution & Automobile Pollution: Definition, Effects – Global Warming, Acid rain & Ozone layer depletion, controlling measures. Solid Waste Management, E - Waste Management & Biomedical Waste Management -	5

	Sources, Characteristics & Disposal methods.	
5	Introduction to GIS & Remote sensing, Applications of GIS & Remote Sensing in Environmental Engineering Practices. Environmental Acts & Regulations, Role of government, Legal aspects, Role of NonGovernmental Organizations (NGOs), Environmental Education & Women Education.	4

Text Books:

1. Benny Joseph. "Environmental Studies", Tata McGraw – Hill Publishing Company Limited. 2005.
2. R.J.Ranjit Daniels and Jagadish Krishnaswamy. "Environmental Studies", Wiley India Private Ltd., New Delhi.2009.
3. R Rajagopalan, "Environmental Studies – From Crisis to Cure", Oxford University Press, 2005.
4. Aloka Debi, "Environmental Science and Engineering", Universities Press (India) Pvt. Ltd. 2012.

Reference Books:

1. Raman Sivakumar, "Principals of Environmental Science and Engineering", 2nd Edition, Cengage learning Singapore, 2005.
2. P. Meenakshi, "Elements of Environmental Science and Engineering", Prentice Hall of India Private Limited, New Delhi, 2006.
3. S.M. Prakash, "Environmental Studies", Elite Publishers Mangalore, 2007.
4. Erach Bharucha, "Text Book of Environmental Studies", for UGC, University press, 2005.
5. G.Tyler Miller Jr., "Environmental Science – working with the Earth", Eleventh Edition, Thomson Brooks /Cole, 2006.

CO-PO Mapping

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	0	0	0	2	2	1	1	1	0	1
CO 2	1	2	1	2	1	1	2	1	1	1	0	1
CO 3	1	1	0	0	0	1	1	1	1	1	0	1
CO 4	1	2	1	2	1	1	1	1	1	1	1	1
CO 5	1	2	1	2	2	1	1	1	1	1	0	1

0 -- No association 1---Low association, 2--- Moderate association, 3---High association