

**APPLIED ELECTRONICS AND INSTRUMENTATION
DEPARTMENT B.TECH CURRICULUM STRUCTURE
UNDER AUTONOMY**



**HALDIA INSTITUTE OF TECHNOLOGY
HALDIA
EAST MEDINIPUR**

**AFFILIATED TO
MAULANA ABUL KALAM AZAD UNIVERSITY OF
TECHNOLOGY, WEST BENGAL**



COURSE CURRICULUM
DEPARTMENT OF APPLIED ELECTRONICS AND INSTRUMENTATION ENGINEERING
HALDIA INSTITUTE OF TECHNOLOGY

1ST YEAR 1ST SEMESTER

THEORY

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
1	Basic Science	BS-M 101	Mathematics-I	3-1-0	4	100
2	Basic Science	BS-PH 101	Physics-I	3-1-0	4	100
3	Engineering Science	ES-EE 101	Basic Electrical & Electronics Engineering	3-1-0	4	100
Total					12	300
Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
5	Basic Science	BS-CH 191	Chemistry Lab-I	0-0-3	1.5	100
6	Engineering Science	ES-CS 191	Computer Programming Lab	0-0-3	1.5	100
7	Engineering Science	ES-ME 191	Engineering Drawing	0-0-3	1.5	100
Total					4.5	300

PRACTICAL

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
4	Basic Science	BS-PH 191	Physics Lab-I	0-0-3	1.5	100
5	Engineering Science	ES-EE 191	Basic Electrical & Electronics Engineering. Lab	0-0-3	1.5	100
6	Engineering Science	ES-ME 191	Workshop Practice	1-0-3	2.5	100
Total					5.5	300

SESSIONAL

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
7	Basic Science	XC-181	Extra-Curricular Activity (NSS, etc.)	0-0-2	0.0	100

1st Semester Total					17.5	700
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COURSE CURRICULUM
DEPARTMENT OF APPLIED ELECTRONICS AND INSTRUMENTATION ENGINEERING
HALDIA INSTITUTE OF TECHNOLOGY

1ST YEAR 2ND SEMESTER

THEORY

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
1	Basic Science	BS-M 201	Mathematics-II	3-1-0	4	100
2	Basic Science	BS-CH 201	Chemistry-I	3-1-0	4	100
3	Engineering Science	ES-CS 201	Computer Programming for Problem solving	3-1-0	4	100
4	Humanities	HM-HU 201	English Communication	3-0-0	3	100
Total					15	400

PRACTICAL

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
5	Basic Science	BS-CH 291	Chemistry Lab-I	0-0-3	1.5	100
6	Engineering Science	ES-CS 291	Computer Programming Lab	0-0-3	1.5	100
7	Engineering Science	ES-ME 291	Engineering Drawing	1-0-3	2.5	100
Total					5.5	300

2nd Semester Total	20.5	700
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1st Year Total	38	1400
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COURSE CURRICULUM
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2ND YEAR 1ST SEMESTER

THEORY

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
1	Basic Science	BS-M 301	Mathematics -III	2-1-0	3	100
2	Professional Core	PC-EI 301	Circuit Theory and Network Analysis	2-1-0	3	100
3	Professional Core	PC-EI 302	Sensors & Transducers	3-0-0	3	100
4	Professional Core	PC-EI 303	Analog Electronic Circuits	3-0-0	3	100
5	Professional Core	PC-EI 304	Digital Electronic Circuits	3-0-0	3	100
6	Mandatory Course	MC-ES 301	Environmental Science	2-0-0	0	100
Total					15	600

PRACTICAL

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
7	Professional Core	PC-EI 391	Circuit Theory Lab	0-0-3	1.5	100
8	Professional Core	PC-EI 392	Sensors & Transducers Lab	0-0-3	1.5	100
9	Professional Core	PC-EI 393	Analog Electronics Lab	0-0-3	1.5	100
10	Professional Core	PC-EI 394	Digital Electronics Lab	0-0-3	1.5	100
11	Basic Science	BS-M 391	Numerical Methods Lab	0-0-2	1.0	100
Total					7.0	500

3rd Semester Total	22	1100
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2ND YEAR 2ND SEMESTER

THEORY

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
1	Professional Core	PC-EI 401	Electrical & Electronic Measurements	3-1-0	4	100
2	Professional Core	PC-EI 402	Microprocessors & Microcontroller	3-1-0	4	100
3	Professional Core	PC-EI 403	Electromagnetic Theory	3-0-0	3	100
4	Engineering Science	ES-CS 401	Data Structure & Algorithm	3-0-0	3	100
5	Basic Science	BS-BIO 401	Biology	3-0-0	3	100
6	Mandatory Course	MC-ES 401	Indian Constitution And Culture	1-0-0	0	100
Total					17	600

PRACTICAL

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
7	Professional Core	PC-EI 491	Electrical & Electronic Measurements Lab	0-0-3	1.5	100
8	Professional Core	PC-EI 492	Microprocessors & Microcontroller Lab	0-0-3	1.5	100
9	Engineering Science	ES-CS 491	Data Structure & Algorithm Lab	0-0-2	1.0	100
10	Humanities	HM-HU 481	Advanced Language Lab	0-0-2	1.0	100
Total					5.0	400

4th Semester Total	22	1000
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2nd Year Total	44	2100
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COURSE CURRICULUM
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3RD YEAR 1ST SEMESTER

THEORY

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
1	Professional Core	PC-EI 501	Control System	3-0-0	3	100
2	Professional Core	PC-EI 502	Industrial Instrumentation	3-0-0	3	100
3	Professional Elective Course-I	PE-EI 501/ PE-EI 502	Optical Instrumentation/ Advanced Sensors/	3-0-0	3	100
4	Open Elective Course-II	OE-EI 501/ OE-EI 502	Object Oriented Programming /Data Base Management System	3-0-0	3	100
5	Open Elective Course-I	OE-EI 503/ OE-EI 504	Digital Signal Processing/ Soft Computing	3-0-0	3	100
6	Humanities	HM-HU 501	Economics For Engineers	2-0-0	2	100
Total					17	600

PRACTICAL

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
7	Professional Core	PC-EI 591	Control System Lab	0-0-3	1.5	100
8	Professional Core	PC-EI 592	Industrial Instrumentation Lab	0-0-3	1.5	100
9	Open Elective Course-II	OE-EI 591/ OE-EI 592	Object Oriented Programming Lab/Data Base Management System Lab	0-0-3	1.5	100
Total					4.5	300

5th Semester Total					21.5	900
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3RD YEAR 2ND SEMESTER

THEORY

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
1	Professional Core	PC-EI 601	Process Control	3-0-0	3	100
2	Professional Core	PC-EI 602	Electrical Machine	3-0-0	3	100
3	Professional Elective Course-II	PE-EI 601/ PE-EI 602	Analog and digital Communication / Embeded System	3-0-0	3	100
4	Professional Elective Course-III	PE-EI 603/ PE-EI 604	Power Electronics/ VLSI and Microeleronics	3-0-0	3	100
5	Open Elective Course-III	OE-EI 601/ OE-EI 602	Internet of Things (IoT) /Artificial Intelligence (AI)	3-0-0	3	100
6	Humanities	HM-HU 601	Values and Ethics in Profession	2-0-0	2	100
Total					17	600

PRACTICAL

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
7	Professional Core	PC-EI 691	Process Control Lab	0-0-3	1.5	100
8	Professional Core	PC-EI 692	Instrumentation System Design Lab	0-0-3	1.5	100
9	Open Elective Course-III	OE-EI 691/ OE-EI 692	Internet of Things (IoT) /Artificial Intelligence (AI)	0-0-3	1.5	100
10	Seminar	EI 681	Seminar	0-0-4	2.0	100
Total					6.5	400

6thSemester Total	23.5	1000
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3rdYear Total	45	1900
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COURSE CURRICULUM
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4TH YEAR 1ST SEMESTER

THEORY

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
1	Professional Elective Course-IV	PE-EI 701/ PE-EI 702	Advanced Process Control / Mechatronics	3-0-0	3	100
2	Professional Elective Course-V	PE-EI 703/ PE-EI 704	Biomedical and Analytical Instrumentation/ Non Destructive Testing	3-0-0	3	100
3	Open Elective Course-IV	OE-EI 701/ OE-EI 702	Telemetry & Wireless Sensor Network/ Non Conventional Energy Sources	3-0-0	3	100
4	Engineering Science	ES-CS 701	Computer Networks	3-0-0	3	100
Total					12	400

PRACTICAL

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
5	Project Phase-I	PROJ-EI-781	Project-I	0-0-4	2	100
6	Industrial Training	PROJ-EI-782	Industrial Training Evaluation (Min. 4- Weeks)		1.0	100
7	Internship-I (Phase-I)	PROJ-EI 783	Internship-I (Min. 12-Weeks)		3.0	100
Total					6.0	300

7thSemester Total					18	700
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4TH YEAR 2ND SEMESTER

THEORY

Sr. No.	Categories	Course code	Course Title	Hours / Week L:T:P	Credit	Marks
1	Professional Elective Course-VI	PE-EI 801/ PE-EI 802	Power Plant Instrumentation / Nano Electronics	3-0-0	3	100
2	Open Elective Course-V	OE-EI 801/ OE-EI 802	Digital Image Processing / Big Data Analysis	3-0-0	3	100
3	Humanities	HM-HU 801	Project Management and Entrepreneurship	2-0-0	2	100
Total					8	300

PRACTICAL

Sr. No.		Course code	Course Title	Hours / Week L:T:P	Credit	Marks
4	Project Phase-II	PROJ-EI881	Project-II	0-0-8	4.0	100
5	Internship-I (Phase-II)	PROJ-EI 882	Internship-II (Min. 8-Weeks)	-	2.0	100
6	Grand Viva	PROJ-EI883	Grand Viva	-	1.0	100
Total					7.0	300

8th Semester Total	17	600
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4th Year Total	33	1300
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Grand Total	160	6700
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THIRD SEMESTER SYLLABUS
UNDER AUTONOMY
DEPARTMENT
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Haldia Institute of Technology
Department of Applied Electronics and Instrumentation Engineering

Third Semester Syllabus

Mathematics-III

Course Name: Mathematics-III (Mathematical Methods)	Category: Basic science Courses
Course Code: BS-M301	Semester: 3rd
L-T-P: 2-1-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 2 hrs./week	Continuous Assessment: 25Marks
Tutorial: 1	Attendance: 5 Marks
Total Lectures: 40	End Semester Exam.: 70 Marks
Pre-Requisites: (10+2) Mathematics	

Objectives:

1. Providing the core concepts of higher Engineering Mathematics and describing the Techniques, this works as an essential tool to solve the problems in their field of applications.
2. To provide an overview of probability and Statistics to engineers.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate the following knowledge, skills and attitudes. Student will be able to:

- CO.1.** Learn the concepts of the theory of Probability with the purpose of providing mathematical models of situations affected or even directed by chance effects. Solve the problems related to Probability distribution, both discrete and continuous.
- CO.2.** Solve the problems related to basic statistics, Correlation-Regression and curve fitting.
- CO.3.** Find the Fourier Series of a function by definition.
- CO.4.** Describing the techniques of Fourier transform and using them to transform a problem into one that can be more easily solved.
- CO.5.** Understand the concept of interpolation, find interpolation polynomial and compute functional values.
- CO.6.** Apply numerical methods to obtain approximate solutions of mathematical problems.

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Basic Probability & Statistics: Probability spaces, conditional probability, independence; Bayes theorem. Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.	8	CO1



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Third Semester Syllabus

Module: 2	Data statistics: Basic Statistics, Measures of Central tendency, measures of dispersions: Moments, skewness and Kurtosis, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.	6	CO2
Module: 3	Fourier Series: Introduction, Periodic functions: Properties, Even & Odd functions: Properties, Special wave forms: Square wave, Half wave Rectifier, Full wave Rectifier, Saw-toothed wave, Triangular wave. Euler's Formulae for Fourier Series, Fourier Series for functions of period 2π , Fourier Series for functions of period $2l$, Dirichlet's conditions, Sum of Fourier series. Theorem for the convergence of Fourier Series (Without Proof). Fourier Series of a function with its periodic extension. Half Range Fourier Series: Construction of Half range Sine Series, Construction of Half range Cosine Series. Parseval's identity (Without Proof).	6	CO3
Module: 4	Fourier Transform: Fourier Integral Theorem (statement only), Fourier Transform of a function, Fourier Sine and Cosine Integral Theorem (statement only), Fourier Cosine & Sine Transforms. Fourier, Fourier Cosine & Sine Transforms of elementary functions. Properties of Fourier Transform: Linearity, Shifting, Change of scale, Modulation. Examples. Fourier Transform of Derivatives. Convolution Theorem (statement only), Inverse of Fourier Transform.	4	CO4
Module: 5	Numerical Methods-I: Error & Interpolataion: Approximation in numerical computation and Interpolation: Truncation and rounding errors, Fixed and floating-point arithmetic. Calculus of finite differences, Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation.	6	CO5
Module: 6	Module Name: Numerical Methods-II: Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms. Numerical solution of nonlinear equation: Bisection method, Regula-Falsi method, Newton-Raphson method. Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods.	6	CO6
Total		36	



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Third Semester Syllabus

Text Books:

1. Reena Garg, Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishers.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
4. Michael Greenberg, Advanced Engineering Mathematics, Pearson.
5. Gupta & Kapoor, Fundamentals of Mathematical Statistics, Gupta (Sultan Chand & SOs).
6. S. Ali Mollah-Numerical Analysis and Computational Procedures.
7. Schaum's Outline of Fourier Analysis and Applications to Boundary Value Problems.

Reference Books:

1. R. J. Beerends -Fourier and Laplace Transforms.
2. N.G. Das, Statistical Methods (Combined Volume), Tata-McGraw Hill.
3. AP Baisnab and Jas M-Elements of Probability and Statistics.
4. Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).
5. Chadrika Prasad & Reena Garg, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi
6. HK Dass-Advanced Engineering Mathematics



Haldia Institute of Technology
Department of Applied Electronics and Instrumentation Engineering

Third Semester Syllabus

Circuit Theory and Network Analysis

Course Name: Circuit Theory and Network Analysis	Category: Professional Core
Course Code: PC-EI 301	Semester: 3rd
L-T-P: 2-1-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25 Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 45	End Semester Exam.: 70 Marks
Pre-Requisites: Knowledge of matrix, KCL, KVL, Laplace Transformation (basic level) and concept of Resistance, Inductor, Capacitor.	

Objectives:

This course aims to introduce with the time domain and frequency domain analysis of various electrical circuits for real time uses and also helps to solve complex networks in simpler way.

Course Outcomes (COs):

At the end of the course, a student will be able to:

- CO.1. Remember** the basic concepts of DC and AC circuit behavior and network theorems.
- CO.2. Understand** the transient response, active filters, the fundamental concepts of network analysis and synthesis of two-port passive networks and the self-inductance, mutual inductance and coefficient of coupling using dot convention of coupled circuit.
- CO.3. Apply** the Thévenin, Norton, nodal, mesh analysis and graph theory to express complex circuits in their simpler equivalent forms.
- CO.4. Analyze** transient response of RL, RC, and RLC circuits and resonant circuits in time and frequency domains.
- CO.5. Compare** the different network solving techniques and solve the complex network problems by applying suitable method.
- CO.6. Design** and **characterize** the active filters.

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Introduction Signal & System Network, Circuit, System, Signal, Continuous & Discrete, Fixed & Time varying, Linear and Nonlinear, Lumped and Distributed, Passive and Active networks and systems. Independent & Dependent sources, Step, Ramp, Impulse, Sinusoidal and Damped Sinusoidal, Square, Saw tooth signals.	3	CO 1



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Third Semester Syllabus

Module: 2	Electrical circuit analysis Analysis of DC & AC Circuits: Kirchoff's Voltage Law & Current Law, Formulation of network equations, Source transformation, Loop variable analysis, Node variable analysis, Concept of Super-mesh and Super-node. Network Theorem: Superposition, Thevenin's, Norton's, Maximum power transfer theorem, Millman's theorem, Tellegen's theorem and its application in circuit analysis and energy distribution system. Solution of Problems with DC & AC sources along with Dependent sources. Coupled Circuits: Coupling, Types of coupling, Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance, Coefficient of coupling, Modeling of coupled circuits, and Solution of problems.	10	CO 1, 2, 3, 5
Module: 3	Time and frequency domain analysis Circuit Transients: DC Transient in R-L & R-C circuits with and without initial charge, R-L-C circuits, Transient analysis of different electrical circuits with and without initial conditions, solution of problems. Laplace Transforms: Concept of complex frequency, transformation of step, exponential, over-damped surge, critically damped surge, damped sine, un-damped sine functions of Laplace Transform, linearity, real-differentiation, real-integration, Initial Value Theorem and Final Value Theorem, Inverse Laplace Transform, applications in circuit analysis, Partial Fractions expansion, Heaviside's Expansion Theorem, Impulse, Step & Sinusoidal response of RL, RC, and RLC circuits. Order of the electrical circuit, Concept of Convolution theorem and its application. Solution of Problems with DC & AC sources. Fourier Transform: Fourier series and Fourier Transform, Application, Difference between Laplace Transform and Fourier Transform.	12	CO 1, 2, 4
Module: 4	Graph Theory Concept of Tree, Branch, Connected and Unconnected graph, planer and non-planer graph sub-graph, rank, Tree link, junctions, Incident	3	CO 3, 5



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Third Semester Syllabus

	matrix, Tie-set matrix, Cut-set matrix, solution of problems.		
Module: 5	Two port networks analysis Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and their inter relations and interconnection. Solution of Problems with DC & AC sources.	4	CO 2, 3, 5
Module: 6	Filter Circuits Concept of Filter, Passive filter and Active filter, Analog filter and Digital filter, Radio frequency filter and Audio frequency filter. Analysis of Low pass, High pass, Band pass, Band reject, All pass filters (first and second order only) using operational amplifier. Solution of Problems.	4	CO 1, 2, 6
Total		36	

Text Books:

1. Network and Systems, D. Roychowdhury, (New Age International)
2. Network Analysis and Synthesis, S.P Ghosh, A.K. Chakraborty (McGraw Hill)

Reference Books:

1. Network Analysis, M.E. Van Valkenburg (Prentice Hall)
2. Network and Systems, Ashfaq Husain, (Khanna Book Publisher)
3. Circuit Theory, A. Chakrabarty (Dhanpat Rai & Co.)
4. Network, Lines and Fields - John D. Ryder



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Third Semester Syllabus

Sensors and Transducers

Course Name: Sensors and Transducers	Category: Professional Core
Course Code: PC-EI 302	Semester: 3rd
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 40	End Semester Exam.: 70 Marks
Pre-Requisites: To understand this course, the learner must have idea of elementary physics and mathematics, Basic Electrical Engineering.	

Objectives: This course aims to familiarize the students with different types of sensor and transducers, their working principle, applicability in measurement and instrumentation systems. The general concept and characteristics of measurement system are also discussed so that learner can appreciate the pertinence of sensors and transducers in instrumentation systems.

Course Outcomes (COs):

After completing the course the student should be able to

- CO.1. Understand** the function of sensors and transducers in measurement systems and **define** various performance characteristics of measurement system.
- CO.2. State and explain** the working principle of various types of sensors and transducers i.e. Mechanical, Electromechanical, Resistive, Inductive, Capacitive, Piezoelectric, Thermal, Magnetic etc.
- CO.3. Choose** a suitable sensor/transducer for a particular industrial application.
- CO.4. Differentiate** various sensors/transducers based on their utility for a particular application.
- CO.5. Develop** the skill to **identify and analyze** the complex technical problems and also capable to give a socio-economic solution to that problem.
- CO.6. Design** simple sensing/transduction system for a small industrial application.

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Introduction: General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Definition, principles of sensing and transduction, classification	3	1



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Third Semester Syllabus

Module: 2	Resistive sensors: Potentiometric type: Forms, materials, resolution, accuracy, sensitivity Strain Gauges: theory, types, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesives, rosettes, applications-force, velocity and torque measurements Resistance Temperature detector: review of materials, construction, types; measuring circuits, ranges, errors and minimization of errors Thermistor: materials, types, constructions, ranges	9	2-6
Module: 3	Inductive sensors: common types- reluctance change type, mutual inductance change type, transformer action type, - brief discussion with respect to materials, construction and input output variables, Ferromagnetic plunger type-short analysis; proximity measurement LVDT: Construction, materials, output-input relationship, I/O curve, discussion	4	2-6
Module: 4	Capacitive sensors: Variable distance- parallel plate type, Variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type: calculation of sensitivities; proximity measurement Stretched Diaphragm type microphones, response characteristics	5	2-6
Module: 5	Piezoelectric elements: piezoelectric effects, charge and voltage coefficients, crystal model, materials, natural and synthetic types – their comparison, Modes of mechanical deformation: TEM, LEM, FSM, TSM, VEM: force and stress sensing, Bimorphs and Multimorphs; piezoelectric accelerometer Industrial weighing systems : Link-lever mechanism, Load cells – pneumatic, piezoelectric, elastic and magneto-elastic types - their mounting, pressductor, different designs of weighing systems, conveyors type, weighfeeder type.	6	2-6
Module: 6	Magnetic sensors: Sensors based on Villari effect for assessment of force, torque, rpm meters Tachometers – Stroboscopes, Encoders, Seismic accelerometer: Measurement of vibration. Optical sensors: LDR, Solar Cell, Photo diode, Photo Transistor, Photo Darlington Pair	9	2-6



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Third Semester Syllabus

	Hall effect: Hall drive, performance characteristics		
Total		36	

Text Books:

1. D Patranabis, Sensors and Transducers, PHI, 2nded.
2. E. A. Doebelin, Measurement Systems: Application and Design, McGraw Hill, New York
3. H. K. P. Neubert, Instrument Transducers, Oxford University Press, London and Calcutta

Reference Books:

1. D.V.S. Murty, Transducers and Instrumentation, PHI, 2nded.
2. K. Krishnaswamy and S. Vijayachitra, Industrial Instrumentation, New Age International Publishers, 2nded.
3. B. G. Liptak, Instrument Engineers' Handbook - Process Measurement and Analysis, Vol. 1, 4th Edition, CRC Press.



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Third Semester Syllabus

Analog Integrated Circuits

Course Name: Analog Integrated Circuits	Category: Professional Core Course
Course Code: PC-EI303	Semester: 3rd
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: 1 hr/week	Attendance: 5 Marks
Total Lectures:45	End Semester Exam.: 70 Marks
Pre-Requisites: No-prerequisite	

Objectives:

The objective of this course is to introduce the student to familiarize and develop skills in the design and analysis of Analog Electronic Circuit, which form the building blocks of almost any electronic system.

Course Outcomes (COs):

- CO.1.** To **understand** various semiconductor devices and subsequently different biasing arrangement in transistor circuits and also the calculation of operating point or Q-point in different biasing circuits.
- CO.2.** To **acquire** extensive knowledge and perception of h-model and high frequency model of transistors.
- CO.3.** To **study** the concepts of both positive and negative feedback in electronic circuits and feedback oscillators
- CO.4.** To **explore** the theoretical & circuitry details of the design of an Op-amp, which is the backbone for the basics of Linear integrated circuits.
- CO.5.** To realize the functional block diagram of NE565/NE566 and an application of IC555 timer as monostable and astable multivibrators.
- CO.6.** To **learn** design guide lines of power supply after understanding series and shunt voltage regulator, 78xx and 79xx series.

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Semiconductor devices Brief overview of semiconductor and junction diode. Introduction to BJT and FET (JFET & MOSFET). Major applications of diode, JFET, MOSFET	3	1
Module: 2	Biasing of BJT Transistor Biasing Circuits: Different types of biasing circuits for BJT , stability factors, bias compensation, dc & ac load line analysis and	3	1



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	thermal runaway. stability factors		
Module: 3	Transistor Amplifier Small Signal Analysis of BJT: Transistor hybrid model, derivation of voltage gain, current gain, input impedance and output impedance, trans-conductance, low frequency small signal analysis of CE, RC coupled amplifier using hybrid- π model and determination of voltage gain, current gain, input impedance and output impedance, Frequency response of a RC , Over view of Power Amplifiers	7	2
Module: 4	Feedback and Oscillator Circuits: Feedback concept, Feedback topologies, classification of amplifiers, Bark-Hausen criteria. Oscillators- Wien bridge oscillator, Phase shift oscillator and Crystal oscillator.	4	3
Module: 5	Operational Amplifier Operational Amplifier (OPAMP): Ideal OPAMP, Block diagram of the internal circuit of OP amp, Equivalent circuit, characteristics, Inverting and non-inverting configuration (ideal & Practical), Different parameters like CMRR, slew rate, offset voltage & current, offset minimizing techniques etc. Applications of OP AMP Linear applications OPAMP: Inverting & Non inverting amplifier, differential amplifier, Instrumentation amplifier and its application, Summing amplifier, adder, scaling amplifier, subtractor , V-I and I- V converter, log and anti-log amplifier, precision rectifier (half & full wave), Analog multiplier, integrator and differentiator (ideal & Practical), AC amplifier, Wave generation using opamp, Analog Computation techniques :solution of differential equation & simultaneous equations , Practical problems using OP AMP Nonlinear applications OPAMP: Comparator, Zero crossing detector , Schmitt Trigger	13	4
Module: 6	Multi-vibrator, PLL & Regulators Introduction to multi-vibrator, IC555, Introduction to VCO & PLL, NE565/NE566. Linear Voltage Regulator: Series and Shunt, IC based, power supply design.	6	5 & 6



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Text Books:

1. Electronic circuits : Discrete and Integrated . by Donald Schilling , Charles Belove , Tuvia Apelewicz , Raymond Saccardi
2. D. Roy Choudhury & Shail B. Jain, Linear Integrated Circuits, New Age International Publishers Ltd., New Delhi.
3. Adel S. Sedra & Kenneth C. Smith, Microelectronic Circuits, Oxford University Press, New Delhi.
4. Jacob Millman & Christos C. Halkias, Integrated Electronics, McGraw Hill.
5. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, PHI Learning, New Delhi.

Reference Books:

1. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3rd Edition, McGraw Hill.
2. Robert L. Boylestad & Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson/PHI, New Delhi.
3. Theodore F. Bogart, Jeffrey S. Beasley, & Guillermo Rico, Electronic Devices and Circuits, Pearson/PHI, New Delhi.
4. Operational Amplifiers & Linear Integrated Circuits - R. F. Coughlin and F. F. Driscoll



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Digital Electronic Circuits

Course Name: Digital Electronic Circuits	Category: Professional Core Courses
Course Code: PC EI 304	Semester: 3RD
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 45	End Semester Exam.: 70 Marks
Pre-Requisites: Basic Electronics Engineering	

Objectives:

The objective of this course is to acquire the basic knowledge of digital logic circuits and its applications useful to design and implementation of real time digital system.

The subject aims to encourage the students with the followings:-

1. Introduce the concept of digital and binary systems.
2. The concept of Boolean algebra and simplification of logic circuits with K-map and QuineMcClausky (Q-M) method.
3. Design and analysis of combinational & arithmetic logic circuits.
4. Design and analysis of sequential logic circuits.
5. The theoretical & circuitry details of various A/D and D/A converters.
6. Basic knowledge of various memory and programmable logic devices & Families using in digital system.

Course Outcomes (COs):

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

- CO.1. Apply** different type of codes and number systems which are used in digital computing and communication systems.
- CO.2. Develop** different types Logic circuit simplification using various mapping and mathematical methods.
- CO.3. Analyze, design and implement** combinational including arithmetic logic circuits.
- CO.4. Analyze, design and implement** sequential logic circuits.
- CO.5. Built** the fundamental knowledge and analyze the operation of various A/D and D/A converters.
- CO.6. Identify** various types of memory elements, PLDs, digital logic families and apply the knowledge in different types of digital circuits for real world application.

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Number System and Codes Introduction to Digital system, Data and number systems,	4	1



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	Decimal, binary, octal and hexadecimal number systems and their arithmetic operations; conversion of one number system to another. Binary codes, natural BCD codes, weighted, non-weighted, sequential, self-complementing, cyclic, Excess-3, Alphanumeric, EBCDIC and Gray codes, Code conversion- from one code to another. Signed binary number representation with 1's and 2's complement methods, Binary arithmetic		
Module: 2	Logic Gates and Boolean algebra Logic Operation-NOT, AND, OR, NAND, NOR, XOR and XNOR –operations, truth tables and universal gates; commonly used 7400 series IC's, standard and IEEE symbols of logic gates. All Postulates and laws of Boolean algebra with proof, De Morgan's theorem. Minimization of Logic Expressions using Algebraic method. Canonical forms of expressions, minterms and maxterms, SOP and POS forms. Simplification and minimization of Logic Expressions using K-map method (up to 6 variables (focussing mainly up to 4 variables)). Concept of don't care and use of don't care terms in K-map method Limitation of K-map and Quine-McClausky (Q-M) method of minimization of logic functions and concept of PI, EPI, RPI, SPI.	6	2
Module: 3	Combinational and arithmetic logic circuit: Introduction to combinational circuits, Design procedure Adders: Half Adder, Full Adder, Binary parallel adder, Composite adder, Carry look ahead adder, BCD adder. Multiplexers and Demultiplexer: basic 2:1, 4:1, 8:1 multiplexer equation and circuit diagram. Implementation of higher order MUX using lower order MUX, function implementation using MUX, basic 1:2 and 1:4 DEMUX equation and circuit diagram. function implementation using	6	3



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	DEMUX, application of MUX and DEMUX Encoder & Decoders: basic 2:4, 3:8, 4:16 decoder equation and circuit diagram. Implementation of higher order decoder using lower order decoder, function implementation using decoder. Application of Decoder 4:2 Encoders and Priority Encoders equation with circuit diagram. Application of DECODER and ENCODER 3 bit and 4 bit EVEN and ODD Parity Generator and checkers, 1 bit, 2 bit, 4 bit Magnitude Comparators with equation and circuit diagram Code converter: Binary to Gray and Gray to Binary, BCD to XS-3 and XS-3 to BCD, BCD to Binary and Binary to BCD		
Module: 4	Module Name: Sequential Logic Circuits Concept of Sequential circuit, difference between combinational and sequential circuit, Introduction to latches (S-R Latch, NOR based S-R latch, NAND based S'-R' latch) with characteristic table, truth table, equation and circuit diagram. Introduction to different types of Flip-Flop (S-R, D, J-K, T) with characteristic table, truth table, Excitation table, equation and circuit diagram. Triggering of flip-flops, Asynchronous inputs in FF, race around condition, Master-slave configuration; Conversion of Flip-flop and application of FF. Asynchronous & Synchronous counters - Full-sequence length counter, Binary up and down counter, Bidirectional counter, Modulo-N counter Synchronous counters - Full-sequence length counter, Binary up and down counter, Bidirectional counter, Modulo-N counter, Truncated Counter, Arbitrary sequence counter. Registers: left, right, serial and parallel shift registers (SISO, SIPO, PIPO, PISO), Bi-directional and universal shift registers, Ring and Johnson (twisted ring) counters, application of register.	10	4
Module: 5	Module Name: Analog - Digital Conversion Introduction to analog- digital data conversion, specification of	4	5



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	D/A converter. D/A conversion- R-2R ladder type, weighted resistor type. Specification of A/D converter; ~~A/D conversion~~ Flash type A/D conversion- Flash type, successive approximation type and dual-slope type, sigma delta converters (introduction)		
Module: 6	Module Name: Memory and Programmable Logic Devices & Families Types of Memory and basic definition – Register, Main memory, secondary memory, sequential access memory, random access memory, static and dynamic memory, volatile and nonvolatile memory, magnetic and semiconductor memory, ROM, PROM, EPROM, EEPROM, RAM, DRAM, SRAM Memory decoding, Memory expansion Design of combinational logic circuit using ROM PLA, PAL Introduction to Digital Logic Families: classification of Digital Logic Families; characteristics of Digital ICs. TTL: characteristics, Totem-Pole output, Open Collector output, Tri-state output, ECL: characteristics, OR/NOR gate. MOS: characteristics, PMOS, NMOS. CMOS: characteristics NAND, NOR, logic circuit realization.	6	6

Text Books:

1. Digital Fundamentals by T.L. Floyd & R.P. Jain (Pearson).
2. Fundamental of digital circuits by A. Anand Kumar (PHI).
3. Digital Electronics, Rishabh Anand (Khanna Publishing House)
4. Digital Integrated Electronics by H. Taub & D. Shilling (TMH).

Reference Books:

1. Digital Circuit & Design by S. Aligahanan & S. Aribazhagan (Bikas Publishing)
2. Digital Electronics by A.K. Maini (Wiley-India)
3. Digital Circuits-Vol-I & II by D. Ray Chaudhuri (Platinum Publishers)
4. Modern Digital Electronics by R.P. Jain (McGraw Hill)
5. Digital Principles and Applications - Albert P. Malvino and Donald P. Leach



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Third Semester Syllabus

Environmental Science

Course Name : Environmental Science	Category: Mandatory Courses
Course Code : MC-ES301	Semester: 3rd
L-T-P: 2-0-0	Credit: 0
Teaching Scheme	Examination Scheme
Theory: 2 hrs./week	Continuous Assessment: 25
Tutorial: Nil	Attendance: 5
Total Lectures: 30	End Semester Exam: 70
Pre-Requisites: No-prerequisite	

Objective:

1. Be able to understand the natural environment and its relationships with human activities.
2. Be able to apply the fundamental knowledge of science and engineering to assess environmental and health risk.
3. Be able to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues.
4. Be able to solve scientific problem-solving related to air, water, noise & land pollution

Course Outcome:

- CO.1.** Understand the components of natural environment, its relationships with human activities and also analyze human impacts on the environment.
- CO.2.** Understand key current environmental problems as well as be conversant with basic environmental legislation.
- CO.3.** Identify and value the effect of the pollutants on the environment: atmosphere (air and noise), water and soil.
- CO.4.** Analyze the mathematical principles for successful solution of practical environmental engineering problems which in turn helps to solve any environmental issue arose during core industrial process or final uncontrolled as well as unplanned discharge.
- CO.5.** Analyze an industrial activity and identify the environmental problems related to that activity as well as apply the basics of an Environmental Management System (EMS) to a core industrial activity.
- CO.6.** Plan strategies to monitor different types of pollution along with selection of the most appropriate technique to purify, reduce and/or control the emission of pollutants.

Module No.	Description of Topics	Contact Hrs.	CO
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Module: 1	Basic ideas of environment, basic concepts, man, society & environment, their interrelationship. Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development. Materials balance: Steady state conservation system, steady state system with non conservative pollutants, step function. Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering.	4	1
Module: 2	Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem components types and function. Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web. Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. Biodiversity- types, importance, Endemic species, Biodiversity Hotspot, Threats to biodiversity, Conservation of biodiversity.	4	2
Module: 3	Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth albedo], Problems. global climate and consequently on sea water level, agriculture and warming. Earth's heat budget. Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model. Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification. Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief references	8	3
Module: 4	Hydrosphere, Hydrological cycle and Natural water.	6	4



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	Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. River/Lake/ground water pollution: River: DO, 5 day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river[deoxygenation, reaeration], COD, Oil, Greases, pH. Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic		
Module: 5	Lithosphere; Internal structure of earth, rock and soil Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste).	3	5
Module: 6	Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighborhood noise] Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L_{10} (18hrIndex), L_d. Noise pollution control. Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol.	5	6

References:

1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International.



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Third Semester Syllabus

Numerical Methods Lab

Name of the Course: Numerical Methods Lab	Category: Basic science Courses
Course Code: BS-M 391	Semester: 3rd
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment: 60
Practical: 2 hrs./week	Internal Assessment: 40
Credit Points: 1	

Course Outcomes:	
CO. 1	To solve problems with Newton forward /backward, Lagrange's interpolation.
CO. 2	To solve problems of numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule
CO. 3	To find numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations.
CO. 4	To find numerical solution of Algebraic Equation by Regula-Falsi and Newton Raphson methods.
CO. 5	To Find the numerical solution to ordinary differential equation by Euler's and Runge-Kutta methods.
CO. 6	Use Software packages like MATLAB, SCILAB, LABVIEW, PYTHON, MATHEMATICA to solve numerical problems
Pre-Requisite:	
1	BS-M101, BS-M202, BS-M301

Experiment No.	Laboratory Experiments	COs
1	Assignments on Newton forward /backward, Lagrange's interpolation.	CO.1
2	Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule.	CO.2
3	Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations	CO.3
4	Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton Raphson methods.	CO.4
5	Assignments on ordinary differential equation: Euler's and Runge-Kutta methods.	CO.5
6	Introduction to Software Packages: Matlab / Python/ Labview / Mathematica	CO.6

Text and reference books:

1. C.Xavier: C Language and Numerical Methods.
2. E. Balagurusamy: Numerical Methods, Scitech.
3. R.S. Salaria: Numerical Methods, Khanna Publishing House
4. Rudra Pratap, Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Oxford University Press.
5. Mark Lutz and David Ascher, Learning Python, Published by O'Reilly & Associates.



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Circuit Theory Lab

Name of the Course: Circuit Theory Lab	Category: Professional Core
Course Code: PC-EI 391	Semester: 3rd
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme:
Tutorial: Nil	External Assessment:60
Practical: 3 hrs./week	Internal Assessment:40
Credit Points:1.5	

Course Outcomes: *At the end of the course, a student will be able to:*

CO. 1	To understand basic concepts of DC and AC circuit behavior.
CO. 2	To apply the concepts of circuit laws for analysis of different circuit performance and determination of different circuit parameters.
CO. 3	To understand the requirement of frequency response of any practical circuit.
CO. 4	To develop the software skill for analyzing different transformation tool and design of electrical circuit based simulations.
CO. 5	To measure and record the experimental data, analyze the results, and prepare a technical laboratory report.
CO. 6	To design circuits with appropriate instruments and safety precautions.
Pre-Requisite:	
1	Knowledge of various passive and active components are required.
2	Concepts of basic electrical parameters and their measuring technique are needed.
3	Theories of different circuit laws are essential.

Experiment No.	Laboratory Experiments	COs
1	Transient response in R-L and R-C Network: Simulation/hardware	CO 1, 2, 5, 6
2	Transient response in R-L-C Series circuits Network: Simulation/hardware	CO 1, 2, 5, 6
3	Determination of Impedance (Z) and Admittance(Y) parameters of two port network	CO 2, 5
4	Frequency response of LP and HP filters	CO 1, 2, 3, 5, 6
5	Frequency response of BP and BR filters	CO 1, 2, 3, 5, 6
6	Generation of Periodic, Exponential, Sinusoidal, Damped sinusoidal, Step, Impulse, and Ramp signals using MATLAB in both discrete and analog form.	CO 4, 5



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7	Determination of Laplace transform and inverse Laplace transformation using MATLAB	CO 4, 5
8	Design and Implementation of Mini Project.	CO 5, 6

Text and reference books:

- Network and Systems, D. Roychowdhury, (New Age International)
- Network Analysis, M.E. Van Valkenburg (Prentice Hall)

Special Remarks (If any):

Student can learn PSPICE simulation also to buildup software knowledge.

Sensors and Transducers Lab:

Name of the Course: Sensors and Transducers Lab	Category: Professional Core
Course Code: PC-EI 392	Semester: 3rd
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme:
Tutorial: Nil	External Assessment: 60
Practical: 2 hrs./week	Internal Assessment: 40
Credit Points: 1.5	

Course Outcomes: At the end of the course, learner will be able to

CO. 1	Identify different types of sensors & transducers which are used for temperature, speed, torque, displacement, light intensity measurement in industry as well as home appliances.
CO. 2	Demonstrate the operations of different sensors and transducers based measurement systems.
CO. 3	Select the appropriate sensor depending on application criteria.
CO. 4	Characterize different types of sensors and draw the related curves.
CO. 5	Understand the safety and maintenance issues related to different sensor based systems.
CO. 6	Function effectively as an individual and as a member in teams at the time of executing laboratory experiments.
Pre-Requisite:	
1	Theoretical knowledge of Sensors and Transducers and awareness of laboratory safety issues.

Experiment No.	Laboratory Experiments	COs
1	Displacement measurement by using a capacitive transducer.	1 - 6



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2	Displacement measurement by using LVDT.	1 - 6
3	Study of a load cell with tensile and compressive load.	1 - 6
4	Torque measurement using Strain gauge transducer.	1 - 6
5	Displacement measurement using Hall proximity sensor.	1 - 6
6	Study of the characteristics of a LDR.	1 - 6
7	Speed measurement using a Stroboscope.	1 - 6
8	Temperature measurement using RTD.	1 - 6
9	Mandatory Design and Implementation of Mini Project.	CO1-6

Analog Circuits Design Lab

Name of the Course: Analog Circuits Design Lab	Category: Professional Core Course
Course Code: PC-EI393	Semester: 3rd
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme:
Tutorial: Nil	External Assessment:60
Practical: 3 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Course Outcomes:	
CO. 1	Set up standard experimental methods and select proper instruments to evaluate performance characteristics of different electronic circuits
CO. 2	Determine experimental procedures for different types of electronic circuits.
CO. 3	Evaluate possible reasons of inconsistency between experimental observations and theoretical values and interpret the experimental data.
CO. 4	Investigate different types of instruments connections keeping in mind technical, economical, safety issues.
CO. 5	Analyze graphical presentations of experimental data and solve different complex technical problems.
CO. 6	Design mini electronic based systems.
Pre-Requisite:	
1	Basic Electronics

Experiment No.	Laboratory Experiments	COs
1	Introduction: Study of characteristics curves of B.J.T &F.E.T	1-5
2	Construction of a two-stage R-C coupled amplifier & study of its gain & Bandwidth.	1-5
3	Study of class A & class B power amplifiers.	1-5
4	Study of class C & Push-Pull amplifiers.	1-5
5	Realization of current mirror & level shifter circuit using Operational Amplifiers.	1-5



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6	Study of timer circuit using NE555 & configuration for monostable & astable multivibrator.	1-5
7.	Construction & study of Bistable multivibrator using NE555.	1-5
8.	Study of Switched Mode Power Supply & construction of a linear voltage regulator using regulator IC chip.	1-5
9.	Construction of a simple function generator using IC.	1-5
10.	Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO).	1-5
11.	Study of DAC & ADC.	1-5
12.	Mandatory Design and Implementation of Mini Project.	6

Text and reference books:

1. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, PHI Learning, New Delhi.
2. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3rd Edition, McGraw Hill.
3. Robert L. Boylestad & Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson/PHI, New Delhi.
4. Theodore F. Bogart, Jeffrey S. Beasley, &Guillermo Rico, Electronic Devices and Circuits, Pearson/PHI, New Delhi.
5. L.K. Maheshwari, Analog Electronics, Laxmi Publications, New Delhi

Digital Electronics Lab

Course Name: Digital Electronics Lab	Category: Professional Core
Course Code: PC-EI 394	Semester: 3rd
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme:
Tutorial: Nil	External Assessment:60
Practical: 3 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Course Outcomes:	
CO. 1	Have a thorough understanding of the fundamental concepts and techniques used in digital electronics.
CO. 2	To understand and examine the structure of various number systems and its application in digital design.
CO. 3	The ability to understand, design and analyze various combinational and sequential circuits
CO. 4	Develop competence in Combinational and Sequential Logic Problem formulation and Logic Optimization
CO. 5	Develop skill to build, and troubleshoot digital circuits.
CO. 6	Ability to identify basic requirements for a design application and propose a cost effective solution.



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Pre-Requisite:

1	Mathematics Fundamentals
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Experiment No.	Laboratory Experiments	COs
1.	Realization of basic gates using Universal logic gates.	CO1,2
2.	Code conversion circuits- BCD to Excess-3 & vice-versa.	CO1-6
3.	Construction of simple arithmetic circuits-Adder, Subtractor.	CO1-6
4.	4-bit parity generator & comparator circuits.	CO1-6
5.	Construction of simple Decoder & Multiplexer circuits using logic gates.	CO1-6
6.	Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.	CO1-6
7.	Realization of RS-JK & D flip-flops using Universal logic gates.	CO1-6
8.	Realization of Asynchronous Up/Down counter.	CO1-6
9.	Realization of Synchronous Up/Down counter.	CO1-6
10.	Realization of Universal Register using JK flip-flops & logic gates.	CO1-6
11.	Realization of Universal Register using multiplexer & flip-flops.	CO1-6
12.	Construction of Adder circuit using Shift Register & full Adder.	CO1-6
13.	Realization of Ring counter & Johnson's counter.	CO1-6
14.	Construction of adder circuit using Shift Register & full Adder.	CO1-6
15.	Mandatory Design and Implementation of Mini Project.	CO1-6

Biology

Course Name: Biology	Category: Professional Core Courses
Course Code: BS-BIO 401	Semester: 4 TH
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: No-prerequisite	

Objectives:

1. Convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.
2. To introduce modern biology with an emphasis on evolution of biology as a multidisciplinary field.
3. To make students aware of application of engineering principles in biology and engineering robust solution inspired by biological examples.
4. To make them aware about recent application of biology in engineering research and industry.

Course Outcomes (COs):

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

BS-BIO 401.1. Understand and explain the biological concepts from an engineering perspective.

BS-BIO 401.2. Understand and explain the concepts of hierarchy of life forms at phenomenological level, biological sensing and its challenges.

BS-BIO 401.3. Understand and explain the concept of genetics as well as how genetic material passes from parent to offspring.

BS-BIO 401.4. Understand, assess and explain the different bio-molecules as building blocks of life, macromolecular analysis, information transfer and metabolism as well as the basic concept of microbial system.

BS-BIO 401.5. Explain, assess and integrate biological principles for developing next generation technologies.

BS-BIO 401.6. Understand and explain the development of artificial systems mimicking human action.

Syllabus Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Module Name: Introduction Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.	2	1
Module: 2	Module Name: Classification Purpose: To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitatacquatic or terrestrial (f) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D.Melanogaster, C.elegance, A.Thaliana, M.musculus	3	2
Module: 3	Module Name: Genetics Purpose: To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences”. Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.	5	1, 3, 5, 6
Module: 4	Module Name: Bio molecules, Enzymes Purpose: To convey that all forms of life has the same building blocks and	7	1, 4,

	yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids. Purpose: To convey that without catalysis life would not have existed on earth. Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.		5, 6
Module: 5	Module Name: Metabolism, Microbiology Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of K_{eq} and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to $CO_2 + H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge. Purpose: Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	8	1, 4, 5, 6
Module: 6	Module Name: Information Transfer, Techniques in Biophysics Purpose: The molecular basis of coding and decoding genetic information is universal. Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination. Purpose: Biophysics is an interdisciplinary science that applies approaches and methods traditionally used in physics to study biological phenomena. The techniques including microscopy, spectroscopy, electrophysiology, single-molecule methods and molecular modelling.	8	1, 4, 5, 6
Module: 7	Module Name: Cancer Biology Purpose: A basic understanding of cancer biology and treatment. The course is not designed for patients seeking treatment guidance—but it can help to understand how cancer develops and provides a framework for understanding cancer diagnosis and treatment. Identification of the major types of cancer worldwide. Description of how genes contribute to the risk and growth of cancer. List and description of the ten cellular hallmarks of cancer. Definition of metastasis, and identification of the major steps in the metastatic process. Description of the role of imaging in the screening, diagnosis, staging, and treatments of cancer. Explanation of how cancer is	3	1, 5, 6

	treated.		
	Total	36	

Text/Reference Books:

1. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach, Pearson Education Ltd, 2014.
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry, John Wiley and Sons, 2009.
3. D. L. Nelson and M. M. Cox, "Principles of Biochemistry, W.H. Freeman and Company, 2012.
4. G. S. Stent and R. Calendar, "Molecular Genetics, Freeman and company, 1978.
5. L. M. Prescott, J. P. Harley and C. A. Klein, "Microbiology, McGraw Hill Higher Education, 2005.
6. Lewis J. Kleinsmith. "Principles of cancer biology, Pearson, 2016

Data Structure & Algorithm

Course Name: Data Structure & Algorithm	Category: Engineering Science Course
Course Code: ES-CS 401	Semester: 4 TH
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25 Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Concept of C-Language	

Objectives:

In view of the notable advancement of data structure in recent few years, it is essential for the students to be familiar with various algorithmic approaches to write program thereby solving problems. The objectives of the course are mentioned below:

1. To represent the significance of algorithms with its properties for solving problems in different engineering domains.
2. To provide the characteristics of various Abstract Data Type for creating the solution- strategies.
3. To demonstrate the significance of non-linear data structures with respect to the access and organization of records.
4. To clarify various sorting and searching algorithms.
5. To expose merits and demerits of altered algorithms in terms of time-complexity.
6. To enhance the ability of selecting appropriate data structure and algorithm for solving specific problems.

Course Outcomes (COs):

Upon successful completion of this course, a student will be able to:

- ES-CS 401.1.** Acquaint with the different properties of algorithm and recognize various types of data structure along with the relevance of their application for solving real world problems.
- ES-CS 401.2.** Comprehend the concept of linked list along with its difference from array and its many applications for solving different problems.
- ES-CS 401.3.** Know the concept of ADT (like stack, queue) and recognize its significance for mapping various real life problems to the programming ground to get the solutions of the corresponding problems.

- ES-CS 401.4.** Create the concept of non-linear data structure like graph, tree and their appliance in various problems in societal issues.
- ES-CS 401.5.** Know different traversal approaches and select proper data structure and algorithm by analyzing time complexity and space complexity for specific problems.
- ES-CS 401.6.** Know different searching and sorting approaches and select proper data structure and algorithm by analyzing time complexity and space complexity for specific problems.

Syllabus Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Introduction of Data Structure Necessity of data structure. Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and properties of an Algorithm, Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.	3	1
Module: 2	Array and Linked List Array: Different representations – row major, column major. Array representation of polynomials. LinkedList: Singly linked list, Insertion-Deletion-Display (also in reverse order) Operations of Linked List, circular linked list, doubly linked list, linked list representation of polynomial.	5	2
Module: 3	Linear Data Structure Stack and Queue: Stack and its implementations (using array, using linked list), applications. Queue, circular queue, dequeues. Implementation of queue- both linear and circular (using array, using linked list), applications. Recursion: Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle.	8	3
Module: 4	Nonlinear Data structures: Trees Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal, algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree explanation with example	9	4

Module: 5	Module Name: Nonlinear Data structures: Graphs Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut-vertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list. Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) . Minimal spanning tree – Prim's algorithm.	5	5
Module: 6	Module Name: Searching, Sorting, Hashing Sorting Algorithms: Bubble sort, insertion sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application – priority queue). Searching: Sequential search, binary search. Hashing: Hashing functions, collision resolution techniques	6	6
	Total	36	

Learning Resources Text

Books:

1. "Data Structures And Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Data Structures and Algorithms Using C", R.S. Salaria, Khanna Publishing House.
3. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
4. "Data Structures in C" by Aaron M. Tenenbaum.
5. **"Data Structures" by S. Lipschutz.**

Reference Books:

1. "Expert Data Structures with C" by R.B. Patel, Khanna Publishing House
2. "Data Structures Using C" by Reema Thareja
3. "Data Structure Using C", 2/e by A.K. Rath, A. K. Jagadev.
4. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein

Indian Constitution and Culture

Course Name: Indian Constitution and Culture	Category: Mandatory Course
Course Code: MC-ES 401	Semester: 4 TH
L-T-P: 1-0-0	Credit: 0
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: No-prerequisite	

Objectives:

1. To provide basic knowledge about the Indian Constitution.
2. To have working idea about the functioning of the Executive, Legislative and Judiciary bodies in our country.

Course Outcome:

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

MC-ES 401.1: Identify the authority to redress the problems in their profession or society.

MC-ES 401.2: Describe: The features of Indian Constitution.

MC-ES 401.3: Workings of the various Legislative, Executive and Judicial bodies in the country appreciate the democratic workings at the grassroots level.

MC-ES 401.4: Understand the jurisdiction and procedures of our courts.

Syllabus details

Module No.	Description of Topic	Contact Hrs.
Module 1	Indian Constitution Sources of Constitutional history, Preamble and its Salient Features, Citizenship, Fundamental Rights and Duties, Directive Principles of State Policy	2
Module 2	Union Government and its administration. Structure of the Indian Union. Legislative bodies: Lok Sabha and the Rajya Sabha, The Speaker and the Chairperson of the Rajya Sabha. Executive Bodies. The President and the Vice-President - Role, Power and the method of Election and Amenities and Removal Procedure The Prime Minister and the Council of Ministers. Central Secretariat	5
Module 3	State Government/s and its administration. Federalism. Centre-State relationship The Governor – Role and Function The Chief Minister and the State Council of Ministers State Secretariat	2
Module 4	The Judiciary The Supreme Court – Organization, Procedure, Jurisdiction and Power Chief Justice and other Judges High Court/s - Organization, Procedure, Jurisdiction and Power Chief Justice and other Judges Subordinate Courts – Structure, Jurisdiction and Procedure Lok Adalats PIL – Scope, Principle and Features	5
Module 5	Local Administration – Urban Municipalities, Municipal Corporations, Town Area, Notified Area Mayor – Role and Function	3
Module 6	Local Administration – Rural Zilla Parishad, Aanchal Parishad and Gram Panchayats Powers, Functions and Key Functionaries Grassroot Empowerment	3
	Total	20

Learning resources

Text books:

1. Indian Polity, M Laxminath, Mcgraw Hill Publications, 5th Edition.

Reference books:

1. Introduction to the Constitution of India, D DBasu, Lexis Nexis Publications of India, 21st Edition.

Electrical & Electronic Measurements

Course Name: Electrical & Electronic Measurements	Category: Professional Core
Course Code: PC-EI 401	Semester: Fourth Semester
L-T-P: 3-1-0	Credit: 4
Teaching Scheme	Examination Scheme
Theory: 4 hrs./week	Continuous Assessment: 25Marks
Tutorial: 1 hr/week	Attendance: 5 Marks
Total Lectures: 48 hours	End Semester Exam.: 70 Marks
Pre-Requisites: Basic Electrical Engineering,Basic Electronics Engineering, Circuit Theory & Networks	

Objective : ---

- 1.To learn methods of measurement, errors in measurement and its classification.
2. To learn the principle of operation of analog and digital meters.
3. To learn the basic principle of operation of instrument transformers.
4. To learn the principle of operation of cathode ray oscilloscope and different sensors and transducers.
5. To learn the principle of measurement of power, energy and different electrical parameters
6. To acquire problem solving skills to solve problems on the topics studied.

Course Outcomes (COs):

PC-EI 401.1 : To **describe** the methods of measurement, errors in measurement and its classification.

PC-EI 401.2 : To **state** the principle of operation of analog indicating instrument.

PC-EI 401.3 : To **understand and apply** various technique of resistance, capacitance and inductance measurement.

PC-EI 401.4 : To **understand and analyze** the operation of Instrument Transformer and power measurement.

PC-EI 401.5 : To **illustrate** the concept of Cathode Ray Oscilloscope.

PC-EI 401.6 : To **design** the various types of Digital Instruments.

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Module Name:Introduction to measurement System Methods of measurement, Measurement system, Classification of instruments, Definition of accuracy, precision, resolution. Speed of response. Errors in measurement, classification of errors. Loading effect due to shunt and series connected instruments.	8	CO1
Module: 2	Module Name:Analog meter General features, Construction, principle of operation and torque equation of moving coil, moving iron,	6	CO2

	electrodynamometer, Induction, and Electrostatic type instruments. Principle of operation of the thermoelectric, rectifier type instruments. Extension of instrument ranges using shunt, multipliers.		
Module: 3	Module Name: Measurement of resistance Measurement of medium resistance, low, and high resistances. Megger. Potentiometers: Principle of operation and application of Crompton's DC potentiometer, Polar and coordinate type of AC potentiometers.	8	CO3
Module: 4	Module Name: Instrument transformer: Disadvantages of shunt & multipliers, Advantages of Instrument Transformers, Principle of operation of current & potential transformer, errors.	4	CO4
Module: 5	Module Name: Measurement of power: Principle of operation of Electrodynamometer & induction type wattmeter, wattmeter errors. Measurement of energy: Construction, theory and operation of AC energy meter, testing of Energy meters.	6	CO4
Module: 6	Module Name: AC bridges: Measurement of inductances, capacitance and frequency by A.C bridges.	4	CO3
Module: 7	Module Name: Cathode Ray Oscilloscope: Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope. Double beam CRO	6	CO5
Module: 8	Module Name: Electronic instruments: Digital voltmeter, Digital multimeter, Digital frequency meter, LCR meter, Impedance analyzer, Vector Network Analyzer, Spectrum Analyzers	6	CO6

Text Books :

1. A course in Electrical & Electronic Measurements & Instrumentation; A.K. Sawhney, Dhanpat Rai and sons.
2. Electrical Measurements and Measuring Instruments; E.W Golding & F.C. Wides, Wheeler Publishing
3. Electronic Instrumentation; H.S.Kalsi, Tata McGraw hill, 2nd edition

Reference Books:

1. Digital Instrumentation; A.J. Bouwens, Tata McGraw Hill
2. Modern Electronic Instrumentation & Measuring Instruments; A.D. Heltrick & W.D. Cooper, Wheeler Publishing

Microprocessors & Microcontroller

Course Name: Microprocessors & Microcontroller	Category: Professional Core Courses
Course Code: PC EI 402	Semester: 4 TH
L-T-P: 3-1-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: 1 hrs./week	Attendance: 5 Marks
Total Lectures: 45	End Semester Exam.: 70 Marks
Pre-Requisites: Digital Electronics	

Objectives:

1. To introduce the architecture and organization of typical microprocessors and microcontroller
2. To develop assembly language programming skill of microprocessor and microcontroller along with applications.
3. To familiarize the technique for interfacing memory and peripheral devices to microprocessor, including several specific standard I/O devices.
4. To understand the hardware/software trade-offs involved in the design of microprocessor based systems.

Course Outcomes (COs):

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

PC EI 402.1: Describe the architecture of Microprocessors (8085, 8086) and Microcontroller (8051).

PC EI 402.2: State the importance and function of different modules of Microprocessor and Microcontroller.

PC EI 402.3: Understand and apply the fundamental of assembly level programming of Microprocessor and Microcontroller.

PC EI 402.4: Understand and analyze the use of timer/counter, interrupt and serial data communication process in microcontroller.

PC EI 402.5: Illustrate how the peripheral (8255 etc.) and memory devices are interfaced with Microprocessor.

PC EI 402.6: Design different real world interfacing circuit using microprocessor and microcontroller.

Syllabus Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Module Name: Introduction to 8085 Microprocessor Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization and interfacing–I/O ports and data transfer concepts– Timing Diagram – Interrupts.	11	1, 2, 5
Module: 2	Module Name: Programming of 8085 Microprocessor Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing – Look up table – Subroutine instructions – stack.	11	3, 6
Module: 3	Module Name: Peripheral Interfacing: Architecture, configuration and interfacing, with 8255.	3	5
Module: 4	Module Name: 8051 Micro Controller: Schematic diagram of intel-8051, microcontroller- registers, oscillators, ports, memory, timers/counters, special function registers, Addressing modes. Instructions related to Data Transfer and Manipulation, Arithmetic, Logical and Branch operations. Explanation with examples of programming related to topic.	10	1, 2, 3
Module: 5	Module Name: 8051 Micro Controller Peripheral Interfacing: Introduction to the Timer/Counter, Serial Communication and Interrupts: operations, special function registers and programming on required. Interfacing with Peripheral Input/Output Devices: ADC, DAC, Display	10	4, 6
Module: 6	Module Name: Architecture of Typical 16-Bit Microprocessors (Intel 8086): Introduction to a 16 bit microprocessor, Architecture and Register Organization, Memory address space and data organization.	3	1
	Total	48	

Text Books:

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085A /8080A, WILEY EASTERN LIMITED.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.
3. A.H. Mukhopadhyay, Microprocessor, Microcomputer and Their Applications, 3rd Edition Alpha Science International, Ltd. Digital Fundamentals by T.L. Floyd & R.P. Jain (Pearson).

Reference Books:

1. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085, 8086, 8051, McGraw Hill Edu, 2013.

2. M. Rafiquzzman: Microprocessors: Theory & Applications (Intel & Motorola), PHI. 2. Berry.B. Bray INTEL 8086/88, 80186, 286, 386, 486, Pentium Pro & Pentium IV.
3. Berry .B. Bray INTEL 8086/88, 80186, 286, 386, 486, Pentium Pro & Pentium IV. Digital Circuit & Design by S. Aligahanan&S.Aribazhagan (Bikas Publishing)

Electromagnetic Theory

Course Name: Electromagnetic Theory	Category: Professional Core Courses
Course Code: PC-EI 403	Semester: 4 TH
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Knowledge differential and integral calculus	

Objectives:

1. To introduce the basic mathematical concepts related to electromagnetic vectorfields
2. To impart knowledge on the concepts of Electrostatic fields, electrical potential, energy density and their applications. Magneto static fields, magnetic flux density, vector potential and its applications.
3. Different methods of emf generation and Maxwell's equations Electromagnetic waves and characterizing parameters.

Course Outcomes:

At the end of the course, students will demonstrate the ability

- PC-EI 403.1.** To understand the basic laws of electromagnetism.
- PC-EI 403.2.** To obtain the electric and magnetic fields for simple configurations under static conditions.
- PC-EI 403.3.** To analyze time varying electric and magnetic fields.
- PC-EI 403.4.** To understand Maxwell's equation in different forms and different media.
- PC-EI 403.5.** To understand the propagation of EM waves.
- PC-EI 403.6.** To impart knowledge on the concepts of Electrostatic fields, electrical potential, energy density and their applications. Magneto static fields, magnetic flux density, vector potential and its applications. Different methods of EMF generation and Maxwell's equations Electromagnetic waves and characterizing parameters

Syllabus Details

Module No.	Description of Topics	Contact Hrs	CO
Module 1	Introduction: Co-ordinate systems and transformation, Cartesian coordinates, Circular cylindrical coordinates, Spherical coordinates & their transformation. Differential length, area and volume in different coordinate systems. Solution of problems. Introduction to Vector calculus: DEL operator, Gradient of a scalar, Divergence of a vector & Divergence theorem, Curl of a vector & Strokes theorem, Laplacian of a scalar, Classification of vector fields, Helmholtz's theorem. Solution of problems.	9	
Module 2	Scalar and Vector fields, Coulomb's Law and concept of Electric Field, Divergence, the Divergence Theorem and Gauss' Law, Concept of Electrostatic Potential, Poisson's Equation, Energy in the Field, Capacitance, capacitance of common two-plate capacitors, including two-wire capacitors, Dielectrics, dielectric boundary conditions, Solution of Laplace's Equation and Poisson's Equation in 1-D Capacitance. Scalar and Vector fields, Coulomb's Law and concept of Electric Field, Divergence, the Divergence Theorem and Gauss' Law.	9	
Module 3	Concept of Electrostatic Potential, Poisson's Equation, Energy in the Field, Capacitance, capacitance of common two-plate capacitors, including two-wire capacitors, Dielectrics, dielectric boundary conditions, Solution of Laplace's Equation and Poisson's Equation in 1-D Capacitance.	6	
Module 4	Force due to a Magnetic field, Force due to combined Electric and Magnetic fields, Biot-Savart Law, calculation of Magnetic Field for simple coil configurations, Ampere's Law, Magnetic flux, Stokes theorem, Magnetic materials, magnetic boundary conditions, Solution of problems. Electromagnetic fields: Faraday's law, Transformer and motional emf, Displacement current, Maxwell's equations, Time varying Potential, Time harmonic fields. Solution of problems.	6	
Module 5	Electromagnetic wave propagation: Wave equation, Wave propagation in lossy dielectric, Plane waves in loss less dielectric, Plane wave in free space, Plane wave in good conductor, Skin effect, Skin depth, Power & Poynting vector, Reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence, Polarization. Solution of problems. Electromagnetic wave propagation: Wave equation, Wave propagation in lossy dielectric, Plane waves in loss less dielectric, Plane wave in free space, Plane wave in good conductor, Skin effect, Skin depth, Power & Poynting vector, Reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence, Polarization. Solution of problems	9	

Module 6.	Transmission line: Concept of lump & distributed parameters, Line parameters, Transmission line equation & solutions, Physical significance of solutions, Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation. Solution of problems.	6	
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Text/References:

1. Principles and Applications of Electromagnetic Fields - Plonsey, R. and Collin, R.E., McGraw Hill. 1961.
2. Engineering Electromagnetics - William H. Hayt, Jr. Fifth Edition. TMH. 1999
3. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
4. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
5. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.

Electrical & Electronic Measurement Lab

Name of the Course: Electrical & Electronic Measurement Lab.	Category: Professional Core Course
Course Code: PC-EI491	Semester: 4 th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: 2 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Course Outcomes:	
CO. 1	Identify different analogue & digital instruments both AC and DC, source and sink devices, their specifications, constructions using basic knowledge of electrical measurement.
CO. 2	Perform the experiments, interpret measured data and compare the measured value with the true value of a quantity, calculate error in measurement, draw calibration & error curve using appropriate techniques.
CO. 3	Develop the concept of calibration and understand the limitations of the different measuring instruments.
CO. 4	Review and analyse different methods of measurement of frequency, self-inductance, Capacitance and resistance using AC and DC bridges and provide valid concluding remarks.
CO. 5	Learn the necessity of safety measures of using different instruments and handling of high voltage AC.
CO. 6	Work as a member in a team, communicate with each other, and share their independent thinking to perform the experiments successfully.
Pre-Requisite:	
1	No pre-requisites

Experiment No.	Laboratory Experiments	COs
1	Calibration of dynamometer type Ammeter and voltmeter by Potentiometer.	
2	Measurement of Low Resistance using Kelvin Double Bridge.	
3	Measurement of frequency by Wien Bridge.	
4	Measurement of inductance by Anderson Bridge.	
5	Measurement of capacitance by De Sauty Bridge.	
6	Study the Static Characteristics of a Measuring Instrument.	

7	Study the Dynamic Characteristics of a Measurement System.	
8	Acquaintance with basic Structure of Digital Multi Meter and Measurement of Different Electrical Parameters.	
9	Wave and Spectrum Analysis using Q – Meter.	
10	Study the static and dynamic characteristics of VCO.	
11	Mandatory Design and Implementation of Mini Project.	

Microprocessor and Microcontroller Lab

Name of the Course: Microprocessor and Microcontroller Lab	Category: Professional Core Courses
Course Code: PC EI 492	Semester: 4 th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: 2 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Course Outcomes:	
CO. 1	To construct and apply the assembly level programming of microprocessor and microcontroller.
CO. 2	To develop the programming logic and concept with the help of algorithm or flowchart.
CO. 3	To troubleshoot assembly language program along with interactions between software and hardware.
CO. 4	To practice the interfacing of microprocessor and microcontroller with peripheral devices for various applications.
CO. 5	To develop the ability to communicate effectively with fellow group members for dividing and sharing the assignments among themselves.
Pre-Requisite:	
1	Digital Electronics

Experiment No.	Laboratory Experiments	COs
1	a) Familiarization with 8085 trainer kit components. b) Familiarization with 8085 simulator on PC.	1 - 5
2	Study of prewritten programs using 8085 Kit / Simulator for i. Arithmetic operation (Addition, Subtraction, Multiplication, Division) ii. Logical operation (AND, OR, NOT, NAND, NOR, XOR, XNOR) iii. Copying a block of memory iv. Shifting a block of memory v. Packing and unpacking of BCD numbers vi. Addition of BCD numbers vii. Binary to ASCII conversion viii. String Matching etc	1 - 5
3	a) Familiarization with 8051 trainer kit components. b) Familiarization with 8051 simulator on PC.	1 - 5
4	Study of prewritten programs using 8051 Kit / Simulator for i. Arithmetic operation (Addition, Subtraction, Multiplication, Division) ii. Logical operation (AND, OR, NOT, NAND, NOR, XOR, XNOR) iii. Any other on need	1 - 5
5	Interfacing withPeripherals and I/O modules: i. 8255 PPI ii. Stepper Motor	1 - 5

	iii. ADC iv. Temperature sensor v. Relay vi. Any other on need	
6	Mandatory Design and Implementation of Mini Project	1 - 5

Data Structure & Algorithm Lab

Name of the Course: Data Structure & Algorithm Lab	Category: Engineering Science Courses
Course Code: ES-CS 491	Semester: 4 th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: 2 hrs./week	Internal Assessment:40
Credit Points: 1.0	

Course Outcomes:	
ES-CS 491.1.	To know the concept of linear data structure like array along with its applications for solving various mathematical problems concerned with different topics like the operations of matrices.
ES-CS 491.2.	To recognize the various types of ADT like stack & queue with their operations and also their applications in the conversion among infix, prefix & postfix notations.
ES-CS 491.3.	To comprehend the significance of recursion for solving problems like Tower of Hanoi.
ES-CS 491.4.	To be acquainted with the concept of linked list with its classification and the relevance of the usage of such concepts according to the nature of the problems.
ES-CS 491.5.	To be aware with various algorithms applied for searching and sorting purposes with the differences regarding their working principles.
ES-CS 491.6.	To understand the significance of non-linear data structures by the implementations of operations done by Binary Search Tree (BST) etc. and also find the importance of hashing in case of any searching problems.
Pre-Requisite:	
1	C-Programming

Experiment No.	Laboratory Experiments	COs
1	Array Addition & Multiplication of Arrays Implementation of Sparse Matrices	1 - 6
2	Abstract Data Type Stacks and Queues: Implementation of Stack using Array, Conversion of infix notation into its corresponding prefix & postfix forms along with the evaluation of postfix expression Addition, Deletion of elements of Linear Queue & Circular Queue Implementation of Stack using Queue and vice-versa	1 – 6
3	Recursion Tail-Recursion, Tower of Hanoi	1 – 6
4	Linked List Implementation of linked lists: inserting, deleting, and inverting a linked list. Implementation of stacks & queues using linked list, Polynomial addition, Polynomial multiplication	1 – 6
5	Searching & Sorting Operations Searching: Linear Search, Binary Search	1 - 6

	Sorting: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort & Heap Sort.	
6	Nonlinear Data structures Tree Traversal of Binary Search Tree, Threaded binary tree traversal Height balanced binary tree – AVL tree (insertion, deletion) & B- Trees – operations (insertion, deletion).	1 – 6
7	Hashing Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.	1-6
8	Mandatory Design and Implementation of Mini Project.	6

Advanced Language Lab

Name of the Course: Advanced Language Lab	Category: Humanities and Social Sciences including management courses
Course Code: HM-HU 481	Semester: 4 th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: 2 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Course Outcomes:	
CO. 1	To distinguish between various contexts of human communication, e.g., one-to-one, small group, organizational, formal, informal, media, family, intercultural communication, technologically mediated communication, etc.
CO. 2	To use knowledge of interview processes in answering typical HR questions and to demonstrate proper interview etiquette.
CO. 3	To analyze a given topic, enumerate main points and deliver a structured speech with proper introduction and conclusion.
CO. 4	To utilize the key skills like active listening, managing conflict, collaborative communication, and proper body language successfully while discussing any given topic in a group.
CO. 5	To defend opinions with evidence and argument while speaking to an audience or discussing a topic in a group.
CO. 6	To employ effective presentation skills to speak about general and academic topics in front of an audience and transfer this skill successfully to higher semester seminars and future career.
Pre-Requisite:	
1	No pre-requisites

Objective:

The overall aim of this course is to inculcate a sense of confidence in the students and help them to become good communicators in their social as well as professional lives.

Detailed Course Outlines

Introductory lecture is to be given to the students so that they get a clear idea of the syllabus and understand the need for having such a practice lab in the first place (3 hours).

Listening Skills:

Audios & Videos related to current affairs will be shown from sources like British Council, BBC, NDTV, TOEFL, IELTS etc to hone the listening skills of students so that they may identify important points and effective strategies in preparation for their speaking skills.

Speaking Skills:

1.Prerequisite for Speaking Activities: Mastering Linguistic, Paralinguistic features, Pronunciation, Body Language Voice modulation Stress, Intonation, Pitch & Accent of connected speech.

2. One Minute Speech: Students will be taught to organize their thoughts and ideas and present them in a coherent manner in front of an audience on any given topic. While giving the speech they will be taught to demonstrate correct body language, voice modulation and appropriate pronunciation

3. Group Discussion: The students are made to understand proper language, etiquette and strategies for group discussion. Audio -Visual aids as pre-requisite for group discussion will be used to hone listening skills. After wards the class is divided into groups and the students have to discuss on given topic.

4. Mock Interview: Students are taught the strategies of a successful interview. They then have to face rigorous practices of mock-interviews.

Reading Skills:

News Paper Reading: Students are advised to how to read current affairs from leading newspapers, comprehend and summaries the news articles and express their opinion in their own words. This activity will help the students immensely to speak during one minute speech and group discussion.

Writing Skills:

Resume Writing: Students will be taught how to write a professional resume for campus placement & future career.

Economics for Engineers

Course Name: Economics for Engineers	Category: Humanities & Social Sciences
Course Code: HM HU 501	Semester: 5 th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25 Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 45	End Semester Exam.: 70 Marks
Pre-Requisites: Mathematics	

Objectives:

1. To provide students the basic concepts of Economic theories related to Engineering so that they can analyze the economic viability of any engineering course of action.
2. To provide students the basic concepts of Finance and the methods of Accounting so that they can use such methods and concepts in order to analyze the economic viability of the engineering or any other courses of action related to any project.

Course Outcome:

- HM HU 501.1:** Remembering the basic concepts, definitions, process know how of Economics for Engineers and recalling the terms already taught with the new list of terms.
- HM HU 501.2:** Understanding and interpreting the models of Economics for Engineers by stating the main ideas of the models and illustrating the related graphs and tables.
- HM HU 501.3:** Identifying the problems on the facts, techniques and rules and solving the same applying knowledge already acquired and utilizing the related formula.
- HM HU 501.4:** Analyzing the information and classifying them into different groups along with examining relationships, making inferences among the parameters of distinguished models.
- HM HU 501.5:** Evaluating different projects by comparing the benefits and costs related to the same, assessing the best option and recommending the same.
- HM HU 501.6:** Creating alternative solutions by adopting new ideas, compiling the existing information, designing new process with the objective of maximizing benefits or outcomes.

Syllabus details

Module No.	Description of Topic	Contact Hrs.	CO
Module 1	1. Economic Decisions Making – Overview, Problems, Role, Decision making process. 2. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	5	1, 2
Module 2	3. Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal & Effective Interest. 4. Cash Flow & Rate Of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate of Return,	5	2, 3
Module 3	5. Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, 6. Sensitivity and Breakeven Analysis. Economic Analysis In the Public Sector -Quantifying And Valuing Benefits & drawbacks.	5	2, 4
Module 4	7. Inflation And Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates. 8. Uncertainty In Future Events - Estimates and Their Use in Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options.	6	1, 2, 3
Module 5	9. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives 10. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements of Tax Regulations For Depreciation And Capital Allowances	8	3, 4
Module 6	11. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems. 12. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	7	4, 5, 6

	Total	36	
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Learning Resources:

Text books:

1. R. PaneerSeelvan: Engineering Economics, PHI
2. Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House
3. Bhabatosh Banerjee : Cost Accounting ,The World Press Private Ltd.
4. Bhabatosh Banerjee : Cost & Management Accounting ,The World Press Private Ltd.
5. Amit Kumar De & Samiron Mukherjee: Economics for Engineers, Matrix Educare Pvt. Ltd.
6. Financial Accounting I : Soumya Mukherjee & Abhik Kr. Mukherjee, Oxford University Press

Reference books:

1. Sullivan and Wicks: Engineering Economy, Pearson
2. James L. Riggs, David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
3. Cost & Management Accounting I : J.K. Mitra , Oxford University Press.

Object Oriented Programming Language

Course Name: Object Oriented Programming Language	Category: Open Elective Course-I
Course Code: OE-EI501	Semester: 5 th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites:	

Course Objective:

1. To understand Object Oriented Programming concepts and basic characteristics of Java.
2. To know the principles of packages, inheritance and interfaces.
3. To define exceptions and use I/O streams.
4. To develop a java application with threads and generics classes.
5. To design and build simple Graphical User Interfaces

Course Outcome:

OE-EI501.1. Develop Java programs using OOP principles.

OE-EI501.2. Develop Java programs with the concepts inheritance and interfaces.

OE-EI501.3. Build Java applications using exceptions and I/O streams.

OE-EI501.4. Develop Java applications with threads and generics classes.

OE-EI501.5. Develop interactive Java programs using swings

Course Details

Module No.	Description of Topics	Contact Hrs	COs
Module 1	Introduction to oop and java fundamentals Object Oriented Programming – Abstraction – objects and classes – Encapsulation- Inheritance – Polymorphism- OOP in Java	5	1,2
Module 2	Characteristics of Java – The Java Environment – Java Source File Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers – static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays, Packages – Java Doc Comments.	5	1-3

Module 3	Inheritance And Interfaces Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces – Object cloning –inner classes, Array Lists – Strings	9	2
Module 4	Exception Handling And I/O Exceptions – exception hierarchy – throwing and catching exceptions– built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files	8	3
Module 5	Multithreading And Generic Programming Differences: Between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, and thread groups. Generic Programming–Generic classes– generic methods – Bounded Types – Restrictions and Limitations.	9	4
Module 6	Event Driven Programming Graphics programming – Frame – Components – working with 2D shapes – Using color, fonts, and images – Basics of event handling – event handlers – adapter classes – actions – mouse events – AWT event hierarchy – Introduction to Swing – layout management – Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows– Menus – Dialog Boxes.	9	5

Text/Reference Books:

1. Herbert Schildt, —Java The complete referencel, 8th Edition, McGraw Hill Education, 2011.
2. Steven Holzner, —Java 2 Black bookll, Dreamtech press,2011.
3. Timothy Budd, —Understanding Object-oriented programming with Javal, Updated Edition, Pearson Education,2000.
4. R.S. Salaria – Mastering Object-Oriented Programming using C++, Khanna Publishing House, 2018.

Database Management Systems

Course Name: Database Management Systems	Category: Open Elective Course-I
Course Code: OE-EI 502	Semester: 5 th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25 Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites:	

Course Objective:

1. To understand the different issues involved in the design and implementation of a database system.
2. To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
3. To understand and use data manipulation language to query, update, and manage a database
4. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
5. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Course Outcomes:

At the end of the course, students will demonstrate following abilities

- OE-EI 502.1.** The design and implementation of a database system. For a given query write relational algebra expressions for that query and optimize the developed expressions
- OE-EI 502.2.** For a given specification of the requirement design the databases using ER method and normalization.
- OE-EI 502.3.** For a given specification construct the SQL queries for Open source and Commercial DBMS -MYSQL, ORACLE, and DB2.
- OE-EI 502.4.** For a given query optimize its execution using Query optimization algorithms
- OE-EI 502.5.** For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability. And implement the isolation property, including locking, time stamping based on concurrency control and serializability of scheduling.
- OE-EI 502.6.** Concept of the file organization along with different index structurings.

Syllabus Details

Module No.	Description of Topics	Contact Hrs	COs
Module 1.	Introduction: Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.	3	1
Module 2.	Entity-Relationship Model : Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.	5	2
Module 3.	Relational Model: Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.	5	1
Module 4.	SQL and Integrity Constraints: Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Sub-queries, Database security application development using SQL, Stored procedures and triggers.	7	3
Module 5.	Relational Database Design: Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF	7	2
Module 6.	Internals of RDBMS Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols, two phase locking.	5	4,5
Module 7.	File Organization & Index Structures: 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.	4	6
	Total	36	

Text/References:

1. “Database System Concepts”, 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
2. “Principles of Database and Knowledge – Base Systems”, Vol 1 by J. D. Ullman, Computer SciencePress.
3. “Fundamentals of Database Systems”, 5th Edition by R. Elmasri and S. Navathe,

Pearson Education

4. “Foundations of Databases”, Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

Digital Signal Processing

Course Name: Digital Signal Processing	Category: Open Elective Course-II
Course Code: OE-EI 503	Semester: 5 th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Knowledge of matrix, KCL, KVL and Laplace Transformation, Fourier Transform.	

Objectives:

This course aims to make students familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors and also to make students aware about the meaning and implications of the properties of systems and signals.

Course Outcomes (COs):

At the end of the course, a student will be able to:

- OE-EI 503.1. Describe** the distinctions between analog, continuous-time, discrete-time and digital signals, and describe the basic operations involved in analog-digital (A/D) and digital-analog (D/A) conversion, and **Understand** the concept of Sampling and reconstruction.
- OE-EI 503.2. Evaluate** different type of mathematical operation on signals.
- OE-EI 503.3. Compute the**
 - a. z-transform of a sequence, identify its region of convergence,
 - b. Inverse z-transform by partial fractions.
 - c. Fourier series and Fourier transform
 - d. Fast Fourier transform of discrete signal.
- OE-EI 503.4. Implement** the DFT in terms of the FFT, as well as some of its applications (computation of convolution sums, spectral analysis).
- OE-EI 503.5. Apply** tests (or examples and counter examples) to demonstrate linearity, time-invariance, causality and stability, and hence show whether or not a given system belongs to the important class of causal, LTI (linear time-invariant) systems.
- OE-EI 503.6. Design** FIR and IIR filters with desired frequency responses.

Syllabus Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Module Name: <i>Discrete-time signals & Systems:</i> Concept of discrete-time signals, unit-sample, unit-step, unit-ramp, real & complex exponentials, periodic, energy, power signal, arithmetic operations on sequences. Concept of discrete-time system, linear, causal, stable, time invariance, recursive, FIR, IIR, invertible systems.	3	CO1, 2, 5
Module: 2	Module Name: <i>Sampling and Reconstruction of Signals</i> Introduction, Periodic Sampling, Frequency-Domain Representation of Sampling, Reconstruction of a Band limited Signal from its samples, Aliasing, Sampling Theorem, Nyquist Rate, Prefiltering to avoid Sampling, A/D Conversion, Analysis of Quantization Error, D/A Conversion.	5	CO1, 2, 3
Module: 3	Module Name: <i>LTI Systems & its Implementation</i> Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and tabular methods to compute convolution supported with examples and exercises, properties of convolution, interconnections of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems. Structures for FIR Systems: Direct-Form, Cascade Form, Lattice and frequency sampling Structures. Structures for IIR Systems: Signal flow graphs, transposed, Direct Form, Cascade Form, Lattice, Lattice Ladder and Parallel form structure.	7	CO2, 5
Module: 4	Module Name: <i>Z-Transform and its applications</i> Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples and exercises, characteristic families of signals along with ROCs, convolution, correlation and multiplication using Z transform, initial value theorem, Parseval's relation, inverse	6	CO 2, 3, 5

	Z-transform by contour integration, power series & partial-fraction expansions with examples and exercises.		
Module: 5	Module Name:<i>Discrete Fourier Transform-Properties & Applications</i> Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods with examples and exercises. Efficient computation of DFT-Fast Fourier Transform: Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithms, signal flow graphs, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.	8	CO 2, 3, 4
Module: 6	Module Name:<i>Digital Filter Design</i> Characteristics of Practical Frequency Selective Filters, Design of Butterworth Discrete-Time IIR filters from Analog filters using impulse invariant and bilinear transforms, FIR filters-Symmetric and ant symmetric, design of linear phase FIR filters using windowing and frequency sampling method. Kaiser Window Filter Design Method, optimum approximations of FIR Filters- Optimal type I & II Low Pass Filters, Park-McClellan Algorithm. Least Squares Design method, Wiener Filters.	7	CO 3, 5,6
	Total	36	

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis& D.G. Manolakis, Pearson Ed.
2. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co.
3. Discrete-Time Signal Processing, Alan V. Oppenheim, Ronald W.Schafer, John R. Buck.
4. Digital Signal Processing Signals, Systems and Filters, A. Antoniou, TMH Publishing Co.

Reference Books:

1. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
2. Digital Signal Processing, S.Salivahanan, A.Vallabraj& C. Gnanapriya, TMH Publishing Co.
3. Digital Signal Processing, A. NagoorKani, TMH Education
4. Digital Signal Processing S. Poornachandra& B. Sasikala, MH Education

Soft Computing

Course Name: Soft Computing	Category: Open Elective Course-II
Course Code: OE-EI-504	Semester: 5 th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 44	End Semester Exam.: 70 Marks
Pre-Requisites: Familiarity with linear algebra, multivariate calculus, and probability theory Knowledge of a programming language	

Objectives:

- *Introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real world problems.*
- *Insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systems Techniques.*
- *To create awareness of the application areas of soft computing technique*
- *Provide alternative solutions to the conventional problem solving techniques in image/signal processing, pattern recognition/classification, control system*

Course Outcomes (COs):

- OE-EI-504.1: Identify and describe** soft computing techniques and their roles in building intelligent machines
- OE-EI-504.2: Recognize** the feasibility of applying a soft computing methodology for a particular problem
- OE-EI-504.3: Apply** fuzzy logic and reasoning to handle uncertainty and solve engineering problems
- OE-EI-504.4: Apply** genetic algorithms to combinatorial optimization problems
- OE-EI-504.5: Apply** neural networks to pattern classification and regression problems
- OE-EI-504.6: Evaluate and compare** solutions by various soft computing approaches for a given problem.

Syllabus Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Introduction: Introduction to Soft-computing, Its Constituent components, Fuzzy Sets, General Idea and importance in practical life, definition,	5	CO 1
Module: 2	Basic Operators: T- Norms, S- Norms, other aggregation operators, Fuzzy relations, implications, extensions, projections and compositions	5	CO 1, 2, 3
Module: 3	Fuzzy Logic: Approximate reasoning, compositional rule of inference, rule based systems, term set, Fuzzification, reasoning, defuzzification	5	CO 2, 3
Module: 4	Fuzzy Models: Different Fuzzy models (MA/TS), Applications of Fuzzy rule based systems	5	CO 2, 3
Module: 5	Genetic Algorithm: Basics of Genetic Algorithm, its adaptation for computing, Application	8	CO 2, 4, 6
Module: 6	GA and Fuzzy based Back propagation Network: Studies of some Fuzzy-neural, Neuro-fuzzy and Fuzzy-GA systems	8	CO 4, 5, 6
	Total	36	

Text Books:

1. Dirankov and Hellendrom Fuzzy logic control, Narosa
2. Rajsekhar and Pai, Neural Networks, Fuzzy logic and Genetic Algorithm: Synthetic and Applications, Pearson Education
3. Goldberg - Genetic algorithm, Pearson 2003

Reference Books:

1. Freeman - Neural Networks, Pearson 2003
2. Jang - Neuro-fuzzy and soft Computing, Pearson 2003

Control System

Course Name: Control System	Category: Professional Core Courses
Course Code: PC EI 501	Semester: 5 TH
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3hrs./week	Continuous Assessment: 25Marks
Total Lectures: 36	Attendance: 5 Marks
	End Semester Exam.: 70 Marks
Pre-Requisites: Engineering mathematics that teaches complex variables and Laplace transform	

Objectives:

1. *To understand the use of transfer function models for analysis of physical systems and introduce the control system components.*
2. *To provide adequate knowledge in the time response of systems and steady state error analysis.*
3. *To accord basic knowledge in obtaining the open loop and closed-loop frequency responses of systems.*
4. *To introduce the concept of stability of physical systems.*
5. *To introduce design of compensators and non-linear systems.*

Course Outcomes (COs):

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

PC EI 501.1: The modeling of different linear-time-invariant systems using transfer.

PC EI 501.2: The concept of time response and steady state error for linear-time invariant systems.

PC EI 501.3: Characterization of plants and control loops.

PC EI 501.4: The concept of stability analysis in time and frequency domain for linear-time invariant systems

PC EI 501.5: The design of compensators.

PC EI 501.6: The concept of non-linear system.

Syllabus Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Mathematical modelling of linear time-invariant systems (LTI): System components and Differential equations of physical Systems – mechanical, electrical systems, thermal systems, electromechanical system, biological system; Concept of analogous systems. Laplace transforms, Transfer function, Solution of set of differential equations using Laplace transformation. Concept of poles and zeros. System order and type number. A brief introduction to non-LTI systems, distributed systems, discrete systems, time-delay system	8	1
Module: 2	Block diagram and signal flow graph analysis: Block diagram reduction techniques, Mason's gain formula. Examples.	4	1
Module: 3	System analysis (time-domain): Time response of first-order and second-order systems. Steady-state errors and error constants.	3	2
Module: 4	Characteristics of feedback control: Feedback Principles, Effect of feedback in stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity, and robustness.	3	3
Module: 5	Stability analysis: Concepts of stability. Necessary conditions for Stability. Routh stability criterion. Relative stability analysis. Introduction to root- locus techniques.	5	4
Module: 6	System analysis (frequency-domain): Bode plots-phase and gain margins, Experimental determination of transfer function. Introduction to Polar Plots. Nyquist plots. Nyquist Stability criterion (including time delay systems).	6	4
Module: 7	Compensator Design: Design of lead, lag and lead-lag compensators, Design (and development) of the simple control system.	4	5
Module: 8	Disadvantages of Transfer function modelling, Introduction to state-space representation.	3	6
	Total	36	

Text/References:

1. Automatic Control System: Basic analysis and design by William A. Wolovich, The Oxford Series in Electrical and Computer Engineering.
2. B. C. Kuo, "Automatic Control System", 10th Mc Graw Hill.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, 5th edition.

4. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009
5. Control Systems Engineering, 6th edition, ISV (WSE), by Norman Nise, Wiley
6. Control Systems, Ambikapathy, Khanna Publishing House, 2018.
7. Control Systems, N K Sinha, New Age International Pvt, 2013.

Industrial Instrumentation

Course Name: Industrial Instrumentation	Category: Professional Core
Course Code: PC-EI 502	Semester: V
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: To understand this course, the learner must have idea of elementary physics, Sensor & Transducers and Basic Measurement.	

Objectives:

- 1. To familiar the students with industrial instruments used in various industries.*
- 2. To acquire knowledge about various techniques used for measurement of process variables such as temperature, pressure, flow and level.*
- 3. To equip the students with the basic knowledge of industrial processes.*
- 4. To learn the construction and working of different types of temperature, pressure, flow and level transducers.*
- 5. To provide the concept of possible sources of error and possible remedies when performing measurements.*
- 6. To realize the basic concepts of hazardous area classification.*

Course Outcomes (COs):

- PC-EI 502.1. Name** different methods for pressure, temperature, flow and level measurement in industry and laboratory.
- PC-EI 502.2. Explain** the working principle of different method of pressure, temperature, flow and level measurement.
- PC-EI 502.3. Apply** the basic knowledge of physics to explain the working principle of the measurement of pressure, temperature, flow and level.
- PC-EI 502.4. Differentiate** characteristics of each technique of measurement for pressure, temperature, flow and level.
- PC-EI 502.5. Select** the suitable method of pressure, temperature, flow and level measurement technique depending on industrial application.
- PC-EI 502.6. Comprehend** the installation, calibration and application of process transmitter.

Syllabus details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Temperature Measurement Temperature scale, ITS 90, fixed points and interpolation equations Filled in systems: liquid, gas and vapour, ranges, media, errors, construction details and comparison, classification Bimetal elements, Thermostats Thermocouples including MI thermocouples: types, thermoelectric power, circuits, ranges, errors, cold junction compensation, compensating cables; Radiation Thermometer sensors used, spectral and other characteristics, Optical Pyrometers; Semiconductor type Temperature Transducers, operation, circuit, range. Accessories instruments required for installation in industrial application like thermo well.	6	1-5
Module: 2	Measurement of Pressure and Vacuum Pressure: Manometers – U tube, Inclined Tube, Well type and Ring Manometers Elastic Pressure Sensor Instruments – Bourdon Tube Pressure Gauge, Capsule Gauge, Differential Pressure Gauge, Pressure Switch Electronic Pr / DP transmitters: capacitive, piezo - resistive and resonating wire type Pressure gauge calibration: Deadweight tester. Vacuum: Mcleod Gauge, Knudsen gauge, thermal conductivity gauge, ionization gauge. Accessories instruments required for installation in industrial application like snubber.	7	1-5
Module: 3	Flow meter I General concepts - Laminar and turbulent flow, Reynolds's number, Effect of temperature and pressure on flow rate measurement, Calibration of flow meters. Head type flow measurement – analysis and calculation, and head producing devices - orifice, nozzle, venturi, pitot tube, multiport averaging pitot Variable Area Flowmeters – Glass and metal tube rotameters,	6	1-5
Module: 4	Flow meter II Electromagnetic type, Ultrasonic type, Vortex type, Positive displacement type Mass flow meters : Coriolis, Thermal, Impeller type Weirs, Flumes and open channel flow measurement, measurement of flow of bulk solids. Accessories instruments required for installation in industrial application like manifolds.	6	1-5
Module: 5	Level Measurement Gauge glass, Bi-Colour, Magnetic and Reflex Level Gauge Float and displacers type instruments – Gauge and Switch D/P type sensors and their installation arrangements Capacitive type level instrument, Ultrasonic and Microwave type, Radar Level Transmitters, level switches – fork type, paddle type. Accessories	6	1,2,6

	instruments required for installation in industrial application like siphon.		
Module: 6	Introduction to process Transmitters Need of transmitter (concept of field area & control room area), Need for standardization of signals, Current, voltage, and pneumatic signal standards, Concept of live & dead zero. Types of transmitters: Two and four wire transmitters, Electronic and Pneumatic transmitters, Electronic Capacitive Differential Pressure Transmitter: Types, Mounting (Installation), Calibration setup, Application of DPT for Level measurement, Zero elevation, suppression, and Square root extractor. Difference between converter & Transmitter, Pneumatic to current converter, Current to pneumatic converter.	5	1,6

Text Books:

1. D. Patranabis, Principles of industrial Instrumentation, TMH, New Delhi, 2nd Ed.
2. K. Krishnaswamy, S. Vijayachitra, Industrial Instrumentation, New Age International Publishers.
3. S.K. Singh, Industrial Instrumentation and Control, McGraw Hill Education.

Reference Books:

1. B. G. Liptak, Instrument Engineers Handbook, vol-I and vol-II, Chilton Book Co. Philadelphia
2. D. M. Considine and G. D. Considine (Eds.) Process Instruments and controls Handbook, McGraw Hill, New York
3. C. R. Alavala, Principles of Industrial Instrumentation and Control Systems, Cengage Learning

Optical Instrumentation

Course Name: Optical Instrumentation	Category: Professional Elective Courses-I
Course Code: PE-EI 501	Semester: V
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25 Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Knowledge of basic optics, Fundamentals of Electromagnetic theory	

Objectives

Course Outcome:

- PE-EI 501.1:** To remember the structures of Optical fiber and their properties.
- PE-EI 501.2:** To understand operation of lasers, LEDs, and Photo-detectors
- PE-EI 501.3:** To apply the advantages of Optical - modulators, Switch, and Amplifiers.
- PE-EI 501.4:** To analyze the application of Optical Fiber Sensors and Laser.
- PE-EI 501.5:** To evaluate the principle of Holography and applications.
- PE-EI 501.6:** To design case studies about Industrial Application of optical fiber and lasers.

Course Details

Module No.	Description of Topics	Contact Hrs	COs
Module 1.	Optical Fibers and Their Properties: Introduction to optical fiber – fiber characteristics – principles of light propagation through a fiber – Different types of fibers and their properties – Losses in the optical fiber – Dispersion – advantages and disadvantages of optical fibers, Connector and splices. Optical Fibers and Their Properties: Introduction to optical fiber – fiber characteristics – principles of light propagation through a fiber – Different types of fibers and their properties – Losses in the optical fiber – Dispersion – advantages and disadvantages of optical fibers, Connector and splices.	8	1, 6
Module 2.	Optoelectronic Components: LED, PD, Optical Modulators Optical sources: LED, DH LED, Edge & Surface emitting LED; Optical detectors: Photodiode, Photoconductive Photodetector, PIN, APD – Electro-optic, Magneto optic and Acousto-optic Modulators. Description of LED, LCD and Plasma Codes and	8	2, 3

	Standards of Instruments.		
Module 3.	Optical Switches and Amplifiers – Coupled mode analysis of directional couplers, electro-optic switches. Optical amplifiers - EDFA, Raman amplifier	3	3
Module 4.	Laser Fundamentals: Two/Three levels and four level lasers – Properties of Semiconductor laser –Laser modes – Resonator configuration – Q-switching and mode locking; Types of Gas lasers, Solid State lasers, etc.	7	2, 4
Module 5.	Industrial Application of Optical Fiber and Lasers: Optical fiber based sensors - for measurement of distance, length, pressure, velocity/ acceleration, current, etc. Laser applications for material processing – Laser heating, welding, melting, etc. Medical applications of lasers - Laser instruments for surgery, removal of tumors of vocal cords, brain surgery, plastic surgery, gynecology and oncology, etc.	8	6
Module 6.	Holography– Basic principle-Methods– Holographic interferometry and application.	2	5
	Total	36	

Text/Reference Books:

1. Introduction to Optoelectronics, J. Wilson and J.F.B. Hawkes, Prentice Hall of India, 2001.
2. Optoelectronics and Optical Fiber Sensors, A. B. Maity, PHI, 2013
3. Fiber Optics and Optoelectronics, R. P. Khare, Oxford Univ. Press, 2004.
4. Laser Fundamentals – W. T. Silfvast, Cambridge Univ. Press, 2004
5. Optical Fiber Communication – Principles and Practice, J.M. Senior, PHI, 1985.
6. Lasers Systems and Applications – S. K. Srivastava, New Age, 2019

Advanced Sensors

Course Name: Advanced Sensors	Category: Professional Elective Course-I
Course Code: PE-EI 502	Semester: 5th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Basic knowledge of electronics, sensor and transduces.	

Objectives:

This course aims to educate students with different advanced sensing technology and also make them familiar with manufacturing and fabrication technique of different silicon and micro sensors. Also it is expected that the knowledge of this course will encourage the students in designing different sensor based projects for application in the field of robotic and industrial automation.

Course Outcomes (COs):

After completing the course the student should be able to

- PE-EI 502.1:** Explain the various principles employed in transducers.
- PE-EI 502.2:** Examine the methods of fabricating a sensor.
- PE-EI 502.3:** Apply knowledge in designing smart sensors.
- PE-EI 502.4:** Discuss the techniques of fabrication and application of MEMS.
- PE-EI 502.5:** Design environmental measurement systems using different chemical sensors.
- PE-EI 502.6:** Develop bio-sensors for agricultural and food processing industry.

Course details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Fundamentals of sensors Transducers for various parameters like temperature, pressure, flow, level, acceleration, vibration, orientation etc.	8	1
Module: 2	Sensor Fabrication: Design considerations and selection criterion as per standards, Sensor fabrication techniques, process details and latest trends in sensor fabrication. Thick film sensing and system design.	7	2
Module: 3	Smart Sensors: Smart sensor basics, signal conditioning and A/D conversion for sensors, examples of available ICs and their applications.	5	3
Module: 4	Micro Electromechanical Sensors: Construction, Features, Applications	7	4
Module: 5	Advanced Sensing Technology: Sensors, instruments and measurement techniques for emerging application areas such as environmental measurement like DO(dissolves oxygen),BOD (biological oxygen demand),COD(chemical oxygen demand)TOC(total organic carbon)Cox(carbon dioxides)NOx(nitrogen oxide),SOx (Sulphur Oxides)	5	5
Module: 6	Bio Sensors: Sensors agricultural measurements such as soil moisture, wind speed, leaf wetness duration, sensors for food processing like smell or odour, taste.	4	6
	Total	36	

Text Books:

1. Chang Liu, Foundations of MEMS, Pearson Education Inc., 2012.
2. Stephen D Senturia, Microsystem Design, Springer Publication, 2000.
3. Tai Ran Hsu, MEMS & Micro systems Design and Manufacture Tata McGraw Hill, New Delhi, 2002.
4. Jacob Fraden /Handbook of Modern Sensors, 2nd Ed.
5. S. M. Sze, Semiconductor Sensors.
6. M J Usher, Sensors and Transducers, MacMillan, 1985.

Reference Books:

1. NadimMaluf, An Introduction to Micro Electro Mechanical System Design, Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, The MEMS Handbook, CRC press Baco Raton, 2001.
3. Julian W. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M. Adams and Richard A.Layton, Introduction to MEMS, Fabrication and Application, Springer, 2010.

Object Oriented Programminglanguage Lab

Name of the Course: Object Oriented Programming language Lab	Category: Open Elective Courses-I
Course Code: OE-EI 591	Semester: 5 th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme:
Tutorial: Nil	External Assessment:60
Practical: 3 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Course Outcome:

OE-EI 5911. Gain the basic knowledge on Object Oriented concepts.

OE-EI 5912. Ability to develop applications using Object Oriented Programming Concepts.

OE-EI 5913. Ability to implement features of object oriented programming to solve real world problems.

OE-EI 5914. Understand advanced features of C++ specifically stream I/O, templates and operator overloading

OE-EI 5915. Understand how to apply the major object-oriented concepts to implement object oriented programs in C++, encapsulation, inheritance and polymorphism

Laboratory Experiments:

Exp. No.	Title of the Experiment	COs
1	Assignments on class, constructor, overloading, inheritance, overriding	
2	Assignments on wrapper class, arrays	
3	Assignments on developing interfaces- multiple inheritance, extending interfaces	
4	Assignments on creating and accessing packages	
5	Assignments on multithreaded programming	
6	Assignments on applet programming	

Data Base Management SystemLab

Name of the Course: Data Base Management SystemLab	Category: Open Elective Courses-I
Course Code: OE-EI 592	Semester: 5 th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme:
Tutorial: Nil	External Assessment:60
Practical: 3 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Course Outcome:

- OE–EI 592.1. Understand, appreciate and effectively explain the underlying concepts of database technologies.
- OE–EI 592.2. Design and implement a database schema for a given problem-domain.
- OE–EI 592.3. Normalize a database.
- OE–EI 592.4. Populate and query a database using SQL DML/DDL commands.
- OE–EI 592.5. Programming PL/SQL including stored procedures, stored functions, cursors, packages.
- OE–EI 592.6. Design and build a GUI application using a4GL

Laboratory Experiments:		COs
1.	Creating Database • Creating a Database • Creating a Table • Specifying Relational Data Types • Specifying Constraints • Creating Indexes	
2.	Table and Record Handling • INSERT statement • Using SELECT and INSERT together • DELETE, UPDATE, TRUNCATE statements • DROP, ALTER statements	
3.	Retrieving Data from a Database • The SELECT statement • Using the WHERE clause • Using Logical Operators in the WHERE clause • Using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING Clause • Using Aggregate Functions • Combining Tables Using JOIN • Sub queries	
4.	Database Management • Creating Views • Creating Column Aliases • Creating Database Users • Using GRANT and REVOKE	

Control System Lab

Name of the Course: Control System Lab	Category: Professional Core Courses
Course Code: PC-EI 591	Semester: 5 th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme:
Tutorial: Nil	External Assessment:60
Practical: 3 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Course Outcomes:	
CO. 1	To understand the different ways of system representations such as Transfer function representation and state space representations and to assess the system dynamic response.
CO. 2	To assess the system performance using time domain analysis and methods for improving it.
CO. 3	To assess the system performance using frequency domain analysis and techniques for improving the performance
CO. 4	To design various controllers and compensators to improve system performance.
CO. 5	To develop the ability to communicate effectively with fellow group members for dividing and sharing the assignments among themselves.
Pre-Requisite:	
1	MATLAB programming, Engineering Mathematics

Experiment No.	Laboratory Experiments	COs
1	Familiarization with MATLAB control system toolbox, MATLAB-SIMULINK toolbox and PSPICE	1 - 5
2	Study of step response for first and second order system with unity feedback with display on CRT screen and calculation of parameters for different system designs.	1 - 5
3	Simulation of impulse response for types 0, 1 and 2 with unity feedback using MATLAB and PSPICE.	1 - 5
4	Determination of root-locus, Bode plot, Nyquist plot using MATLAB toolbox for a given second order transfer function and listing of the specifications.	1 - 5
5	Determine the effect of P, I, D actions on first order simulated process and obtaining the system transfer functions from Bode plot	1 - 5
6	Lag and lead compensation – Magnitude and phase plot	1 – 5
7	Create the state space model of a linear continuous system.	1 – 5

Industrial Instrumentation Lab

Name of the Course: Industrial Instrumentation Lab	Category: Professional Core Courses
Course Code: PC EI 592	Semester: 5th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme:
Tutorial: Nil	External Assessment: 60
Practical: 3 hrs./week	Internal Assessment: 40
Credit Points: 1.5	

Course Outcomes:	
CO. 1	Illustrate the different methods for the measurement of temperature, pressure, flow and level.
CO. 2	Elucidate the construction and working of various industrial devices used to measure temperature, pressure, flow and level.
CO. 3	Explicate the construction and working of various industrial devices used to measure temperature, pressure, flow, level, viscosity and moisture.
CO. 4	Ability to analyze, formulate and select suitable sensor for the given industrial applications.
CO. 5	Demonstrate the knowledge of calibrations used in the measurement and control processes.
CO. 6	Demonstrate skills in trouble shooting problems with the measurement and control of industrial processes.
Pre-Requisite:	
1	Knowledge of sensor & Transducers

Experiment No.	Laboratory Experiments	COs
1	Study of Thermocouple characteristics and Measurement of Temperature with it.	1, 2, 3, 4 & 6
2	Measurement of Temperature using AD 590 IC Sensor.	1, 2, 3, 4 & 6
3	Calibration of Pressure Gauge using Dead Weight Tester.	5
4	Measurement of low pressure using Pirani gauge.	1, 2, 3, 4 & 6
5	Measurements of Volumetric flow rate by head type flow meter.	1, 2, 3, 4 & 6
6	Measurements of flow rate and velocity of fluid flow by Variable Area type flow meter.	1, 2, 3, 4 & 6
7	Measurements of Mass flow rate by Mass flow meter.	1, 2, 3, 4 & 6
8	Measurement of level using capacitive type level instrument.	1, 2, 3, 4 & 6

Values & Ethics in Profession

Course Name: Values and Ethics in Profession	Category: Humanities and Social Sciences
Course Code: HM-HU 601	Semester: VI
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 24	End Semester Exam.: 70 Marks
Pre-Requisites: No-prerequisite	

Objectives:

To understand the ethical and moral problems faced in the corporate and wider philosophical settings along with social importance and their intellectual challenges are given its due placement.

Course Outcomes:

- HM-HU 601. 1. Understanding** the significance of Indian ethos and culture and analyzing the implementation of ancient Indian thoughts in management today
- HM-HU 601. 2. Evaluating** how the ethical principles guide our moral actions and judgments and identifying how the unethical practices are standing as obstacles for socio-economic development.
- HM-HU 601. 3. Assessing** the ethical challenges and dilemmas of engineering practices and creating norms for administrating ethical management initiatives in an organization
- HM-HU 601. 4. Interpreting** the global principles of corporate social responsibility to design and develop an organization's plan towards societal growth and sustainability
- HM-HU 601. 5. Estimating** the impact of the rapid technological growth and applying varied eco-friendly technologies for sustainable development
- HM-HU 601. 6. Identifying and prioritizing** human values as core of our behavior to promote social stability and social progress thereby comprehending the process of living in peace and harmony

Course content:

Module No.	Description of Topic	Contact Hrs.	CO
1	Being good and responsible Gandhian values such as truth and non-violence – comparative analysis on leaders of past and present – society’s interests versus self interests – Prevention of harassment, violence and terrorism - Personal Social Responsibility: Helping the needy, charity and serving the society, Essence of harmony in today’s world, Value Education, Service Learning, Emotional intelligence	2	6
2	Profession and Human Values Values Crisis in contemporary society, Nature of values: Value Spectrum of a good life, Psychological values: Integrated personality; mental health, Societal values, Moral and Ethical values, Value based leadership , Dishonesty - Stealing - Malpractices in Examinations - Plagiarism – Abuse of technologies: Hacking and other Cyber Crimes	4	2, 3, 6
3	Indian Ethos in Management Indian Ethos, Indian Ethos for Management, Work Ethos and values for Indian managers, Impact of values on stakeholders, Value system in work culture, Trans-cultural human values, Importance of Karma to managers, Nishkama Karma and its impact on employees today, Teaching Ethics, Gurukul system of learning	3	1, 6
4	Corruption Corruption: ethical values, causes, impact, laws, prevention –electoral malpractices – white collar crimes - tax evasions – unfair trade practices.	2	3
5	Addiction and Health Peer pressure, Drug Abuse Alcoholism: ethical values, causes, impact, laws, prevention-ill effects of smoking-Prevention of suicides-Sexual Health: Prevention and impact of pre- marital pregnancy and Sexually Transmitted Diseases. Abuse of different types of legal and illegal drugs: ethical values, causes, impact, laws and prevention	2	3
6	Ethics of Profession Engineering profession: Ethical issues and challenges in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional Ethics, Ethical governance in business, Whistle blowing and beyond, Case studies, Corporate Social Responsibility and good corporate	5	1, 3, 4, 6

	citizenship, Ethical dilemma in different business areas, Managing ethical dilemmas		
7	Effects of Technological Growth Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development, Energy Crisis: Renewable Energy Resources, Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics, Appropriate, Technology Movement of Schumacher; later developments, Technology and developing notions. Problems of Technology transfer, Technology assessment impact analysis.	5	2, 4, 5
	Total	24	

Learning Resources

Textbook:

- 1 Human Values- A.N.Tripathi.
- 2 Professional Ethics and Human Values – Premvir Kapoor, Khanna Publishing House
- 3 Christine E. Gudorf, James Edward Huchingson, ‘Boundaries: A Casebook in Environmental Ethics’, Georgetown University Press, 2010

References:

- 1 Ethics- S. Balachandran, K. C. R. Raja & B. K. Neir
- 2 Values and Ethics in Profession- Sisir Mazumder (Everest)
- 3 Ethics in Engineering- Martin Schinzinger
- 4 Mike W. Martin & Ronald Schnitzinger, Engineering Ethics, New Delhi: Tata Reference McGraw Hill, Latest Edition
- 5 OC Ferrell, John Paul Frederick, Linda Ferrell; Business Ethics – Ethical Books Decision making and Cases- 2007 Edition, Biz Tantra, New Delhi
- 6 L.H. Newton & Catherine K.D., “Classic cases in Environmental Ethics”, Belmont: California Wadsworth, 2006

Internet of Things (IoT)

Course Name: Internet of Things (IoT)	Category: Open Elective Courses -III
Course Code: OE-EI 601	Semester: VI
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Basic concept of programming	

Objectives:

- 1. To understand the application areas of IoT*
- 2. To understand building blocks of Internet of Things and characteristics*
- 3. To realize the revolution of Internet in Mobile Devices & Sensor Networks*

Course Outcomes (COs):

OE-EI 601.1: Understand the application areas of IOT.

OE-EI 601.2: Realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.

OE-EI 601.3: Understand building blocks of Internet of Things and characteristics.

OE-EI 601.4: Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.

OE-EI 601.5: Building state of the art architecture in IoT.

OE-EI 601.6: Design IoT applications for smart cities and smart houses

Course Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Introduction Introduction to IoT, Concept of Smart sensors and actuators	4	1
Module: 2	Basics of IoT Basic of IoT networking Internet Communications: An Overview MQTT, CoAP, REST Api and gRPC, Different Communication protocols: (RFID, IEEE 802.15.4, Zigbee, 6LoWPAN, Bluetooth), LoRa, Machine-to-Machine (M2M) Communications, MQTT Broker	6	1, 2, 3
Module: 3	Programming with IoT Introduction to Python programming with IoT modules i.e. Paho MQTT, Web modules: urllib2, Flask, Flask-RESTful	8	5
Module: 4	Sensors Interfacing Introduction to Arduino Programming, integration of Sensors having analog and i2c. Connecting Arduino with ESP8266 WiFi module	8	2, 6
Module: 5	IoT wit Raspberry Pi Introduction to Python Raspberry Pi, Implementation of IoT with Raspberry Pi.	8	5
Module: 6	Application IoT application: Smart Cities and Smart Homes	2	4, 6
	Total	36	

Learning Resources

Text books:

1. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley publication, 1st Edition, November 2013.
2. Jeeva Jose, Internet of Things, Khanna Publishing House, New Delhi (AICTE Recommended – 2018)
3. Michale Miller , “The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World”, Pearson Education
4. Hanes David, Salgueiro Gonzalo, Grossetete Patrick, Barton Rob , “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things” , Pearson Education
5. RMD Sundaram Shriram, K Vasudevan, Abhishek S Nagarajan, “Internet of Things” , Wiley publication,

Reference books:

1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing
2. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing

Artificial Intelligence

Course Name: Artificial Intelligence	Category: Open Elective
Course Code: OE-EI 602	Semester: 7th
L-T-P: 3-1-0	Credit: 4
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: 1 hrs/week	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Mathematics	

Objective:

To learn the methods for analyzing the behaviour of nonlinear control systems and the designing of control systems.

Course Outcomes (COs):

At the end of the course, a student will be able to:

- OE-EI 602.1. Compare** AI with human intelligence and traditional information processing and discuss its strengths and limitations.
- OE-EI 602.2. Discuss** the core concepts and algorithms of advanced AI, including various searching, knowledge and reasoning, decision making, various learning process, natural language processing, robotics, and so on.
- OE-EI 602.3. Apply** the basic principles, models, and algorithms of AI to recognize, model, and **solve** problems in the **analysis** and **design** of information systems.
- OE-EI 602.4. Analyze** the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.
- OE-EI 602.5. Design** AI functions and components involved in intelligent systems such as computer games, expert systems, semantic web, information retrieval, machine translation, mobile robots, decision support systems, and intelligent tutoring systems.
- OE-EI 602.6. Explain** various search techniques, knowledge & reasoning, and learnings used in expert systems

Course content

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Introduction [2] Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents [2] Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. Problem Solving [2] Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	6	1,3
Module: 2	Search techniques [5] Solving problems by searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies Heuristic search strategies [5] Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. Adversarial search [4] Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.	14	2,3,4
Module: 3	Knowledge & reasoning [3] Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation	3	2,3,4
Module: 4	Using predicate logic [2] Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Probabilistic reasoning [4] Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.	6	2,4,6
Module: 5	Natural Language processing [2] Introduction, Syntactic processing, semantic analysis,	7	2,4,5,6

	discourse & pragmatic processing. Learning [2] Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning. Expert Systems [3] Representing and using domain knowledge, expert system shells, knowledge acquisition		
	Total	36	

Text Books:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP
5. Logic & Prolog Programming, Saroj Kaushik, New Age International
6. Expert Systems, Giarranto, VIKAS
7. Artificial Intelligence, Russel, Pearson

Process Control

Course Name: Process Control	Category: Professional Core
Course Code: PC-EI 601	Semester: VI
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: To understand this course, the learner must have idea of sensor and transducer, industrial instrumentation and control theory.	

Objectives:

- 1. To study the operation of different types of industrial processes.*
- 2. To study the different control strategies used in industrial applications.*

Course Outcomes (COs):

- PC-EI 601.1:** Explain the block diagram of different control loop with response curve and demonstrate its various components.
- PC-EI 601.2:** Describes different process characteristics parameters with suitable examples.
- PC-EI 601.3:** Compare different types of controllers according to their feature and tuning scheme for practical processes.
- PC-EI 601.4:** Demonstrate the construction and use of different types of control valves with practical problems.
- PC-EI 601.5:** Distinguish between different control schemes such as feedforward, ratio, cascade, split, override, adaptive and batch control.
- PC-EI 601.6:** Describe modern control systems such as PLC, DCS and SCADA communicated by HART protocol..

Course Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Module Name: Introduction to process control Details: Introduction, Evolution of process control, process control and automation, classification of process variables, open loop and closed loop systems, servo and regulatory control, compensatory and anticipatory control configuration. Process plant characteristics parameters: self-regulation, Process potential, process quantity and process capacitance, process resistance, process time lag, process characteristics and process reaction rate, process controllability.	5	1,2
Module: 2	Module Name: Different control modes Details: Discontinuous type: On-off, multi-position, floating control mode. Continuous type: proportional, proportional-integral, proportional-derivative, proportional-integral-derivative, inverse derivative control mode. Some special characteristics like integral windup, integral tracking, bump less transfer, derivative overrun etc. Controller selection guideline, offset minimization. Enhance set point tracking and load rejection in process control.	9	1,3
Module: 3	Module Name: Tuning of controllers Details: Controller performance indices, concept of good control, closed loop and open loop tuning methods, comparison of tuning methods. Implementation of Controller: Electronic P, PI, PD, PID controller design. Pneumatic controllers – brief analysis	6	1,3
Module: 4	Module Name: Advanced control techniques Details: schemes, brief analysis and uses (i) Ratio control (ii) Cascade control (iii) Feed forward control (iv) split range control (v) override control (vi) Adaptive control (vii) Continuous control and Batch control	5	1,5
Module: 5	Module Name: Final control elements Details: Classification, actuators: self-operated, pneumatic, electro-pneumatic, hydraulic, electric motor operated and stepper motor operated actuators, valve positioner and	7	1,4

	transmitter, classification of control valves, performance and application of different control valves, valve type and construction, valve sizing, valve characteristics, Cavitation, Flashing, valve testing, valve selection guidelines, safety valve and their selection. Control valve accessories: Air filter regulator, I/P converter.		
Module: 6	Module Name: Modern control Details: Control schemes in industrial processes- distillation columns, heat exchanger, furnaces, reactors, boiler, evaporator, combustion. Introduction to Programmable Logic Controllers – 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 Hardware and Software. Overview of HART protocol, Introduction to SCADA.	4	6

Text Books:

1. Curtis D Johnson – Process Control Instrumentation Technology, - Pearson Education/PHI
2. Chemical process control, G. Stephanopoulos, PHI.
3. Process Control-Principles and application, S. Bhanot, Oxford University press.
4. Principle of Process control, D. Patranabis, TMH.
5. Automatic Process Control, D.P. Eckman, John Wiley.
6. Instrumentation and Process Control, D.C. Sikdar, Khanna Publishing House.

Reference Books:

1. Harriot – Process zcontrol, MGH
2. Process control instrumentation technology, C.D. Johnson, PHI
3. Process Control, S.K. Singh, PHI.
4. Instrument Engineers Handbook, B.G. Liptak, Chilton Book Co. Philadelphia
5. Elements of Chemical Process Technology, O.P. Gupta, Khanna Publishing House

Electrical Machine

Course Name: Electrical Machine	Category: Professional Core
Course Code: PC-EI 602	Semester: VI
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Basic Electrical, Circuit Theory , Electromagnetic Theory	

Objective:

1. To review the concept of magnetic fields and magnetic circuits
2. To learn the principle of production of electromagnetic force and torque.
3. To learn the basic principle of operation of DC machine
4. To learn the principle of operation and characteristics of DC motor and generator
5. To learn the principle of operation, connections and different tests on Transformers
6. To acquire problem solving skills to solve problems of DC machines and Transformers

Course Outcomes (COs):

After study through the course, students will be able to

PC-EI 602.1: Deascribe the basic principle of operation of DC machine

PC-EI 602.2: State the principle of operation and characteristics of DC motor and generator

PC-EI 602.3: Understand and Apply the principle of operation, connections and different tests on Transformers

PC-EI 602.4: Analyze the principle of operation and characteristics of single & three phase Induction machines

PC-EI 602.5: Illustrate the principle of operation and characteristics of synchronous machine

PC-EI 602.6: Design special eletro-mechanical devices

Course details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	DC machines: Basic construction of a DC machine, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.	4	1
Module: 2	DC machine - motoring and generation: Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines	4	2
Module: 3	Transformers: Principle, construction and operation of single-phase transformers, Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers.	10	3
Module: 4	Induction Machines: Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines. Single-phase induction motors: Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications	10	4
Module: 5	Synchronous machines: Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Parallel operation of alternators - synchronization and load division.	2	5
Module: 6	Special Electromechanical devices: Principle and construction of switched Reluctance motor, Permanent magnet machines, Brushless DC machines, Hysteresis motor, Stepper motor, Tacho generators.	6	6

Text books:

1. Electrical Machines-I, P.S. Bimbhra, Khanna Publishing House (AICTE)
2. Electrical Machinery, P.S. Bimbhra, 7th Edition, Khanna Publishers
3. Electric machines, D.P. Kothari & I.J. Nagrath, 3rd Edition, Tata Mc Graw-Hill Publishing Company Limited
4. Electrical Machines, P.K. Mukherjee & S. Chakrabarty, 2nd edition, Dhanpat Rai Publication.

Reference books:

1. Electric Machinery & Transformers, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
2. Electrical Machines, R.K. Srivastava, Cengage Learning
3. Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition.
4. The performance and Design of Alternating Current Machines, M.G.Say, CBS Publishers & Distributors.
5. Electric Machinery & transformer, Irving L Koskow, 2nd Edition, Prentice Hall India

Analog and Digital Communication

Course Name: Analog and Digital Communication	Category: Professional Elective Course-II
Course Code: PE-EI 601	Semester: 6th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Basic knowledge of analog and digital electronic circuits, signals and systems.	

Objectives: This course aims to equip the students with basic concept of communication system. It emphasizes on technical details of different analog and digital modulation and detection techniques, their performance in different noise conditions. The evolution of mobile communication is also introduced.

Course Outcomes (COs):

After study through the course, students will be able to

- PE-EI 601.1: Gain** the knowledge of components of analog and digital communication system.
- PE-EI 601.2: Demonstrate understanding** of various analog and digital modulation and demodulation techniques.
- PE-EI 601.3: Analyze** transmitter and receiver circuits used in communication systems.
- PE-EI 601.4: Evaluate** the performance of modulation and demodulation techniques in various transmission environments.
- PE-EI 601.5: Compare** and **contrast** design issues, advantages, disadvantages and limitations of analog and digital communication systems.
- PE-EI 601.6: Get acquainted** with different generations of mobile communication system and their technicalities.

Course Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Modulation Techniques: Introduction to Communication Process, Communication Channels, Modulation advantages, effect of noise in communication system	2	1-5
Module: 2	Amplitude Modulation: 1. Standard Amplitude Modulation Techniques: Mathematical representation of Amplitude Modulation (AM), modulation index, total power, side band power, efficiency, generation of AM, Demodulation of AM, Envelop Detection, Limitations of AM. 2. Introduce DSB-SC, Generation, with non linear device, switching modulator, ring modulator, De-generation of DSB-SC, synchronous demodulation, effect of phase and frequency error. 3. SSB-SC generation, phase shift method; filter method, Hilbert transform, de-generation of SSB-SC, its application. 4. VSB generation and de-generation, uses of it in communication. QAM	8	1-5
Module: 3	Frequency Modulation: 1. Angle Modulation: Mathematical representation of Angle modulation, FM & PM Concept of Narrow and Wide-band angle modulation, Calculation of Bandwidth for FM and PM with Narrow and Wide-band modulation. 2. Basic block diagram representation of generation of FM & PM, Concept of VCO & Reactance modulator Angle Modulation, Frequency Modulation (FM), Phase Modulation (PM), Narrowband FM, Generation of FM, 3. Detection of FM, Discriminator circuit. Phased locked Loop.	6	1-5
Module: 4	Pulse Modulation: 1. Sampling process. Types of sampling, Aliasing effect. 2. Pulse Amplitude modulation and Pulse code modulation, Quantization, quantization error, Differential pulse code modulation. Delta modulation.	8	1-5
Module: 5	Digital Modulation: 1. Line coding technique, on-off, polar, bipolar, ISI, Nyquist criterion for zero ISI, eye pattern 2. Digital modulation technique: (Coherent communication with waveforms) ASK, BPSK, FSK, QPSK, DPSK, MSK. 3. Matched filter, Probability of Error evaluations for ASK and BPSK.	6	1-5
Module: 6	Mobile Communication: 1. Wireless Standards: Overview of 2G and 3G cellular	6	6

	standards		
	2. Cellular concepts-Cell structure, frequency reuse, cell splitting, handoff, interference.		
	3. Multicarrier modulation, TDM,FDM,OFDM		
	4. MIMO and space time signal processing, spatial multiplexing, concept of multipath fading, Performance measures- Outage, average SNR, average capacity, bit error rate.		

Text Books:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. B.P. Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press.
4. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.

Reference Books:

1. Sanjay Sharma, "Communication Systems (Analog and Digital)", Katson Books.
2. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
3. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
4. VK Garg&JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

Embedded System

Course Name: Embedded System	Category: Professional Elective Course-II
Course Code: PE-EI 602	Semester: 6th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Microprocessor and Microcontroller	

Objectives:

1. To have knowledge about the basic working of a microcontroller system and its programming in assembly language.
2. To provide experience to integrate hardware and software for microcontroller applications systems.

Course Outcomes (COs)

PE-EI 602.1. Understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.

PE-EI 602.2. Understand the role of embedded systems in industry.

PE-EI 602.3. Understand the programming techniques of different microcontrollers.

PE-EI 602.4. Design processor and controller based intelligent systems for real life problems.

3.

Module No.	Description of Topics	Contact Hrs
1	Introduction to Embedded System : Embedded system VS General computing systems, Purpose of Embedded systems, Design challenge – optimizing design metrics, embedded processor technology, Microprocessor and Microcontroller, Hardware architecture of the real time systems. A/D converter and D/A Converter, RISC vs CISC, Example of Embedded system.	7
2.	Introduction to AVR microcontroller: Introduction to AVR (ATmega 328p-pu) microcontroller, pin layout, architecture, program memory, Data Direction register , Port Registers (PORTx), PWM registers (8-bit), ADC registers, basics of communication, overview and interfacing I/O devices with I2C Bus, UART and Serial Peripheral Interchange (SPI) bus, Programming Embedded Systems with AVR (ArduinoAPI).	10

3.	Introduction to ARM microcontroller: Architecture of ARM Embedded microcontroller, ARM instruction set, Introduction to ARMv8-A based embedded development board (i.e. Raspberry Pi rev.4), Programming a Raspberry Pi rev.4 using Python 2.7, User defined LED blink using Raspberry Pi GPIOs, communication between an Arduino UNO rev.3 with Raspberry Pi 4 over USB serial.	10
4.	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.	10
5.	Case Studies: i) Interfacing with Temperature Sensor.(AVR microcontroller and ARM microcontroller Based) ii) Interfacing with Servo Motor. (AVR microcontroller and ARM microcontroller Based) iii) Interfacing with Gas Sensor.(AVR microcontroller and ARM microcontroller Based) iv) Interfacing with LDR light sensor.(AVR microcontroller and ARM microcontroller Based)	8

Outcomes:

To acquire knowledge about microcontrollers embedded processors and their applications.

1. Foster ability to understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.
2. Foster ability to write the programs for microcontroller.
3. Foster ability to understand the role of embedded systems in industry.
4. Design processor and controller based intelligent systems for real life problems.

Text/References:

1. Raj Kamal, Embedded systems- Architecture, Programming and Design, McGraw Hill Education (India) Pvt.Ltd.
2. Dhananjay Gadre, "Programming and Customizing the AVR Microcontroller"; McGraw Hill Education, 2014.
3. Elliot Williams, "AVR Programming: Learning to Write Software for Hardware", Maker Media, Incorporated, 2014
4. An Embedded Software Primer – David E. Simon, Pearson Ed., 2005.

POWER ELECTRONICS

Course Name: POWER ELECTRONICS	Category: Professional Elective Course-III
Course Code: PE-EI 603	Semester: VI
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites:	

Objectives:

1. To understand the functioning and characteristics of power switching devices.
2. To understand the principle of operation of converters.
3. To understand different triggering circuits and techniques of commutation of SCR
4. To find external performance parameter of converters.
5. To analyze methods of voltage control, improvement of power factor and reduction of harmonics of the converter
6. To understand various applications of converters

Course Outcomes (COs):

- PE-EI 603.1.1. To **describe** the functioning and characteristics of power switching devices.
- PE-EI 603.1.2. To **state** different triggering circuits and techniques of commutation of SCR
- PE-EI 603.1.3. To **apply** the principle of operation of phase controlled rectifier.
- PE-EI 603.1.4. To **analyze** the principles of dc to dc converter.
- PE-EI 603.1.5. To **illustrate** various types Inverters
- PE-EI 603.1.6. To **design** various applications of converters

Course Details

Module No.	Description of Topics	Contact hrs	CO
Module 1	Introduction: Concept of power electronics, application of power electronics, uncontrolled converters, advantages and disadvantages of power electronics converters, power electronics systems, power diodes, power transistors, power MOSFETS, IGBT and GTO.	04	1
Module 2	PNPN devices: Thyristors, brief description of members of Thyristor family with symbol, V-I characteristics and applications. Two transistor model of SCR, SCR turn on methods, switching characteristics, gate characteristics, ratings, SCR protection, series and parallel operation, gate triggering circuits, different commutation techniques of SCR.	05	2
Module 3	Phase controlled converters: Principle of operation of single phase and three phase half wave, half controlled, full controlled converters with R, R-L and RLE loads, effects of freewheeling diodes and source inductance on the performance of converters. External performance parameters of converters, techniques of power factor improvement, single phase and three phase dual converters	06	3
Module 4	DC-DC converters: Principle of operation, control strategies, step up choppers, types of choppers circuits based on quadrant of operation, performance parameters, multiphase choppers.	05	4
Module 5	Inverters: Definition, classification of inverters based on nature of input source, wave shape of output voltage, method of commutation & connections. Principle of operation of single phase and three phase bridge inverter with R and R-L loads, performance parameters of inverters, methods of voltage control and harmonic reduction of inverters. Three-phase voltage source inverter: 180° VSI & 120° VSI ,Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub cycle , Cyclo-converters ,Ac Voltage Controller and Static Switch	13	5
Module 6	Applications: Speed control of AC and DC motors. HVDC transmission. Static Switch, UPS.	03	6

Text books:

1. Power Electronics, M.H. Rashid, 4th Edition, Pearson
2. Power Electronics, P.S. Bhimra, , 3rd Edition, Khanna Publishers
3. Power Electronics, V.R. Moorthi, Oxford.
4. Power Electronics, M.D. Singh and K.B. Khanchandani, Tata Mc Graw Hill.

Reference books

1. Modern Power Electronics & AC drives, B.K. Bose, Prentice Hall
2. Power Electronics, Mohan, Undeland & Robbins, Wiley India
3. Element of power Electronics, Phillip T Krein, Oxford.
4. Power Electronics systems, J.P. Agarwal, Pearson Education.
5. Analysis of Thyristor power conditioned motor, S.K. Pillai, University Press.
6. Power Electronics, M.S. Jamal Asgha, PHI.
7. Power Electronics : Principles and applications, J.M. Jacob, Thomson

VLSI & MICROELECTRONICS

Course Name: VLSI & MICROELECTRONICS	Category: Professional Elective Course-III
Course Code: PE-EI 604	Semester: 6th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25 Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Knowledge in Basic Electronics, MOS, Transistors etc.	

Objectives:

This course aims to introduce with the VLSI technology, IC design through VHDL.

Course Outcomes (COs):

At the end of the course, a student will be able to:

- PE-EI 604.1:** Tell about the technology, design concepts, design style, design principles, and design domains.
- PE-EI 604.2:** Explain and distinguish various Microelectronics circuit fabrication process for VLSI circuit design.
- PE-EI 604.3:** Apply the concepts of digital circuit design for designing VLSI circuits using MOS transistors
- PE-EI 604.4:** Draw sticks diagram and Layout diagrams to represent VLSI design process.
- PE-EI 604.5:** Describe the digital VLSI circuit design using VHSL language.
- PE-EI 604.6:** Design and Develop combinational and sequential digital circuits applying the concepts applying the concept of digital circuit design and VHDL language.

Course Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Introduction to VLSI Design: VLSI Design Concepts, Moor's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI – basic idea only), Types of VLSI Chips (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA), Design principles (Digital VLSI – Concept of Regularity, Granularity etc), Design Domains (Behavioral, Structural, Physical), Y-Chart, Digital VLSI Design Steps.	7	CO 1
Module: 2	MOS Formation: Thin and Thick Film Integrated Circuits, Methods of producing film, monitoring and control of film thickness; Design and fabrication of individual components; Processing steps for realization of systems. Monolithic IC Technology : Planner processing steps for realization of integrated circuit using bipolar, MOS and CMOS technology; Epitaxy; Diffusion; Ion-Implantation; Oxidation and passivation; Masking and lithography; Etching; Metallisation and ohmic contacts; Die and wire bonding, packaging and encapsulation; Advantages and disadvantages of bipolar, MOS and CMOS systems.	8	CO 2, 3
Module: 3	MOS structure: E-MOS & D-MOS, Charge inversion in E-MOS, Threshold voltage, Flatband voltage, Potential balance & Charge balance, Inversion, MOS capacitances. Three Terminal MOS Structure: Body effect. Four Terminal MOS Transistor: Drain current, I-V characteristics. Current-voltage equations (simple derivation). Scaling in MOSFET: Short Channel Effects, General scaling, Constant Voltage & Field scaling. CMOS: CMOS inverter, Simple Combinational Gates - NAND gate and NOR Gate using CMOS.	8	CO 4,5
Module: 4	Micro-electronic Processes for VLSI Fabrication: Silicon Semiconductor Technology- An Overview, Wafer processing, Oxidation, Epitaxial deposition, Ion-implantation & Diffusion, Cleaning, Etching, Photo-lithography – Positive & Negative photo-resist	3	CO 4,5
	Basic CMOS Technology – (Steps in fabricating CMOS), Basic n-well CMOS process, p-well CMOS process, Twin tub process, Silicon on insulator Layout Design Rule: Stick diagram with examples, Layout rules.	2	CO 4,5
Module: 5	Hardware Description Language – VHDL or Verilog Combinational & Sequential Logic circuit Design.	8	CO 6

Text Books:

1. Physical design automation of VLSI systems - B. T. Press and M.J. Lorenzetti Benjamin (Eds.)
2. Logic Minimization for VLSI Synthesis - R.K. Brayton et al – Klumer Academic Publisher.
3. VLSI Design - D.P.Das - – Oxford University Press
4. Digital Integrated Circuit, J.M.Rabaey, Chandrasan, Nicolic, Pearson Education.
5. CMOS Digital Integrated Circuit, S.M.Kang&Y.Lebibici, TMH.
6. Modern VLSI Design, Wayne Wolf, Pearson Education.

Reference Books:

1. Advance Digital Design Using Verilog , Michel D. Celliti, PHI
2. Digital Integrated Circuits, Demassa& Ciccone, John Willey & Sons .
3. Modern VLSI Design: system on silicon, Wayne Wolf; Addison Wesley Longman Publisher
4. Basic VLSI Design, Douglas A. Pucknell& Kamran Eshraghian, PHI
5. CMOS Circuit Design, Layout & Simulation, R.J.Baker, H.W.Lee, D.E. Boyee, PHI

Process Control Lab

Name of the Course:Process Control Lab		Category: Professional Core
Course Code:PC-EI 691		Semester: VI
Duration: 6 months		Maximum Marks: 100
Teaching Scheme		Examination scheme: Maximum marks: 100
Tutorial: Nil		External Assessment:60
Practical: 2 hrs./week		Internal Assessment:40
Credit Points: 1.5		
Course Outcomes:		
CO. 1	Define P&I diagram for different types of Process control loops like Temperature, Pressure, Flow and Level.	
CO. 2	Demonstrate the operations of different types of Process control loops.	
CO. 3	Operate various field instruments related to different types of Process control loops.	
CO. 4	Compare the merits and demerits among conventional control action with PLC and DCS.	
CO. 5	Perform effectively as an individual and as a member in teams at the time of executing laboratory experiments.	
CO. 6	Conclude the safety and maintenance issues related to those processes.	
Pre-Requisite:		
1	Sensor and Transducer	
2	Industrial Instrumentation	
3	Control Theory	

Experiment No.	Laboratory Experiments	COs
1	Study of Flow, Level, Pressure, Temperature processes and construction of the P&I diagrams in accordance with ISA guidelines / standards.	1
2	Study of a typical Temperature Control Loop having Furnace, suitable final control element, Temperature transmitter, conventional PID controller or Control System, and data logger/recorder.	1,3,5,6
3	Study of a typical Pressure Control Loop having Pressure source, Pressure Transmitter, Motorized/Pneumatic control valve, and conventional PID controller/Control System.	1,3,5,6
4	Study of a typical Flow Control Loop having suitable Flow meter, Motorized/ Pneumatic control valve, and conventional PID controller/Control System.	1,3,5,6
5	Study of a typical Level Control Loop having Level Transmitter, Motorized/ Pneumatic control valve, and conventional PID controller/Control System.	1,3,5,6
6	Study of a typical Air Duct Flow Monitoring and Control.	1,3,5,6
7	PLC Programming through PC.	4,5,6
8	Study of a PC based Automation Software / Simulation Software.	4,5,6
9	PLC and DCS based instrumentation experiments.	4,5,6

Text and reference books: B. W. Bequette, Process Control – Modeling, Design and Simulation, PHI
W. Bolton, Programmable Logic Controllers, Elsevier
B. G. Liptak, Instrument Engineers Handbook, Chilton Book Co.,
Philadelphia.

Name of the Course: Instrumentation System Design Lab	Category: Professional Core Courses
Course Code: PC-EI 692	Semester: 6 th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme:
Tutorial: Nil	External Assessment:60
Practical: 2 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Course Outcomes:	
CO. 1	Learn the issues related to practical implementation of applications using electronic circuits.
CO. 2	Design sensors and suitable signal conditioning circuit.
CO. 3	Design process control loop.
CO. 4	To design various controllers and compensators to improve system performance.
CO. 5	To develop the ability to communicate effectively with fellow group members for dividing and sharing the assignments among themselves.
Pre-Requisite:	
1	Sensors, Process Control , Analog Electronics

Experiment No.	Laboratory Experiments	COs
1	Design of sensors for measurement of process parameters	1 - 5
2	Design of appropriate signal conditioning circuit for different sensors.	1 - 5
3	Design of PID controllers.	1 - 5
4	Design of PC based instrumentation system.	1 - 5
5	Electronic system design employing microcontrollers.	1 - 5
6	Electronic circuit design using PCB layout with suitable software	1 – 5

References:

1. Johnson, C.D., 2014. *Process control instrumentation technology*. Pearson.

Internet of Things Lab (IoT)

Course Name: Internet of Things Lab(IoT)	Category: Open Elective -II
Course Code: OE-EI691	Semester: Sixth
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: 3 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Laboratory Experiments:

Exp. No.	Name of the Experiment	COs
1	Familiarization with Python and writing programs in PyCharm IDE using Anaconda Framework.	
2	Program to implement Paho MQTT client in Python.	1-6
3	Program simple web server in Python using Flask framework.	1-6
4	Familiarization with Arduino IDE and writing a program using Arduino IDE for LED blinking.	1-6
5	Study of LM35/DHT-11 temperature sensors and write programs to monitor them with Arduino with Thing Speak.	1-6
6	Setup Raspbian on the Raspberry Pi and write a program to blink an LED using Python.	1-6
7	Interfacing digital sensors and relay boards with Raspberry Pi	1-6
8	Familiarization with Python and writing programs in PyCharm IDE using Anaconda Framework.	1-6

Course Outcome:

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

1. Gather engineering knowledge related to IoT.
2. Students can analysis the problem and able to design/develop the solutions
3. Implement basic IoT applications on embedded platform
4. Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
5. Able to understand building blocks of Internet of Things and characteristics.
6. Design IoT applications in different domain and be able to analyze their performance

Artificial Intelligence Lab(AI)

Course Name: Artificial Intelligence Lab(AI)	Category: Open Elective -II
Course Code: OE-EI692	Semester: Sixth
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: 3 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Laboratory Experiments :Solve the problems Using Prolog/LISP	
1	Concepts on number: Factorial, GCD,LCM, Digit count.
2	Concept on list: Maximum, Minimum, Palindrome Searching, Union, Intersection
3	Sorting of list: Selection sort, Quick sort,
4	Knowledge Base: Create KB and apply rules.
5	Graph Searching algorithms: DFS,BFS
6	Implement Puzzle: Wolf Goat cabbage, Monkey Banana Problem.

Course Outcome:

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

1. Apply Artificial Intelligence techniques for problem solving.

Seminar

Name of the Course: Seminar	Category: Seminar
Course Code: EI 681	Semester: Sixth
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: 2 hrs./week	Internal Assessment:40
Credit Points: 2	

Course Outcomes:	
CO. 1	Graduates will demonstrate knowledge of Applied Sciences substrate with Allied field of engineering/technology.
CO. 2	Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
CO. 3	Graduate will be able to communicate effectively in both verbal and written form through critical thinking process which will assist them in the preparation of their proposal and dissertation.
CO. 4	Pursue new and enriched understandings of the texts through sustained inquiry and reevaluate initial hypotheses in light of evidences.
CO. 5	Express, articulate, discuss and defend well formed arguments within a group or to an audience or to different engineering communities.
CO. 6	Graduate will develop confidence for self education and ability for life-long learning.

Computer Networks

Course Name: Computer Networks	Category: Engineering Science
Course Code: ES-CS 701	Semester: Seventh
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: To understand this course, the learner must have idea of basic knowledge in computer.	

Objectives: Resource sharing is the main objective of the computer network. The goal is to provide all the program, data and hardware is available to everyone on the network without regard to the physical location of the resource and the users.

Course Outcomes (COs):

- CO.1. The incumbent would be able to determine the comparison between Data (Analog, Digital), Signal (Analog, Digital) and how to be transmitted (analog, digital) through different media and different networking related terms as simplex, duplex, internet, reference models etc.**
- CO.2. The incumbent would be able to describe the techniques to correct post-transmission error by ARQs, error detection methods and describe and determine different medium access sub layers like ALOHA, MA.**
- CO.3. The incumbent would be able to differentiate repeaters, hubs, bridges, switches, routers, gateways and describe different necessary routing protocols and tables.**
- CO.4. The incumbent would be able to describe different application layer protocols like DNS, SMTP, HTTP, FTP etc. and characterize different types of data representation techniques.**
- CO.5. The incumbent would be able to determine how to improve the quality of services, the security of the system by digital signature, firewalls.**
- CO.6. The incumbent would be able to demonstrate modern topics like ATM, cable modem, WLAN, Bluetooth etc. to design terminal to terminal data transmission through wired or wireless media.**

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Module Name: Overview of Data Communication and Networking: Details: Introduction, Data communications: components, data representation (ASCII, ISO etc.), direction of data flow (simplex,	5	1

	half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study		
Module: 2	Module Name: Physical Level: Details: Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit Switching: time division & space division switch, TDM bus; Telephone Network.	5	2,3
Module: 3	Module Name: Data link Layer: Details: Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back-N ARQ, Selective repeat ARQ, HDLC;] Medium Access sub layer: Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet (in brief)	9	2,3
Module: 4	Module Name: Network layer: Details: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing : IP addressing, sub netting; Routing : techniques, static vs. dynamic routing , Unicast Routing Protocols: RIP, OSPF, BGP; Other Procols: ARP, IP, ICMP, IPV6	6	3,4
Module: 5	Module Name: Transport layer: Details: Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS:Leaky bucket algorithm, Token bucket algorithm,	5	5
Module: 6	Module Name: Application Layer: Details: Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls. Modern topics: ISDN services & ATM, DSL technology, Cable Modem: Architecture and operation in brief. Wireless LAN: IEEE 802.11, Introduction to blue-tooth.	6	4,6

Text Books:

1. Data Communications and Networking (3rd Ed.), A. Forouzan , TMH
2. Computer Networks (4th Ed.), A. S. Tanenbaum, Pearson Education/PHI
3. Data and Computer Communications (5th Ed.), W. Stallings, PHI/ Pearson Education

Reference Books:

1. Computer Networking -A top down approach featuring the internet, Kurose and Rose Pearson Education
2. Communication Networks, Leon, Garica, Widjaja, TMH
3. Communication Networks, Walrand, TMH.

4. Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.), Comer, Pearson Education/PHI

Course Name: Non-Conventional Energy Sources	Category: Open Elective Courses IV
Course Code: OE-EI 702	Semester: 7 th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3hrs./week	Continuous Assessment: 25Marks
Total Lectures: 36	Attendance: 5 Marks
	End Semester Exam.: 70 Marks
Pre-Requisites: Electrical and Electronics Engineering	

Objectives:

1. To understand the concept of renewable energy sources in replacing non-renewable energy sources.
2. To provide adequate knowledge in solar energy generation systems.
3. To accord basic knowledge in obtaining energy from wind energy systems.
4. To introduce with the bioenergy and biodiesel techniques, tidal energy, wave and geothermal energy.
5. To introduce the energy audit and energy conversion.

Course Outcomes (COs):

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

- OE-EI 702.1.** Understand the basic concept of Non-Conventional Energy source and application in real life.
- OE-EI 702.2.** Understand and explain Solar Energy generation and application.
- OE-EI 702.3.** Understand and apply Electricity Generation from Wind Energy
- OE-EI 702.4.** Understand and apply Electricity Generation from Bio Energy and Bio diesel techniques.
- OE-EI 702.5.** Understand and explain Electricity generation from Tidal, Wave and Thermal energy.
- OE-EI 702.6.** Understand the audit and energy conservation.

Course Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Classification of Energy Sources Advantages of Non-Conventional Energy Sources over Conventional Sources Economics, Impact on Environment.	3	1,2
Module: 2	Thermal Energy Generation from Solar Energy: Solar radiation and its Characteristics. Solar Collector: flat Plate, evacuated tube, focusing, Solar Energy use for water heating, Solar thermal power generation. Principle of energy conversion in Solar Photovoltaic cells, Different types of PV Cells, Mono-poly crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems	7	1,2

Module: 3	Electricity Generation from Wind Energy: Wind as energy source, Design of Wind turbine, Selection of site of Wind farm, characteristics of different types of wind generators used with wind turbines.	8	3
Module: 4	Electricity Generation from Bio Energy: Resources and conversion process: bio gas conversion, bio gas plant, bio mass gasifier, co-generation. Bio diesel: Sources, usability and advantages over mineral product	8	4
Module: 5	Electricity Generation from Tidal Energy: Principle, selection of site, Economics and future prospect. Electricity Generation from Wave Energy: Principle, selection of site and future prospect Electricity Generation from Geo Thermal Energy: Principle , location , economics and prospect Introduction to Energy Conservation & Audit	5	5
Module: 6	Introduction to Energy Conservation & Audit	5	6

Reference Books:

1. Bansal, Kleeman& Melisa - "Renewable Energy Sources & Conversion Technology" - TMH New Delhi.
2. S P Sukhatme - "Solar Energy"
3. Twidell& Weir - "Renewable Energy Resources"; ELBS
4. Non Conventional Energy Sources – G. D. Rai
5. Non-Conventional Energy Resources – Chandra & Chandra, Khanna Publishing House
6. Energy Technology, O.P. Gupta, Khanna Publishing House
8. Wells N T – Biomedical Ultrasonics, Academic Press,London 1977

Telemetry & Wireless Sensor Network

Course Name: Telemetry & Wireless Sensor Network	Category: Open Elective Course IV
Course Code: OE-EI 701	Semester: 7th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 50	End Semester Exam.: 70 Marks
Pre-Requisites: Basic knowledge of Laplace transformation & Fourier transformation analog and digital communication, sensor and transducers, computer networks.	

Objectives: Study of telemetry aims to make the students capable to apply different modulation and multiplexing techniques in the field of measurement system. Telemetry plays an important role in remote monitoring and control of industrial processes. Advancement of telemetry leads to more complex but efficient system called Wireless Sensor Network where large amount of measurement data from large number of sensors are efficiently and securely stored, transmitted and analyzed. This course aims to make students able to apply the knowledge of telemetry and WSN in solving different industrial, domestic and healthcare related problems.

Course Outcomes (COs):

After completing the course the student should be able to

OE-EI 701.1. Identify the elementary concepts and system functional blocks of telemetry system and **utilize** the various coding techniques for information exchange.

OE-EI 701.2. Describe utilities of various modulation and multiplexing processes in telemetry systems and their technicalities.

OE-EI 701.3. Understand the building blocks of different modern communication systems and **apply** this knowledge to **design** different telemetry systems.

OE-EI 701.4. Get acquainted to the concept of WSN and **list** its application areas.

OE-EI 701.5. Learn the basics of WSN node Architecture and Network Architecture.

OE-EI 701.6. Design WSN based remote metering systems for industrial and biometric applications which will lead to betterment of mankind.

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Purpose of telemetry, basic scheme, voltage, current and frequency telemetry. Coding: Concepts of Information transfer, bits, symbols, codes -source, line, channel, BCD, ASCII, BAUDOT, AMI, CMI, Manchester, HDBM, Block, Differential, Hamming, and Convolution.	9	1,3,6

	Inter symbol interference, Bit error rate, noise		
Module: 2	Modulation , multiplexing: FM-AM, FM-FM, PAM-AM, PAM-FM, PCM-AM, etc. FDM systems: IRIG standards in FDM systems. SCO's, Mux and Demux circuits, Detectors and Demodulators, Pulse averaging, Quadrature FM and PLL, Mixers	8	2,3,6
Module: 3	TDM systems: TDM- PAM, PAM- PM, TDM- PCM systems, synchronization. Fiber optic Communication- The Fibre as transmission medium, Interconnections, Repeaters, Sources, Detectors Satellite Communication: TT and C services, subsystems, The earth station	8	2,3,6
Module: 4	Introduction to Wireless Sensor Networks Motivation, Performance Requirement Wireless Sensor Network Architecture: Protocols and Standards, Sensing and Communication Range Hardware Platform, Motes, Sensor Devices, Types of Sensors, Sensor's Specification	9	4,5,6
Module: 5	Fundamentals of MAC Protocols: MAC and Routing Layer Design Issues: 802.15.4 for Wireless Sensor Networks, Routing Protocols for Wireless Sensor Networks: Geographic and Random Routing, Clustering Algorithms	8	5,6
Module: 6	Transport Control Protocols for Wireless Sensor Networks: Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, CODA (Congestion Detection and Avoidance), ESRT (Event-to-Sink Reliable Transport), RMST (Reliable Multi segment Transport), PSFQ (Pump Slowly, Fetch Quickly), GARUDA, ATP (Ad Hoc Transport Protocol), Problems with Transport Control Protocols, Performance of Transport Control Protocols, Congestion, Packet Loss Recovery.	8	5,6
	Total	50	

Text Books:

1. D. Patranabis, Telemetry principles, TMH, New Delhi
2. E. L. Gruenberg, Handbook of Telemetry and Remote control, McGraw Hill
3. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005
4. KazemSohraby, Daniel Minoli and TaiebZnati, "Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.

Reference Books:

1. Swobada G – Telecontrol Method and Application of Telemetry and Remote Control, Von Nostrand, 1971

2. A. Hac, *Wireless Sensor Network Designs*, John Wiley & Sons , 2009

Journals:

1. K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349
2. R.Swain and P.M.Khilar,"Heterogeneous Fault Diagnosis for Wireless Sensor Networks," International Journal of Adhoc Networks, Elsevier Science, Vol. 69, Feb 2018, PP. 15-37.

Course Code: PE-EI701	Category: Professional Elective Courses-IV
Course Name: Advanced Process Control	Semester: Seventh
L-T-P: 3-0-0	Credit: 3
Total Lectures: 30	
Pre-Requisites: To understand this course, the learner must have idea of Sensor and Transducer, Industrial instrumentation and Process control.	

Objectives:To make the students understand the basic concepts of

- Digital control and Fuzzy logic control
- Distributed control system and SCADA
- Different communication protocol
- Different plant wise unit operations.

Module No.	Description of Topic	Contact Hrs.	CO's
1.	Module I : Introduction to DigitalControl Introduction to Digital control and controller, Advantage and limitation of digital control, Signal digitization - finite difference approximation of derivatives, rectangular rules for integration, trapezoidal techniques / bilinear transformation, Impulse invariance method, Step invariance method, Signal reconstruction - Zero and First Order Hold.	5	1
2.	Module II:Digital modelling and Stability analysis Digital Modeling using discrete approximation, ARMA, ARX Loop Design using Digital Modeling, Stability Studies - W - plane transforms, Jury Stability Criterion, Smoothingfilterrealizationusingdifferenceequations.	5	2
3.	Module III: Fuzzy logic control Crisp Set, Fuzzy Set, Fuzzy Operators, Overview of FLC	3	3
4.	Module IV: Distributed control system DCS – Basic Components and their Functions. HMI – Operator & Engineering Interface – Functions and Requirements, Redundancy – Processor, Bus and Input-Output level, Introduction to SCADA, Introduction to DDC.	6	4
5.	Module V: Communication Protocol ISO/OSI Reference Model : Data Highway and Fieldbus : Network Access protocols – TDMA, CSMA/CD, Token passing, Master – Slave; Network Transmission Media – Twisted Pair, Co-axial, FO : Network Topology – Mesh, Ring, Star, Bus : Management Information System (MIS) and Computer Integrated Processing (CIP). Basic of Fieldbus and Profibus, HART and MODBUS.	5	5
6.	Module VI: Unit operations of Petrochemical & Petroleum Refinery (a) Distillation column control (b) Reciprocating compressor control (c) Dryer control	6	6

	(d) Centrifuge control system (For pressure and Flow): Centrifugal compressor control, Centrifugal pump control.		
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Course outcomes:

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

1. **Explain** the concept of digital control schemes used in process control.
2. **Describe** the concept of Digital modeling and Stability analysis.
3. **Demonstrate** the fundamental concepts of Fuzzy logic control.
4. **Analyze** the different functional blocks of Distributed control system.
5. **Explain** different communication protocol used in process control.
6. **Investigate** various plant wise unit operations.

Text Books:

1. Power Plant Instrumentation, K. Krishnaswamy, M. PonniBala, PHI Learning Private Limited.
2. Principles of Industrial Instrumentation, D. Patranabis, TMH New Delhi

Reference Books:

1. Electric Power Engineering Handbook – Edited by L. L. Grigsby.
2. Instrument Engineers Handbook, B. G. Liptak, Chilton Book Co., Philadelphia

Course Name: Mechatronics	Category: Professional Elective Course-IV
Course Code: PE-EI 702	Semester: Seventh
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 30	End Semester Exam.: 70 Marks
Pre-Requisites: To understand this course, the learner must have idea of Sensor and Transducer, Measurement, Control System.	

Objectives: To acquaint the Mechatronics & Robotics with theory and working principles of different types of sensors and mechanical systems used in the manufacturing industry and their applications.

Course Outcomes (COs):

- CO.1.** Understand the basic concept of Mechatronics system. Engineering for designing the mechatronics system.
- CO.2.** Analyze the different mathematical modelling of the liquid level, pneumatic systems, hydraulic systems and thermal systems for actuation of mechatronics systems.
- CO.3.** Understand the working of robot design with coordinate system.
- CO.4.** Apply the knowledge of different parts of robots for real time application and robot design.
- CO.5.** Understand and apply the robot kinematics in real time problem.
- CO.6.** Apply the knowledge in different application for mankind.

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Module Name: General Concepts of Mechatronics Details: Introduction, Definition of Mechatronics, Mechanical Systems: Introduction to various systems of units, mathematical modeling of mechanical systems, Newton's laws, moment of inertia, forced response and natural response, rotational systems, spring mass system, free vibration, spring mass damper system, mechanical systems with dry friction, work energy and power, passive elements and active elements an energy method for deriving equations of motion, energy and power transformers.	5	1
Module: 2	Module Name: System Modelling Details: Fluid and Thermal systems: Mathematical modeling of liquid level system: Resistance and capacitance of liquid level systems with interaction. Mathematical modeling of pneumatic systems: Resistance and capacitance of pneumatic systems, mathematical modeling of a pneumatic systems, liberalization of non-linear systems. Mathematical modeling of hydraulic systems: Hydraulic circuits, hydraulic servometer and mathematical model of hydraulic servo motor	5	2

	dashpots. Mathematical modeling of thermal systems: Thermal resistance and thermal capacitance mathematical modeling of thermal systems		
Module: 3	Module Name: General Concepts of Robotics Details: Introduction, Definition of robot, classification of robots according to coordinate system (Robot configurations: Polar, Cartesian, cylindrical and Jointed-arm configuration) and control method, Main components of robots – manipulator, sensors, controller etc, Robot characteristics –payload, reach, repeatability, accuracy, resolution.	6	3
Module: 4	Module Name: Robot End effectors & Actuators: Details: Types, mechanical grippers, other types of grippers, Tools as end effecters. Characteristics of actuating systems, Actuating System – Hydraulic devices, pneumatic devices, electric motors, other special actuators.	6	4
Module: 5	Module Name: Transmission Details: Kinematics of Robot: Homogenous coordinates, Homogeneous transformation matrices, Direct and Inverse Kinematics of robots, Trajectory Planning.	4	5
Module: 6	Module Name: Application Details: Application of Robots: Handling, loading and unloading, Welding, Spray painting, Assembly, Machining, Inspection, Rescue robots, Underwater robots, Parallel robot, and Medical robot.	4	6

Text Books:

1. Bolton, W, Mechatronics. 3rd edn, Addison-Wesley.
2. Robotics: Control, Sensing, Vision and Intelligence by Fu, Gonzalez and Lee
3. Introduction to Robotics: Mechanics and Control (3rdEdition) by John J. Craig
4. Robot Dynamics and Control: by Spong and Vidyasagar
5. Introduction to Robotics, S K Saha, McGraw Hill

Reference Books:

1. Fuller, J, Robotics: Introduction, Programming and Projects, 2nd edn, Prentice-Hall.
2. Schuler, C, & McNamnee, W, Industrial Electronics & Robotics, McGraw-Hill.
3. Karnopp DC, Margolis DL & Rosenberg RC, System Dynamics: Modeling and Simulation of Mechatronics Systems. 3rd edn. Wiley Interscience.
4. Control of Robot Manipulations: F.I.Lewis, C.T.Abdallah, D.M.Dawson
5. Kinematic Analysis of Robot Manipulators: Carl D. Crane and Joseph Duffy
6. Robotics for Engineers: Koren Y.
7. Robot Modelling: Control and Application with software: by P.G.Ranky and C.Y.Ho

Course Name: Biomedical and Analytical Instrumentation	Category: Professional Elective Course-V
Course Code: PE-EI 703	Semester: 7th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 4 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 40	End Semester Exam.: 70 Marks
Pre-Requisites: Students should have knowledge in Biology, signal processing, and engineering communication.	

Course Outcomes (COs):

- CO.1.** The incumbent would be able to outline the knowledge about human physiology system the principle operation and design and the background knowledge of biomedical instruments and specific applications of biomedical engineering
- CO.2.** The incumbent would be able to describe the operating principles of electrical and other transducers, analog and digital instrumentation, to apply signal acquisition and processing, electrical safety in the medical environment, electrical properties of nerve and muscle physiology
- CO.3.** The incumbent would be able to support by instrumentation used in cardiopulmonary, neurological, surgical, and rehabilitation areas of medicine, and imaging technique, signal transmission
- CO.4.** Understand the effects of different constituent in a process outcome and analysis the performance of various on-line or off-line instruments.
- CO.5.** Understand the principle of different spectroscopic techniques.
- CO.6.** Describe and differentiate between online and offline process and Identifies suitable instruments for analysis gaseous, liquid or solid substance.

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Human Systems and Electrodes and Transducers Details: Introduction to physiology of cardiac, nervous, muscular and respiratory systems; Different types of transducers and their selection for biomedical applications, Electrode theory, different types of electrodes Hydrogen Calomel, Ag-AgCl, pH, PO ₂ Pco ₂ electrodes	6	1, 2
Module: 2	Measurements of Important Human parameters Details: Measurement of electrical activities of heart, brain and muscle: ECG measurement and instrumentation techniques; Measurement of Blood Pressure & Blood flow; Defibrillator	6	2, 3
Module: 3	Signal Processing, transmission and Imaging Details: Instrumentation in clinical laboratory Ultrasound	6	2,3

	imaging and IR Imaging. Biotelemetry: Transmission and Reception aspects of Biological signals via long distances.		
Module: 4	Gas Analysis : Thermal Conductivity Type, Heat of Reaction Method, Paramagnetic for O ₂ , Dumbell and Servomax for O ₂ , Thermomagnetic for O ₂ , Zirconia Cell Type for O ₂ , Cell for Continuous O ₂ analysis microelectrodes, Spectroscopic Techniques, IR Radiation Absorption Type, Dual-Channel IR Spectrometry, Single-Channel IR Spectrometry, IR Sources, Comparison of their performances, IR detectors.	6	4,5,6
Module: 5	Liquid and Solid Analysis: Dissolved Oxygen Analysis Cells, pH electrodes, circuits and applications, Spectroscopic Techniques: Absorption in Visible and UV-range, monochromators and detectors, Sources and their ranges, Colorimetry, Viscosity and Density Measurement. Atomic Spectral Methods: Emission and Absorption: Visible, UV and X-rays; sources, principles, detectors, sample preparation etc.	6	4,5,6
Module: 6	Special Topics: Chromatography, GC, GLC, LC, HPLC, Columns, Detectors; X-ray methods of analysis; Introduction to NMR and ESR.	6	4,5,6

Text Books:

1. Cromwell L – Biomedical Instrumentation and Measurement, Pearson
2. Khandpur R S – Handbook of Biomedical Instrumentation, TMH, N. Delhi 1991
3. Principles of Industrial Instrumentation- D.C. Patranabis, Publisher: Tata McGraw Hill
4. Principles of Instrumental Analysis- Skoog, Holler, Nieman, Publisher: Thomson Brooks/Cole
5. Handbook of Analytical Instruments- R.S. Khandpur, Publisher: Tata McGraw Hill

Reference Books:

1. Carr – Introduction to Biomedical Equipment Technology 4/e – Pearson
2. Introduction to Instrumental Analysis-Robert D. Braun, Publisher: Pharma Book Syndicate

Course Name: Non Destructive Testing	Category: Professional Elective Courses- v
Course Code: PE-EI 704	Semester: 7 th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 3hrs./week	Continuous Assessment: 25Marks
Total Lectures: 36	Attendance: 5 Marks
	End Semester Exam.: 70 Marks
Pre-Requisites: Engineering Physics	

Objectives:

1. To understand the use of NDT methods in industry.
2. To provide adequate knowledge in NDT methods.
3. To accord basic of physics of ultrasonic.
4. To introduce with ultrasonic systems in industrial instrumentation.
5. To introduce ultrasonic systems in medical instrumentation.

Course Outcomes (COs):

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

- CO.1.** Understand why Non Destructive Testing (NDT) is useful for industry or clinical process.
- CO.2.** Understand and analyze different techniques of NDT General, Visual, Chemical and Mechanical system.
- CO.3.** Understand and analyze Ultrasonic wave used in NDT.
- CO.4.** Understand and analyze Ultrasonic method in Industry and Medical measurement techniques.
- CO.5.** Comprehend the methods of hazard identification and safety measures.

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Introduction and importance of NDT. General Principles and Basic Elements of NDT.	5	1,2
Module: 2	Surface feature inspection and testing: General, Visual, Chemical, and Mechanical Magnetic-magnetization, flux, and Electro potential, Electrical resistivity, Electromagnetic-eddy current techniques.	8	1,2
Module: 3	Ultrasonic waves, principle of propagation, Ultrasonic Test methods: Echo, Transit time, Resonance, Direct contact and immersion types	7	3,
Module: 4	Ultrasonic methods of measuring thickness, depth, flow, level etc. Various parameters affecting ultrasonic testing and measurements, their remedy Ultrasonic in medical diagnosis and therapy	10	4
Module: 5	Hazardous Area Instrumentation Basic Concepts Classification based on site, material and temperature – IEC and North American system Methods of Protection – Explosion proof, Intrinsic safety, Purging and Pressurization, Non-Incendiary ; IEC Equipment Protection Level (EPL) NEMA and IP codes	6	5

Reference Books:

1. Mclutiv e p (Ed) – NDT Handbook, American Society for NDT, 1989.
2. Hull B and John V – Non Destructive Testing, FI BS/McMillan.
3. Krantkramer - Ultrasonic Testing of materials, Springer 2005
4. Handbook of Nondestructive Testing, McGraw Hill, 1998
5. U. Schnars, W. Jeuptner - Digital Holograpy, Springer, 2005
6. W. J. Price – Nuclear radiation Detection, McGraw Hill, New York, 1958
7. Krauthsamer J and Krauthsamer H – Ultrasonic Testing of Materials, Springer Verlag, Berlin, New York.
8. Wells N T – Biomedical Ultrasonics, Academic Press,London 1977

INTERNSHIP-I

Name of the Course: INTERNSHIP-I	Category: Internship
Course Code: PROJ-EI 783	Semester: 7th
Duration:	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: Minimum of 12 weeks	Internal Assessment:40
Credit Points: 3	

OBJECTIVES

Internships are educational and career envelopment opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. Following are the intended objectives of internship training:

- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.

Course Outcomes:	
CO. 1	Learn to apply the Technical knowledge in real industrial situations.
CO. 2	Gain experience in writing Technical reports/projects
CO. 3	Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
CO. 4	Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
CO. 5	Understand the psychology of the workers and their habits, attitudes and approach to problem solving
CO. 6	Develop soft skills in management, team skill & leadership skill and responsibilities in the work environment.

Benefits to Students:

- An opportunity to get hired by the Industry/ organization.
- Practical experience in an organizational setting.
- Excellent opportunity to see how the theoretical aspects learned in classes are integrated into the practical world. On-floor experience provides much more professional experience which is often worth more than classroom teaching.
- Helps them decide if the industry and the profession is the best career option to pursue.
- Opportunity to learn new skills and supplement knowledge.

- Opportunity to practice communication and teamwork skills.
- Opportunity to learn strategies like time management, multi-tasking etc in an industrial setup.
- Opportunity to meet new people and learn networking skills.
- Makes a valuable addition to their resume.
- Enhances their candidacy for higher education.
- Creating network and social circle and developing relationships with industry people.
- Provides opportunity to evaluate the organization before committing to a full time position.

PROJECT-I

Name of the Course:PROJECT-I	Category:Project Stage-I
Course Code: PROJ-EI 781	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: 4 hrs./week	Internal Assessment:40
Credit Points: 2	

Objective:

Final Year Projects represent the culmination of study towards the Bachelor of Engineering degree. Projects offer the opportunity to apply and extend material learned throughout the program. Assessment is by means of a seminar presentation, submission of a thesis, and a public demonstration of work undertaken.

Course Outcomes:	
CO. 1	Identify a particular domain for their project work and engage themselves in independent study to research literature in the identified domain.
CO. 2	Recognize and formulate the engineering problems in selected domain by consolidating the literature search, fundamental knowledge and skills in engineering to solve the identified engineering problem.
CO. 3	Select the engineering tools/components for solving the identified engineering problem and accomplish the budget analysis of the project through the utilization of resources (finance, power, area, bandwidth, weight, and size, any other).
CO. 4	Sketch the project planning, scheduling and execution control and Perform in the team, contribute to the team and mentor/lead the team.
CO. 5	Design and develop a functional product prototype by considering the prescribed standards/ safety norms.
CO. 6	Demonstrate the project in effective written and oral communication through the project report, four-page IEEE paper format, and presentation of the project work and identify the community that shall benefit through the solution to the identified engineering problem and also demonstrate concern for environment.
Pre-Requisite:	
Knowledge and skills developed in previous courses and current study	

Industrial Training Evaluation

Name of the Course: Industrial Training Evaluation	Category: Industrial Training
Course Code: PROJ-EI 782	Semester: 7 th
Duration:	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: hrs./week	Internal Assessment:40
Credit Points: 1	

Course Outcomes:	
CO. 1	Get the opportunity to Apply the knowledge and skills students have acquired on campus in a real-life work situation.
CO. 2	To provide students with opportunities for practical, hands-on learning from practitioners in the areas of specialization.
CO. 3	To expose students to a work environment, common practices, employment opportunities and work ethics in their relevant field.
CO. 4	To enhance the employability skills of the students.
CO. 5	Familiar with Modern tool usage, The engineer and society
CO. 6	Develop soft skills in management, team skill & leadership skill and responsibilities in the work environment.
Pre-Requisite:	
1	Knowledge and skills developed in previous courses.
2	
3	

Text and reference books:

Special Remarks (If any):

Course Code: HM-HU 801	Category: Humanities and social sciences including Management Courses
Course Name: Project Management and Entrepreneurship	Semester: Eighth
L-T-P: 3-0-0	Credit: 2
Total Lectures: 30	
Pre-Requisites:	

Module No.	Description of Topic	Contact Hrs.
1	Introduction Concept of Management, Management: Art and Science, Management Vs Administration, Levels of Management, Functions of management, Management as a Profession, Management skills, Qualities and characteristics of managers. Evolution of Management thought: Early contributions: Taylor and Scientific Management, Fayol's Administrative Management, Bureaucracy, Human Relations, and Modern Approach, Social responsibility of managers, Managerial Ethics.	6
2	Planning and Organizing Concept of planning, Significance of planning, Classification of planning: Strategic plan, Tactical plan and Operational plan, Process of planning, Barriers to effective planning. MBO, Management by Exception. Decision Making: Strategies of decision making, Steps in rational decision making process, Factors influencing decision making process, Psychological bias and decision support system. Organizing: Defining organizing, Principles of organizing, Process of organizing, Types of organizational structure, Span of control, Line and Staff Relationship, Centralization vs. Decentralization of authority, Informal organization.	10
3	Staffing, Directing and Motivation Staffing: Concept, Objective of staffing, System approach to staffing, Manpower planning. Directing: Concept, Techniques of directing and supervision, Types of supervision, Essential characteristics of supervisor. Motivation: Concept, Forms of employee motivation, Need for motivation. Theories of motivation: Maslow, Herzberg, McClelland, Vroom, Porter and Lawler, Job Satisfaction.	6
4	Leadership and Control Leadership vs Management, Process of Leadership, Importance of leadership, Characteristics of an effective leader, Communication Process, Channels and Barriers, Effective Communication, Controlling: Concept, Importance of controlling, Types of control, Steps in control process, Coordination Concept, Importance, Principles and Techniques of Coordination, Concept of Managerial Effectiveness.	8

Course Outcomes (CO):

The students will be able to -

1. To understand the basic concept of management, diagnose the management issues in organizations, explain and analyze key principles of management planning, leading and controlling in business organizations

2. To explain the ethical standards and external environmental aspects of the organizations, list and exercise social responsibility and sustainability in the practical context and maintaining good governance for organization
3. To explain the basic concept, tools and environmental framework of marketing management and its importance on the organization in order to develop the effective marketing communications strategy
4. To explain the basic concept and functions of human resource management, human resource development and their applications in the organization, training and knowledge of human factors in engineering and various job designs
5. To evaluate various kinds of skills in inter-personal communication, team work, leading people, and handling conflict in organizations
6. To understand individual personalities and interpersonal skills needed for effective communications in a diverse business environment

Learning Resources:

Text Books:

1. Durai, P. (2015). Principles of Management, Text and Cases. New Delhi: Pearson Education.
2. Koontz, H. (2010). Essentials of Management. New Delhi: Tata McGraw-Hill Education.
3. Stoner, Freeman & Gilbert Jr. (2009). Management. New Delhi: Prentice Hall.
4. Premvir Kapoor (2018), Principles of Management, Khanna Publishing House, New Delhi

Reference book:

1. Weihrich, H. & Koontz, H. (2010). Management- A Global Perspective: New Delhi: Tata McGraw-Hill Education.
2. Robbins & Coulter (2013). Management. New Delhi: Prentice Hall.
3. Robbins, S.P. & Decenzo, D. A. (2014). Fundamentals of Management: Essential Concepts and Applications. New Delhi: Pearson Education.
4. Luthans, F. (2010). Organizational Behaviour. New York: McGraw-Hill

Course Name: Digital Image Processing	Category: Open Elective Course-V
Course Code: OE-EI 801	Semester: 8th
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: 4 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 43	End Semester Exam.: 70 Marks
Pre-Requisites: Digital Signal Processing, Signals and Systems	

Objectives:

- To understand the different representation of digital images.
- To understand the importance of adequate sampling frequencies and the appearance of artifacts.
- To study the image fundamentals and mathematical transforms necessary for image processing.

Course Outcomes (COs):

OE-EI 801.1. Mathematically represent the various types of images and **formulate** them for further processing.

OE-EI 801.2. Evaluate images for enhancement of certain properties or for optimized use of the resources.

OE-EI 801.3. Analyze images in the frequency domain using various transforms.

OE-EI 801.4. Implement the algorithms related to morphological image processing.

OE-EI 801.5. Design and implement algorithms that perform basic image processing (e.g. noise removal and image enhancement).

OE-EI 801.6. Design and implement algorithms for advanced image analysis (e.g. image compression, image segmentation).

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Introduction: Introduction to structure of human eye, Imageformation in the human eye, Brightness adaptation and discrimination, Image sensing and acquisition, storage, Processing, Communication, Display Image Sampling and quantization, Basicrelationships between pixels.	5	1
Module: 2	Image Transforms (implementation): Introduction to Fourier transform, DFT and 2-D DFT, Properties of 2-D DFT, FFT, IFFT, Walsh transform, Hadamard transform, Discrete cosine transform, Slant transform, Optimum transform: Karhunen- Loeve (Hotelling) transform.	8	CO 1, 2
Module: 3	Image Enhancement: Image Enhancements and Filtering- Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and	8	CO 1, 3

	order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.		
Module: 4	Image Compression: Fundamentals, Redundancies: Coding, Interpixel Psycho-visual, fidelity criteria, Image compression models, Error free compression, Lossy compression, Image compression standards: Binary image and Continuous tone Still Image compression standards, Video compression standards.	8	CO 5, 6
Module: 5	Morphological Image Processing: Introduction, Dilation, Erosion, Opening, closing, Hit-or-misses transformation, Morphological algorithm operations on binary Images, and Morphological algorithm operations on gray-scale Images.	6	CO 1, 4
Module: 6	Image Segmentation: Representation and Description: Detection of discontinuities, Edge linking and Boundary detection, Thresholding Region based segmentation, Image Representation schemes, Boundary descriptors, and Regional descriptors.	8	CO 5, 6

Text Books:

1. R.C Gonzalez and R. Woods :-Digital Image Processing, (Indian reprint: Pearson publication,2001)
2. Anil K. Jain :- Digital Image Processing (Prentice-Hall,India)

Reference Books:

1. W. K. Pratt :-Digital Image Processing, - 2nd Edition, (John Wiley & Sons).
2. B. Chanda & D. Dutta Majumder, Digital Image Processing and Analysis, (Prentice-Hall, India)
3. M. A. Sid-Ahmed :- Image Processing- Theory, Algorithms & Architecture, (McGraw-Hill)

Course Name: Big Data Analysis	Category: Professional Elective V
Course Code: OE-EI 802	Semester: VIII
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures:36	End Semester Exam.: 70 Marks
Pre-Requisites:	

Course Outcomes (CO):

The students will be able to -

OE-EI 802.1: Upon completion of this course, students will be able to do the following:

OE-EI 802.2: Students will to build and maintain reliable, scalable, distributed systems with Apache Hadoop.

OE-EI 802.3: Students will be able to write Map-Reduce based Applications Learning with MLlib.

OE-EI 802.4: Students will be able to design and build MongoDB based Big data Applications and learn MongoDB query language

OE-EI 802.5: Students will learn difference between conventional SQL query language and NoSQL basic concepts

OE-EI 802.6: Students will learn tips and tricks for Big Data use cases and solutions.

Module No.	Description of Topic	Contact Hrs.	COs
1	INTRODUCTION TO BIG DATA Introduction– distributed file system–Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce	6	
2	INTRODUCTION TO HADOOP AND HADOOP ARCHITECTURE Big Data – Apache Hadoop & HadoopEcoSystem, Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce -, Data Serialization.	8	
3	HDFS, HIVE AND HIVEQL, HBASE HDFS-Overview, Installation and Shell, Java API; Hive Architecture and Installation, Comparison with Traditional Database, HiveQL Querying Data, Sorting And Aggregating, Map Reduce Scripts, Joins & Sub queries, HBase concepts, Advanced Usage, Schema Design, Advance Indexing, PIG, Zookeeper, how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.	6	
4	SPARK Introduction to Data Analysis with Spark, Downloading Spark and Getting Started, Programming with RDDs, Machine Learning with MLlib.	8	
5	NoSQL What is it?, Where It is Used Types of NoSQL databases, Why NoSQL?, Advantages of NoSQL, Use of NoSQL in Industry, SQL vsNoSQL, NewSQL	5	
6	Data Base for the Modern Web Introduction to MongoDB key features, Core Server tools, Mongo DB through the JavaScript's Shell, Creating and Querying through Indexes, Document-Oriented, principles of schema design, Constructing queries on Databases, collections and Documents, MongoDB Query Language.	7	

Learning Resources:

Reference Books:

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirkderooset al., “Understanding Big data”, McGraw Hill, 2012.
3. BIG Data and Analytics, Sima Acharya, Subhashini Chhellappan, Willey
4. MongoDB in Action, Kyle Banker,PiterBakkum , Shaun Verch, Dream tech Press
5. Tom White, “HADOOP: The definitive Guide”, O Reilly 2012.
6. VigneshPrajapati, “Big Data Analyticswith R and Haoop”, Packet Publishing 2013.
7. Learning Spark: Lightning-Fast Big Data Analysis Paperback by Holden Karau
8. V.K. Jain, Big Data and Hadoop, Khanna Publishing House, 2017.

Course Name: Power Plant Instrumentation	Category: Professional Elective Course-VI
Course Code: PE-EI801	Semester: VIII
L-T-P: 3-0-0	Credit: 3
Teaching Scheme	Examination Scheme
Theory: hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures:30	End Semester Exam.: 70 Marks
Pre-Requisites: To understand this course, the learner must have idea of Sensor and Transducer, Industrial instrumentation and Process control.	

Objectives:To acquaint the Power Plant Professionals with theory and working principles of different types of instruments used in the power plant and their applications.

Course Outcomes (COs):

CO.1. Create an overall perception about different types of power plant like Thermal, Hydel and Nuclear along with the measuring instruments associated with these particular types of process.

CO.2. Evaluate instruments parameter to get overall control of a power plant by knowing the working principle of each block such as Turbine, Condensers, Generators, Coal handling, Water treatment, Feed water, combustion air and flue gases.

CO.3. Analyze the feedback signal for different control unit of power plant such as Boiler control, Furnace draft control, Steam temperature control and Feed water control etc. The supervisory control and monitoring is accompanying with different control loop for enhanced closed loop responses.

CO.4. Apply all type of safety interlocks to ensure zero accident by incorporating protective gears, emergency measures and Alarm systems. Moreover, the pollution due to the power plant is also measured, monitor and control for the environmental safety.

CO.5. Understand the data handling processing, logging, acquisition, accounting, display and storage of data from Power plant. The coupling between the turbine and generator along with transmission through three phases are considered as an output side of the power plant.

CO.6. Describes the modelling and simulation of power plant in HMI section using DCS and PLC for better closed loop control.

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	Module Name:General Concepts Details: Power Plants of different types: Setups, energy conversions and measurement requirements, examples of Thermal, Hydel, and Nuclear plants. Thermal power plant and system instrumentation.	6	1
Module: 2	Module Name:Instrumentation for Details: 1) Turbines 2) Condensers 3) Generators 4) Coal handling 5) Water treatment 6) Feed water, combustion air and flue gases	10	1,2
Module: 3	Module Name:Control Details: Boiler Control - Steam pressure control, combustion control, Furnace Draft control, Steam temperature Control, Feed water control, Data logger and computer control, supervisory control and monitoring system.	5	1,3
Module: 4	Module Name:Safety Details: Instrumentation for safety interlocks - protective gears, emergency measures, Alarm systems and Analysis etc. Pollution measurement, monitoring and control.	3	1,2,4
Module: 5	Module Name:Transmission Details: Data handling-processing, logging, acquisition, accounting, display and storage. Instrumentation for Generator and Bus bar coupling.	4	1,3,4,5
Module: 6	Module Name:Modelling and simulation Details: Introduction to power plant modelling/simulation, Understand the basic interface (HMI) of a typical power plant with all safety measures.	2	5,6

Text Books:

1. Power Plant Instrumentation, K. Krishnaswamy, M. Ponni Bala, PHI Learning Private Limited.
2. Principles of Industrial Instrumentation, D. Patranabis, TMH New Delhi.

Reference Books:

1. Electric Power Engineering Handbook – Edited by L. L. Grigsby.
2. Instrument Engineers Handbook, B. G. Liptak, Chilton Book Co., Philadelphia

Course Code: PE-EI802	Category: Professional Elective Courses-VI
Course Name: NANO ELECTRONICS	Semester: Eighth
L-T-P: 3-0-0	Credit: 3
Total Lectures: 34	
Pre-Requisites: Basic Electronics	

COURSE OUTCOME (CO):

PE-EI802.1: To identify the concept, advantages and challenges of Nano electronics

PE-EI802.2: To describe the characteristics of carrier distribution and transport in nanoscale structures

PE-EI802.3: To apply the concept of different types of nano diodes, nano transistors and their junction physics

PE-EI802.4: To analyze the construction and operation of various nano display, logic and memory devices

PE-EI802.5: To evaluate different nano-photonics devices for optical fiber sensor systems

PE-EI802.6: To design various nano fiber sensors for industrial applications like temperature, pressure, displacement, fluid flow, rotation, etc.

Module No.	Description of Topic	Contact Hrs.	COs
1	Fundamentals on Nanoelectronics – Concepts of Nanoelectronics, Technological revolution from Microelectronics to Nanoelectronics and beyond, Moore's Law Trends and Limits, Technological advantages in various applications like - Automotive, Health Care, Biochips, Lab-on-Chips , Safety and Security, Industrial Applications, etc.	4	1, 2
2	Nano diode – classification of nanostructure (1D or quantum well, 2D or quantum wire, 3D or quantum dot), band structure and energy level modification in various nanostructures, electron transport in nanostructures, design of nano diodes, Resonant-tunnelling diodes, nano-Light emitting diodes, nano lasers, nano solar cell, etc.	6	3
3	Nano transistor & Nano Display systems – nano transistor, nano Field-effect transistors, Single-electron-transfer devices, Potential-effect transistors, nano display system, etc.	6	3, 4
4	Nano Logic Devices – Nano MOSFET & CMOS Devices, Device structure and Speed Performance of nano FETs, Switching Delay Formulation, Power dissipation, Parasitic Capacitance in Logic Devices, FinFET and Double-Gate Devices, Choice of Materials for Advanced CMOS	6	4
5	Nano Memory Devices - Mainstream Memories (DRAM and NAND), Evolution and Scaling Limits, Various Memories Technologies like Ferroelectric Memories, Magnetic Memories, Phase Change Memories, Resistive RAMs, OxRAM and CBRAM, Emerging Memories Architectures, From Cell to Arrays, 3D RRAM Architectures, Opportunities for Emerging Memories etc.	6	5
6	Nano Integrated Sensors and Actuators – Nano Mechanical sensors, Nano MEMS, Nano Pressure Sensors, Acceleration Sensors, Nano Gas Sensors, Biosensors, Electrostatic,	6	6

	Electromagnetic and Piezoelectric Sensors, Nano Optical Fibers, Integrated Fiber Sensors for Industrial applications.		
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Books:

1. Nanoelectronics - Materials, Devices, Applications – R. Piers, et al (Ed), Wiley VCH, 2016
2. Introduction to Nanoelectronics Science, Nanotechnology, Engineering, and Applications – V. V. Mitin, V.A. Kochelap and M. A. Stroscio, Cambridge University Press, 2008
3. Fundamentals of Nanoelectronics - G. W. Hanson, Pearson/Prentice Hall, 2008
4. Intersubband Transitions in Quantum Structures – R. Paiella (Ed), McGraw-Hill, 2006
5. Nanophotonics and Nanostructured Fiber Sensors – A. B. Maity, Narosa, 2019
6. Sensors Based on Nanostructured Materials - F. J. Arregui (Ed), Springer, 2009

INTERNSHIP-II

Name of the Course: INTERNSHIP-II	Category: Internship
Course Code: PROJ-EI 882	Semester: 8th
Duration:	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: Minimum of 8 weeks	Internal Assessment:40
Credit Points: 2	

OBJECTIVES

Internships are educational and career envelopment opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. Following are the intended objectives of internship training:

- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.

Course Outcomes:	
CO. 1	Learn to apply the Technical knowledge in real industrial situations.
CO. 2	Gain experience in writing Technical reports/projects
CO. 3	Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
CO. 4	Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
CO. 5	Understand the psychology of the workers and their habits, attitudes and approach to problem solving
CO. 6	Develop soft skills in management, team skill & leadership skill and responsibilities in the work environment.

Benefits to Students:

- An opportunity to get hired by the Industry/ organization.
- Practical experience in an organizational setting.
- Excellent opportunity to see how the theoretical aspects learned in classes are integrated into the practical world. On-floor experience provides much more professional experience which is often worth more than classroom teaching.
- Helps them decide if the industry and the profession is the best career option to pursue.
- Opportunity to learn new skills and supplement knowledge.

- Opportunity to practice communication and teamwork skills.
- Opportunity to learn strategies like time management, multi-tasking etc in an industrial setup.
- Opportunity to meet new people and learn networking skills.
- Makes a valuable addition to their resume.
- Enhances their candidacy for higher education.
- Creating network and social circle and developing relationships with industry people.
- Provides opportunity to evaluate the organization before committing to a full time position.

Name of the Course:PROJECT-II	Category:Project Stage-II
Course Code: PROJ-EI 881	Semester:8th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination scheme: Maximum marks:
Tutorial: Nil	External Assessment:60
Practical: 8 hrs./week	Internal Assessment:40
Credit Points: 4	

Objective:

Final Year Projects represent the culmination of study towards the Bachelor of Engineering degree. Projects offer the opportunity to apply and extend material learned throughout the program. Assessment is by means of a seminar presentation, submission of a thesis, and a public demonstration of work undertaken.

Course Outcomes:	
CO. 1	Identify a particular domain for their project work and engage themselves in independent study to research literature in the identified domain.
CO. 2	Recognize and formulate the engineering problems in selected domain by consolidating the literature search, fundamental knowledge and skills in engineering to solve the identified engineering problem.
CO. 3	Select the engineering tools/components for solving the identified engineering problem and accomplish the budget analysis of the project through the utilization of resources (finance, power, area, bandwidth, weight, and size, any other).
CO. 4	Sketch the project planning, scheduling and execution control and Perform in the team, contribute to the team and mentor/lead the team.
CO. 5	Design and develop a functional product prototype by considering the prescribed standards/ safety norms.
CO. 6	Demonstrate the project in effective written and oral communication through the project report, four-page IEEE paper format, and presentation of the project work and identify the community that shall benefit through the solution to the identified engineering problem and also demonstrate concern for environment.
Pre-Requisite:	
Knowledge and skills developed in previous courses and current study	