

**Department: Electrical Engineering**  
***Curriculum Structure & Syllabus***  
***(Effective from 2018-19 admission batch)***

**Under Autonomy (GR A: ECE, EE, EIE, BME; GR B: CSE, IT, ME, CE, FT)**

1st Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	BS	M 101	Mathematics – I	3	1	0	4	4
2	BS	CH 101 / PH 101	Chemistry (Gr. A) / Physics – I (Gr. B)	3	0	0	3	3
3	ES	EE 101 / EC 101	Basic Electrical Engineering (Gr. A) / Basic Electronics Engineering (Gr. B)	3	0	0	3	3
4	HS	HU 101	English	2	0	0	2	2
<b>Total of Theory</b>							<b>12</b>	<b>12</b>
<b>B. PRACTICAL</b>								
5	BS	CH 191 / PH 191	Chemistry Laboratory (Gr. A) / Physics – I Laboratory (Gr. B)	0	0	3	3	1.5
6	ES	EE 191 / EC 191	Basic Electrical Engineering Laboratory (Gr. A) / Basic Electronics Engineering Laboratory (Gr. B)	0	0	3	3	1.5
7	ES	ME 191 / ME 192	Engineering Graphics & Design (Gr. A) / Workshop/Manufacturing Practices (Gr. B)	0	0	3	3	1.5
8	PROJ	PR 191	Project – IA	0	0	1	1	0.5
9	PROJ	PR 192	Project – IB	0	0	1	1	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
10	MC	MC 181	Induction Program	0	0	0	0	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>23</b>	<b>17.5</b>

\* Project – I on any one practical paper (0.5 credit)

2nd Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	BS	M 201	Mathematics – II	3	1	0	4	4
2	BS	CH 201 / PH 201	Chemistry (Gr. B) / Physics – I (Gr. A)	3	0	0	3	3
3	ES	EE 201 / EC 201	Basic Electrical Engineering (Gr. B) / Basic Electronics Engineering (Gr. A)	3	0	0	3	3
4	ES	CS 201	Programming for Problem Solving	3	0	0	3	3
5	ES	ME 201	Engineering Mechanics	3	0	0	3	3
<b>Total of Theory</b>							<b>16</b>	<b>16</b>
<b>B. PRACTICAL</b>								
6	ES	CS 291	Programming for Problem Solving Laboratory	0	0	3	3	1.5
7	BS	CH 291 / PH 291	Chemistry Laboratory (Gr. B) / Physics – I Laboratory (Gr. A)	0	0	3	3	1.5
8	ES	EE 291 / EC 291	Basic Electrical Engineering Laboratory (Gr. B) / Basic Electronics Engineering Laboratory (Gr. A)	0	0	3	3	1.5
9	ES	ME 291 / ME 292	Engineering Graphics & Design (Gr. B) / Workshop/Manufacturing Practices (Gr. A)	0	0	3	3	1.5
10	HS	HU 291	Language Laboratory	0	0	2	2	1
11	PROJ	PR 291	Project – II	0	0	1	1	0.5
12	PROJ*	PR 292	Innovative Activities – I	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
13	MC	MC 281	NSS / Physical Activities / Meditation & Yoga / Photography / Nature Club	0	0	0	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>34</b>	<b>24</b>

- \* Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation / innovation / entrepreneurship cell of the institute; participation in conferences / workshops / competitions etc.; Learning at Departmental Lab / Tinkering Lab / Institutional workshop; Working in all the activities of Institute's Innovation Council for e.g., IPR workshop / Leadership Talks / Idea / Design / Innovation / Business Completion / Technical Expos etc. (evaluation by Programme Head through certification)

Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

3rd Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	ES	EE 301	Electrical Circuit Analysis	3	1	0	4	4
2	PC	EE 302	Measurement and Instrumentation	3	0	0	3	3
3	PC	EE 303	Analog Electronics	3	0	0	3	3
4	BS	M(EE) 301	Mathematics – III	3	1	0	4	4
<b>Total of Theory</b>							<b>14</b>	<b>14</b>
<b>B. PRACTICAL</b>								
5	ES	EE 391	Electrical Circuit Analysis Laboratory	0	0	3	3	1.5
6	PC	EE 392	Measurement and Instrumentation Laboratory	0	0	3	3	1.5
7	PC	EE 393	Analog Electronics Laboratory	0	0	2	2	1
8	PROJ	PR 391	Project – III	0	0	2	2	1
9	PROJ*	PR 392	Innovative Activities – II	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
10	MC	MC 301	Environmental Science	3	0	0	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>27</b>	<b>19.5</b>

- \* Students may choose either to work on participation in all the activities of Institute's Innovation Council for e.g., IPR workshop/ Leadership Talks / Idea / Design / Innovation / Business Completion / Technical Expos etc.

Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

4th Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	BS	PH 401	Physics – II	3	0	0	3	3
2	PC	EE 401	Electrical Machines – I	3	0	0	3	3
3	PC	EE 402	Power Electronics	3	0	0	3	3
4	PC	EE 403	Digital Electronics	3	0	0	3	3
5	PC	EE 404	Electromagnetic Fields	2	0	0	2	2
6	HS	HU 401	Values and Ethics in Profession	2	0	0	2	2
<b>Total of Theory</b>							<b>16</b>	<b>16</b>
<b>B. PRACTICAL</b>								
7	BS	PH 491	Physics – II Laboratory	0	0	3	3	1.5
8	PC	EE 491	Electrical Machines – I Laboratory	0	0	3	3	1.5
9	PC	EE 492	Power Electronics Laboratory	0	0	3	3	1.5
10	PC	EE 493	Digital Electronics Laboratory	0	0	2	2	1
11	PROJ	PR 491	Project – IV	0	0	2	2	1
12	PROJ*	PR 492	Innovative Activities – III	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
13	MC	MC 481	Behavioural & Interpersonal Skills	0	0	3	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>32</b>	<b>23</b>

\* Students may choose either to work on participation in all the activities of Institute's Innovation Council for e.g., IPR workshop / Leadership Talks / Idea / Design / Innovation / Business Completion / Technical Expos etc.

Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

5th Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	PC	EE 501	Electrical Machines – II	3	0	0	3	3
2	PC	EE 502	Power System – I	3	0	0	3	3
3	PC	EE 503	Control System – I	3	0	0	3	3
4	OE	EE 504	A. Data Structure	3	0	0	3	3
			B. Computer Network					
			C. Internet of Things					
5	PE	EE 505	A. Electrical Energy Conservation and Auditing	3	0	0	3	3
			B. Electromagnetic Waves					
			C. Illumination Engineering					
			D. Power Plant Engineering					
<b>Total of Theory</b>							<b>15</b>	<b>15</b>
<b>B. PRACTICAL</b>								
6	PC	EE 591	Electrical Machines – II Laboratory	0	0	3	3	1.5
7	PC	EE 592	Power System – I Laboratory	0	0	3	3	1.5
8	PC	EE 593	Control System – I Laboratory	0	0	3	3	1.5
9	OE	EE 594	A. Data Structure Laboratory	0	0	3	3	1.5
			B. Computer Network Laboratory					
			C. Internet of Things Laboratory					
10	PROJ	PR 591	Project – V	0	0	2	2	1
11	PROJ*	PR 592	Innovative Activities – IV	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
12	MC	MC 501	Constitution of India	3	0	0	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>32</b>	<b>22.5</b>

\* Students may choose either to work on participation in Hackathons etc. Development of new product / Business Plan / registration of start-up.

Students may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry / NGO's / Government organizations / Micro / Small / Medium enterprises to make themselves ready for the industry / Long Term goals under rural Internship. (Duration 4-6 weeks)

Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

6th Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	PC	EE 601	Microprocessor and Microcontroller	3	0	0	3	3
2	PC	EE 602	Power System – II	3	0	0	3	3
3	PC	EE 603	Control System – II	3	0	0	3	3
4	OE	EE 604	A. Data Base Management System	3	0	0	3	3
			B. Embedded Systems					
			C. Software Engineering					
5	PE	EE 605	A. Digital Signal Processing	3	0	0	3	3
			B. High Voltage Engineering					
			C. Computer Architecture					
<b>Total of Theory</b>							<b>15</b>	<b>15</b>
<b>B. PRACTICAL</b>								
6	PC	EE 691	Microprocessor and Microcontroller Laboratory	0	0	2	2	1
7	PC	EE 692	Power System – II Laboratory	0	0	3	3	1.5
8	PC	EE 693	Control System – II Laboratory	0	0	3	3	1.5
9	OE	EE 694	A. Data Base Management System Laboratory	0	0	3	3	1.5
			B. Embedded Systems Laboratory					
			C. Software Engineering Laboratory					
10	PROJ	PR 691	Project – VI	0	0	2	2	1
11	PROJ*	PR 692	Innovative Activities – V	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
12	MC	MC 681	Technical Lecture Presentation & Group Discussion – I	0	0	3	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>31</b>	<b>22</b>

- \* Students may choose either to work on participation in all the activities of Institute's Innovation Council for e.g., IPR workshop / Leadership Talks / Idea / Design / Innovation / Business Completion / Technical Expos etc.

Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

7th Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	PC	EE 701	Electrical Drives	3	0	0	3	3
2	OE	EE 702	A. Object Oriented Programming using JAVA	3	0	0	3	3
			B. Big Data Analysis					
			C. Digital Image Processing					
3	PE	EE 703	A. Power System – III	3	0	0	3	3
			B. Restructured Electrical Power System					
			C. Computer Applications in Power System					
4	PE	EE 704	A. Power System Dynamics and Control	3	0	0	3	3
			B. Power Quality and FACTS					
			C. HVDC Transmission Systems					
5	HS	HU 703	Industrial and Financial Management	2	0	0	2	2
<b>Total of Theory</b>							<b>14</b>	<b>14</b>
<b>B. PRACTICAL</b>								
6	PC	EE 791	Electrical Drives Laboratory	0	0	3	3	1.5
7	OE	EE 792	A. Object Oriented Programming Laboratory	0	0	3	3	1.5
			B. Big Data Analysis Laboratory					
			C. Digital Image Processing Laboratory					
8	PROJ	PR 791	Project – VII	0	0	0	6	3
9	PROJ*	PR 792	Innovative Activities – VI	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
10	MC	MC 781	Technical Lecture Presentation & Group Discussion – II	0	0	3	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>29</b>	<b>20.5</b>

\* Students may choose either to work on participation in Hackathons etc. Development of new product / Business Plan / registration of start-up.

Students may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry / NGO's / Government organizations / Micro / Small / Medium enterprises to make themselves ready for the industry / Long Term goals under rural Internship. (Duration 4-6 weeks)

Innovative activities to be evaluated by the Programme Head / Event Coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

8th Semester								
Sl No	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	PE	EE 801	A. Wind and Solar Energy Systems	2	0	0	2	2
			B. Utilization of Electric Power					
			C. Line Commutated and Active Rectifiers					
2	PE	EE 802	A. Advanced Electric Drives	3	0	0	3	3
			B. Control Systems Design					
			C. Industrial Electrical System					
3	HS	HU 801	Principles of Management	2	0	0	2	2
<b>Total of Theory</b>							<b>7</b>	<b>7</b>
<b>B. PRACTICAL</b>								
4	PROJ	PR 891	Project – VIII	0	0	8	8	4
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
5	MC	MC 804	Essence of Indian Knowledge Tradition	3	0	0	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>18</b>	<b>11</b>



## *Detailed Syllabus*

1st Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	BS	M 101	Mathematics – I	3	1	0	4	4
2	BS	CH 101 / PH 101	Chemistry (Gr. A) / Physics – I (Gr. B)	3	0	0	3	3
3	ES	EE 101 / EC 101	Basic Electrical Engineering (Gr. A) / Basic Electronics Engineering (Gr. B)	3	0	0	3	3
4	HS	HU 101	English	2	0	0	2	2
<b>Total of Theory</b>							<b>12</b>	<b>12</b>
B. PRACTICAL								
5	BS	CH 191 / PH 191	Chemistry Laboratory (Gr. A) / Physics – I Laboratory (Gr. B)	0	0	3	3	1.5
6	ES	EE 191 / EC 191	Basic Electrical Engineering Laboratory (Gr. A) / Basic Electronics Engineering Laboratory (Gr. B)	0	0	3	3	1.5
7	ES	ME 191 / ME 192	Engineering Graphics & Design (Gr. A) / Workshop/Manufacturing Practices (Gr. B)	0	0	3	3	1.5
8	PROJ	PR 191	Project – IA	0	0	1	1	0.5
9	PROJ	PR 192	Project – IB	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 181	Induction Program	0	0	0	0	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>23</b>	<b>17.5</b>

**Course Name: Mathematics – I**

**Course Code: M 101**

**Contact: 3L:1T:0P**

**Total contact Hours: 48**

**Credit: 4**

**Prerequisite:** The students to whom this course will be offered must have the concept of (10+2) standard matrix algebra and calculus.

**Course Outcome:**

- CO1.** Recall the distinctive characteristics of matrix algebra and calculus.
- CO2.** Understand the theoretical working of matrix algebra and calculus.
- CO3.** Apply the principles of matrix algebra and calculus to address problems in their disciplines.
- CO4.** Examine the nature of system using the concept of matrix algebra and calculus.

**Course Content**

**Module I: Matrix Algebra (11)**

Echelon form and Normal (Canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton theorem.

**Module II: Differential Calculus and Infinite Series (10)**

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Concept of sequence and series, Tests for convergence of infinite series: Comparison test, D'Alembert's ratio test, Raabe's test, Cauchy's root test, Power series; Taylor's series, Series for exponential, trigonometric and logarithm functions.

**Module III: Multivariable Calculus (Differentiation) - I (9)**

Function of several variables, Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; Chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function, Jacobian.

**Module IV: Multivariable Calculus (Differentiation) - II (7)**

Maxima and minima of functions of two variables, Method of Lagrange multipliers; Directional derivatives, Gradient, Divergence, Curl.

**Module V: Integral Calculus (11)**

Evolutes and involutes; Evaluation of definite integrals and its applications to evaluate surface areas and volumes of revolutions; Improper integrals; Beta and Gamma functions and their properties.

**Text Books:**

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

**Reference Books:**

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
3. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
4. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
6. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	2	3	1	-	-	-	-	-	-	-	-	1

**Course Name: Chemistry**  
**Course Code: CH 101**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credits: 3**

**Prerequisite:** A basic knowledge in 10+2 science with chemistry.

**Course Outcome:**

- CO1.** Able to describe the fundamental properties of atoms & molecules, atomic structure and the periodicity of elements in the periodic table.
- CO2.** Able to apply fundamental concepts of thermodynamics in different engineering applications.
- CO3.** Able to apply the knowledge of water quality parameters, corrosion control & polymers to different industries.
- CO4.** Able to determine the structure of organic molecules using different spectroscopic techniques.
- CO5.** Capable to evaluate theoretical and practical aspects relating to the transfer of the production of chemical products from laboratories to the industrial scale, in accordance with environmental considerations.

**Course Content**

**Module-I: Inorganic Chemistry** **9**

**Atomic structure** **(5 Lectures)**

Bohr's theory to hydrogen-like atoms and ions; spectrum of hydrogen atom. Quantum numbers, Introduction to the concept of atomic orbitals, diagrams of s, p and d orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle and its limitation, introduction to Schrodinger equation.

**Periodic properties** **(4 Lectures)**

Modern Periodic table, group trends and periodic trends in physical properties: electron affinity, electronegativity, polarizability, oxidation states, effective nuclear charges, penetration of orbitals, variations of s, p and d orbital energies of atoms.

**Module-II: Physical Chemistry** **8**

**Use of free energy in chemical equilibria** **(6 Lectures)**

Thermodynamic functions: internal energy, enthalpy, entropy and free energy. 2nd Law of Thermodynamics, Estimations of entropy and free energies, Free energy and emf, Cell potentials, the Nernst equation and applications.

**Real Gases** **(2 Lectures)**

Reason for deviation of real gases from ideal behaviour, Equations of state of real gases, Vander Waals' equation, pressure & volume correction, validity, critical state of gas.

**Module III: Organic Chemistry** **8**

**Stereochemistry** **(4 Lectures)**

Representations of 3 dimensional structures, Chirality, optical activity, isomerism, structural isomerism, stereoisomers, enantiomers, diastereomers, configurations (D,L & cis trans), racemisation.

**Organic reactions** (4 Lectures)  
 Concepts of inductive effect, resonance, hyperconjugation, introduction to reactions involving substitution, addition, elimination, oxidation (Baeyer villiger oxidation), reduction (Clemmensen reduction, Wolff-Kishner reduction)

**Module IV: Industrial Chemistry** 8

**Water** (2 Lectures)  
 Hardness, alkalinity, numerical

**Corrosion** (2 Lectures)  
 Types of corrosion: wet & dry, preventive measures

**Polymers** (3 Lectures)  
 Classification of polymers, conducting polymers, biodegradable polymers

**Synthesis of a commonly used drug molecule** (1 Lecture)  
 Paracetamol, Aspirin

**Module V: Spectroscopic techniques in Chemistry** 3  
 Electromagnetic radiation, Principles of spectroscopy, spectrophotometer, infrared spectroscopy, fingerprint region, functional group region, UV-VIS spectroscopy, <sup>1</sup>H Nuclear magnetic resonance spectroscopy, chemical shift.

**Text Books**

1. A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
2. General & Inorganic Chemistry, P.K. Dutt
3. General & Inorganic Chemistry, Vol I, R.P. Sarkar
4. Physical Chemistry, P.C. Rakshit

**Reference Books**

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane (iii) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
3. Physical Chemistry, by P. W. Atkins
4. Organic Chemistry: Structure and Function by K. P. C. Vollhardt and N. E. Schore, 5th Edition
5. <http://bcs.whfreeman.com/vollhardtschore5e/default.asp>

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	2	2	-	-	-	-	1	2	2
CO2	3	3	3	2	1	-	2	1	-	1	-	3
CO3	3	3	3	3	3	1	1	1	-	1	-	2
CO4	2	3	3	3	3	-	-	-	-	1	1	2
CO5	3	3	3	3	1	1	1	-	1	-	2	3

**Course Name: Basic Electrical Engineering**

**Course Code: EE 101**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credits: 3**

**Pre-requisite:** Basic 12<sup>th</sup> standard Physics and Mathematics, Concept of components of electric circuit.

**Course Outcome:** After completion of the course students able to

- CO1.** Understand Basic Electrical circuits, Power distribution and Safety measures.
- CO2.** Analyze and apply DC network theorems.
- CO3.** Analyze and apply concept of AC circuits of single-phase and three-phase.
- CO4.** Analyze and apply concepts of AC fundamentals in solving AC network problems.
- CO5.** Understand basic principles of Transformers and Rotating Machines.

### Course Content

**Module I: DC Circuits (9L)**

Definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, node, branch, active and passive elements, Kirchhoff's laws, Source equivalence and conversion, Network Theorems - Superposition Theorem, Thevenin's Theorem, Norton Theorem, Maximum Power Transfer Theorem, Star-Delta Conversions.

**Module II: AC Fundamentals (9L)**

Sinusoidal quantities, Average and RMS values, peak factor, Form factor, Phase and Phase difference, concept of phasor diagram, V-I Relationship in R, L, C circuit, Combination R-L-C in series and parallel circuits with phasor diagrams, impedance and admittance, impedance triangle and power triangle, Power factor, concept of resonance, Power in AC circuit, simple problems (series and parallel circuit only), Three-phase balanced circuits, Concept of three-phase power measurement.

**Module III: Single-Phase Transformer (5L)**

Brief idea on constructional parts, classifications, working principle. Problems on EMF equation. Phasor diagram, Equivalent circuit.

**Module IV: Electrical Rotating Machines (8L)**

**a) DC Machines (4L)**

Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation.

**b) Three-Phase Induction Motor (4L)**

Basic concept of three phase circuit and production of rotating magnetic field. Working principle of three-phase induction motor and torque-speed characteristics (concept only). No numerical problem.

**Module V: General Structure of Electrical Power System (1L)**

Power generation to distribution through overhead lines and underground cables with single line diagram.

**Module VI: Electrical Installations (4L)**

Earthing of Electrical Equipment, ideas of basic components- MCB, MCCB, ELCB, SFU, Megger.

**Text books:**

1. D. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, TMH.
2. V. Mittle & Arvind Mittal, Basic Electrical Engineering, TMH.
3. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication.
4. Chakrabarti, Nath & Chanda, Basic Electrical Engineering, TMH.
5. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education.

**Reference books:**

1. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Printice Hall India, 1989.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	2	-	-	-	2	2	1
CO2	2	3	-	-	-	-	-	-	-	-	1	1
CO3	2	3	1	-	-	-	-	-	-	-	1	1
CO4	1	2	3	1	-	-	-	-	-	-	-	1
CO5	3	-	-	-	-	-	-	-	-	-	-	1

**Course Name: English**  
**Course Code: HU 101**  
**Contact: 2L:0T:0P**  
**Total Contact Hours: 24**  
**Credits: 2**

**Prerequisite:** The course presupposes a high school level knowledge of English grammar, punctuation, and elementary to intermediate reading and writing skills.

**Course Outcome:**

- CO1.** Able to comprehend the basic knowledge of communication skills in English through exposure to communication theory and practice.
- CO2.** Apply the basic grammatical skills of the English language through intensive practice.
- CO3.** Able to develop listening and writing skills.
- CO4.** Able to write Official Letters , Technical report, memo, notice, minutes, agenda, resume, curriculum vitae.
- CO5.** Able to apply /illustrate all sets of English Language and Communication skills in creative and effective ways in the professional sphere of their life.

**Course Content**

<b>Module 1:</b>	<b>Communication in a Globalized World</b>	<b>4L</b>
1.1	Definition, Process, Types of Communication	
1.2	Verbal and Non-Verbal Communication	
1.3	Barriers to Communication	
1.4	Workplace Communication	
<b>Module 2:</b>	<b>Functional Grammar</b>	<b>4L</b>
2.1.	Articles, Prepositions and Verbs	
2.2.	Verb-Subject Agreement	
2.3.	Voice, Modality and Modifiers	
2.4.	Direct and Indirect Speech	
2.5.	Common Errors in English	
<b>Module 3:</b>	<b>Vocabulary and Reading</b>	<b>6L</b>
3.1.	Word Roots, Prefixes and Suffixes	
3.2.	Antonyms, Synonyms and one word Substitution	
3.3.	Reading—Purposes and Skills (Skimming, Scanning & Intensive Reading)	
3.4.	Reading Comprehension (Fictional and Non-fictional prose)	
<b>Module 4:</b>	<b>Professional Writing</b>	<b>10L</b>
4.1.	Writing Functions: Describing, Defining, Classifying	
4.2.	Structuring—coherence and clarity	
4.3.	Business Writing—Letters (Enquiry, Order, Sales, Complaint, Adjustment, Job Application letters), Memos, Notices, Circulars, Agendas and Minutes of Meetings).	
4.4.	E-mails—types, conventions, jargons and modalities.	
4.5.	Reports and Proposals	
4.6.	Précis writing	
4.7.	Essay writing	
4.8.	Punctuation and its importance in writing	
4.9.	Writing for an Audience	



**Text Books:**

1. Ruskin Bond: The Night Train at Deoli
2. Khushwant Singh: The Portrait of a Lady
3. Roald Dahl: Lamb to the Slaughter
4. Somerset Maugham: The Man with the Scar
5. Anne Frank: The Diary of a Young Girl (Letters of 3rd February 1944, 12th February 1944 and 13th February 1944)
6. Jawaharlal Nehru: "How Britain Ruled India" (Glimpses of World History, Chap 112)

**Reference Books:**

1. Raymond Murphy. *English Grammar in Use*. 3<sup>rd</sup> Edn. CUP, 2001.
2. A. J Thomson and A. V. Martinet. *A Practical English Grammar* Oxford: OUP, 1980.
3. Michael Swan. *Practical English Usage*. Oxford: OUP, 1980.
4. Simeon Potter. *Our Language*. Oxford: OUP, 1950.
5. Pickett, Laster and Staples. *Technical English: Writing, Reading & Speaking*. 8<sup>th</sup> ed. London: Longman, 2001.
6. Ben Heasley and Liz Hamp-Lyons. *Study Writing*. Cambridge: CUP, 2006.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	-	-	1	-	1	3	3	3	3
CO2	-	-	-	-	-	2	-	-	2	3	3	3
CO3	-	3	2	2	-	3	2	2	3	3	3	3
CO4	-	-	-	2	-	2	-	-	3	3	2	3
CO5	-	2	1	-	-	2	2	1	3	3	2	3

**Course Name: Chemistry Laboratory**

**Course Code: CH 191**

**Contact: 0L:0T:3P**

**Total Contact Hours: 24**

**Credits: 1.5**

**Prerequisite:** 10+2 science with chemistry

**Course Outcome:**

- CO1.** Able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.
- CO2.** Able to work as an individual also as a team member.
- CO3.** Able to analyse different parameters of water considering environmental issues.
- CO4.** Able to synthesize nano and polymer materials.
- CO5.** Capable to design innovative experiments applying the fundamentals of chemistry.

**List of Experiments:**

**9**

1. To determine the alkalinity in given water sample.
2. Redox titration (estimation of iron using permanganometry)
3. To determine calcium and magnesium hardness of a given water sample separately.
4. Preparation of phenol-formaldehyde resin (Bakelite).
5. Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).
6. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.
7. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
8. Determination of dissolved oxygen present in a given water sample.
9. To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution).
10. Innovative experiment: Preparation of silver nano-particles.

**Text Books:**

1. A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
2. General & Inorganic Chemistry, P.K. Dutt
3. General & Inorganic Chemistry, Vol I, R.P. Sarkar
4. Physical Chemistry, P.C. Rakshit

**Reference Books:**

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane (iii)Fundamentals of Molecular Spectroscopy, by C. N. Banwell
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
3. Physical Chemistry, by P. W. Atkins
4. Organic Chemistry: Structure and Function by K. P. C. Vollhardt and N. E. Schore, 5th Edition
5. <http://bcs.whfreeman.com/vollhardtschore5e/default.asp>

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	1	3	2	2	2	-	-	-	-	1	2	2
<b>CO2</b>	3	3	3	2	1	-	2	1	-	1	-	3
<b>CO3</b>	3	3	3	3	3	1	1	1	-	1	-	2
<b>CO4</b>	2	3	3	3	3	-	-	-	-	1	1	2
<b>CO5</b>	3	3	3	3	1	1	1	-	1	-	2	3

**Course Name: Basic Electrical Engineering Laboratory****Course Code: EE 191****Contact: 0L:0T:3P****Credits: 1.5****Prerequisite:** Basic Physics and applied physics, Basic Mathematics, Basic concept of Electric Circuit.**Course Outcome:**

- CO1.** Identify and use common electrical components.
- CO2.** To develop electrical networks by physical connection of various components and analyze the circuit behaviour.
- CO3.** Apply and analyze the basic characteristics of transformers and electrical machines.

**List of Experiments:**

1. Basic safety precautions – earthing, introduction to measuring instruments – Voltmeter, Ammeter, Multimeter, Wattmeter, Real life Resistor, Capacitor, Inductor.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition and Maximum Power Transfer Theorem.
4. Characteristics of Fluorescent, Tungsten and Carbon filament lamps.
5. Study of R-L-C series circuit.
6. Three-phase Power measurement with two wattmeter method.
7. Demonstration of cut-out sections of machines: DC Machine (commutator-brush arrangement), Induction Machine (squirrel cage rotor).
8. Measurement of primary and secondary voltage and current of single-phase transformer – Open Circuit and Short Circuit Test.
9. Starting, Reversing and speed control of DC shunt motor.
10. Torque-Speed characteristics of DC Machine.
11. Torque-Speed characteristics of Three-phase Induction Motor.
12. Test on single-phase Energy Meter.
13. Innovative experiments

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	-	-	-	-	-	1
CO2	2	3	-	-	-	-	-	-	-	-	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	1

**Course Name: Engineering Graphics & Design**

**Course Code: ME 191**

**Contact: 0L:0T:3P**

**Credits: 1.5**

**Prerequisite:** Basic knowledge of geometry

**Course Outcome:**

- CO1.** Get introduced with Engineering Graphics and visual aspects of design.
- CO2.** Know and use common drafting tools with the knowledge of drafting standards.
- CO3.** Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.
- CO4.** Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.

**List of Drawing:**

**Traditional Engineering Graphics:**

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

**Module 1: Introduction to Engineering Drawing**

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

**Module 2: Orthographic & Isometric Projections**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

**Module 3: Sections and Sectional Views of Right Angular Solids**

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only)

**Computer Graphics:**

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

**Module 4: Overview of Computer Graphics**

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

**Module 5: CAD Drawing, Customization, Annotations, layering**

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerancing; Using various methods to draw straight lines, circles, applying dimensions and

annotations to drawings; Setting up and use of Layers, Changing line lengths (extend/lengthen); Printing documents; Drawing sectional views of solids and project the true shape of the sectioned surface; Drawing annotation, CAD modeling of parts and assemblies with animation, Parametric and non parametric solid, surface and wireframe modeling, Part editing and two dimensional documentation of models.

### **Module 6: Demonstration of a simple team design project**

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies for engineering analysis and tool-path generation for component manufacture, Use of solid-modeling software for creating associative models at the component and assembly levels.

#### **Text Books:**

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. (Corresponding set of) CAD Software Theory and User Manuals

#### **Reference Books:**

1. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Narayana, K.L. & P Kanniah (2008), Text book on Engineering Drawing, Scitech Publishers.

#### **CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	-	1	1	-	1	2	1	-	-
CO2	2	1	2	-	1	1	-	2	1	2	1	1
CO3	2	1	3	2	3	-	-	2	2	2	1	1

2nd Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	BS	M 201	Mathematics – II	3	1	0	4	4
2	BS	CH 201 / PH 201	Chemistry (Gr. B) / Physics – I (Gr. A)	3	0	0	3	3
3	ES	EE 201 / EC 201	Basic Electrical Engineering (Gr. B) / Basic Electronics Engineering (Gr. A)	3	0	0	3	3
4	ES	CS 201	Programming for Problem Solving	3	0	0	3	3
5	ES	ME 201	Engineering Mechanics	3	0	0	3	3
<b>Total of Theory</b>							<b>16</b>	<b>16</b>
<b>B. PRACTICAL</b>								
6	ES	CS 291	Programming for Problem Solving Laboratory	0	0	3	3	1.5
7	BS	CH 291 / PH 291	Chemistry Laboratory (Gr. B) / Physics – I Laboratory (Gr. A)	0	0	3	3	1.5
8	ES	EE 291 / EC 291	Basic Electrical Engineering Laboratory (Gr. B) / Basic Electronics Engineering Laboratory (Gr. A)	0	0	3	3	1.5
9	ES	ME 291 / ME 292	Engineering Graphics & Design (Gr. B) / Workshop/Manufacturing Practices (Gr. A)	0	0	3	3	1.5
10	HS	HU 291	Language Laboratory	0	0	2	2	1
11	PROJ	PR 291	Project – II	0	0	1	1	0.5
12	PROJ*	PR 292	Innovative Activities – I	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
13	MC	MC 281	NSS / Physical Activities / Meditation & Yoga / Photography / Nature Club	0	0	0	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>34</b>	<b>24</b>

- \* Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation / innovation / entrepreneurship cell of the institute; participation in conferences / workshops / competitions etc.; Learning at Departmental Lab / Tinkering Lab / Institutional workshop; Working in all the activities of Institute's Innovation Council for e.g., IPR workshop / Leadership Talks / Idea / Design / Innovation / Business Completion / Technical Expos etc. (evaluation by Programme Head through certification)

Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

**Course Name: Mathematics – II**

**Course Code: M 201**

**Contact: 3L:1T:0P**

**Total Contact Hours: 48**

**Credits: 4**

**Prerequisite:** The students to whom this course will be offered must have the concept of (10+2) standard calculus.

**Course Outcome:** On successful completion of the learning sessions of the course, the learner will be able to:

- CO1.** Use mathematical tools to evaluate multiple integrals and vector integrals.
- CO2.** Apply effective mathematical tools for the solutions of ordinary differential equations that model physical processes.
- CO3.** Recall the properties of Laplace Transform to evaluate multiple integrals and their usage.
- CO4.** Understand the concept of Laplace transform to solve ordinary differential equations.

### Course Content

**Module I: Multivariable Calculus (Integration):** **(12 Lectures)**

Double integration, Change of order of integration in double integrals, Triple integrals, vector line integrals, scalar surface integrals, vector surface integrals, Green's theorem, Gauss divergence theorem and Stokes' theorem.

**Module II: First Order Ordinary Differential Equations (ODE):** **(10 Lectures)**

Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation, Solution of first order and higher degree ODE: solvable for  $p$ , solvable for  $y$  solvable for  $x$  and Clairaut's equation.

**Module III: Second Order Ordinary Differential Equations (ODE):** **(12 Lectures)**

Solution of second order ODE with constant coefficients: C.F. & P.I., Method of variation of parameters, Cauchy-Euler equations, Reduction of 2<sup>nd</sup> order ODE to a pair of first order ODEs, Solution of simultaneous linear ODEs.

**Module IV: Laplace Transform (LT):** **(14 Lectures)**

Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of  $t f(t)$ , LT of  $\frac{f(t)}{t}$ , LT of derivatives of  $f(t)$ , LT of  $\int f(t)dt$ , Evaluation of improper integrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties, Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODE with constant coefficients (initial value problem) using LT.

#### **Text Books:**

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.



- Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

**Reference Books:**

- Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- Boyce, W. E. and DiPrima, R. C., Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
- Ross, S. L., Differential Equations, 3rd Ed., Wiley India, 1984.
- Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.
- Coddington, E. A., An Introduction to Ordinary Differential Equations, Prentice Hall, India, 1995.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	-	1
CO4	3	3	2	-	-	-	-	-	-	-	-	1

**Course Name: Physics – I**  
**Course Code: PH 201**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credits: 3**

**Pre requisite:** Knowledge of Physics up to 12<sup>th</sup> standard.

**Course Outcome:** At the end of the course students should be able to

- CO1.** Describe various types mechanical resonance and its electrical equivalence.
- CO2.** Explain basic principles of Laser, Optical fibers and various types of semiconductors.
- CO3.** Apply superposition to explain interference and diffraction as well as apply wave mechanics to attainment of Heisenberg's uncertainty principle.
- CO4.** Analyze importance of light as a carrier of information and examine different crystallographic structures according to their co-ordination number and packing factors.
- CO5.** Justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics.

### **Course Content**

**Module 1: Waves & Oscillations (6L)**

Simple Harmonic Motion (only preliminary idea), damped harmonic motion-over damped, critically damped and under damped motion, energy decay, logarithmic decrement, force vibration and resonance (amplitude, velocity resonance), sharpness of resonance, quality factor, related numerical problems. 6L

**Module 2: Classical Optics (8L)**

**Interference of light:** Huygens's principle, superposition of waves, conditions of sustained interference, Newton's ring (qualitative descriptions of working principles and procedures-no deduction required). Engineering applications, Numerical Problems. 3L

**Diffraction of light:** Fresnel and Fraunhofer class, Fraunhofer diffraction of a single slit, multiple slits, intensity distributions, missing order, Rayleigh criterion (no deduction) and resolving power of grating and microscope (no deduction), related numerical problems. 5L

**Module 3: Quantum Mechanics – I (8L)**

**Quantum Theory:** Inadequacy of classical physics and its modifications by Planck's quantum hypothesis-qualitative (no deductions), particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of modified and unmodified lines), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment. 4L

**Quantum Mechanics 1:** Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions; uncertainty principle, relevant numerical problems. 4L

**Module 4: Solid State Physics – I (7L)**

**Crystal Structure:** Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems. 4L

**Semiconductor:** Physics of semiconductors, electrons and holes, metal, insulator and semiconductor, intrinsic and extrinsic semiconductor, p-n junction. 3L

**Module 5: Modern Optics – I (7L)**

**Laser:** Concepts of various emission and absorption process, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser. 5L

**Fibre optics:** Principle and propagation of light in optical fibres- Numerical aperture and Acceptance angle, Numerical problems. 2L

**Text Books:****Waves & Oscillations:**

1. Sound-N. K. Bajaj (TMH)
2. Advanced Acoustics-D. P. Roy Chowdhury (Chayan Publisher)
3. Principles of Acoustics-B.Ghosh (Sridhar Publisher)
4. A text book of sound-M. Ghosh ( S. Chand publishers)
5. A text book of Light- K.G. Mazumder & B.Ghoshs, (Book & Allied Publisher)
6. Physics of Oscillations and Waves- R.P. Singh
7. College Physics Vol. II - A.B. Gupta
8. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

**Classical & Modern Optics:**

1. A text book of Light- K.G. Mazumder & B.Ghoshs (Book & Allied Publisher)
2. A text book of Light-Brijlal & Subhramanium, ( S. Chand publishers)
3. Modern Optics-A. B. Gupta ( Book & Allied Publisher)
4. Optics-Ajay Ghatak (TMH)
5. Optics-Hecht
6. Optics-R. Kar, Books Applied Publishers
7. Physical Optics Möler
8. Optics -F.A. Jenkins and H.E White

**Quantum Mechanics-I**

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
2. Quantum Mechanics-Bagde and Singh (S. Chand Publishers)
3. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)
4. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
5. Quantum Mechanics-Bransden (Pearson Education Ltd.)
6. Perspective of Modern Physics-A. Beiser (TMH)
7. Quantum mechanics -A.K. Ghatak and S Lokenathan
8. Modern Physics -E.E. Anderson
9. Physics Volume 2 -Haliday, Resnick & Krane Published by Wiley India

**Solid State Physics-I:**

1. Solid state physics-Puri & Babbar ( S. Chand publishers)
2. Materials Science & Engineering-Kakani Kakani
3. Solid state physics- S. O. Pillai
4. Introduction to solid state physics-Kittel (TMH)
5. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)
6. Problem in Solid state physics -S.O. Pillai (a. b.)

**Reference Books:**

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Perspective & Concept of Modern Physics -Arthur Baiser
4. Principles of engineering physics – Md. N Khan and S Panigrahi.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	1
CO4	2	3	-	-	-	-	-	-	-	-	-	1
CO5	1	3	-	-	-	-	-	-	-	-	-	1

**Course Name: Basic Electronics Engineering**

**Course Code: EC 201**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credits: 3**

**Prerequisite:** A basic course in Electronics and Communication Engineering Progresses from the fundamentals of electricity, direct current (DC) devices and circuits, series and parallel circuits to the study of active and passive components, Ohm's Law, Kirchhoff's Law i.e. KVL, KCL, Ampere's Law etc.

**Course Outcome:**

- CO1.** Study PN junction diode, ideal diode, diode models and its circuit analysis, application of diodes and special diodes.
- CO2.** Learn how operational amplifiers are modelled and analysed, and to design Op-Amp circuits to perform operations such as integration differentiation on electronic signals.
- CO3.** Study the concepts of both positive and negative feedback in electronic circuits.
- CO4.** Develop the capability to analyse and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis.

**Course Content**

**Module-I: Basics of semiconductor** **5**  
 Conductors, Insulators, and Semiconductors- crystal structure, Fermi Dirac function, Fermi level, E-k and Energy band diagrams, valence band, conduction band, and band gap; intrinsic, and extrinsic (p-type and n-type) semiconductors, position of Fermi level in intrinsic and extrinsic semiconductor, drift and diffusion current – expression only ( no derivation) , mass action law , charge neutrality in semiconductor, Einstein relationship in semiconductor , Numerical problems on- Fermi level, conductivity, mass action law, drift and diffusion current .

**Module-II: P-N Junction Diode and its applications** **7**  
 P-N junction formation and depletion region , energy band diagram of p-n junction at equilibrium and barrier energy , built in potential at p-n junction , energy band diagram and current through p-n junction at forward and reverse bias, V-I characteristics and current expression of diode , temperature dependencies of V-I characteristics of diode , p-n junction breakdown – conditions , avalanche and Zener breakdown , Concept of Junction capacitance, Zener diode and characteristics. Diode half wave and full wave rectifiers circuits and operation (  $I_{DC}$  ,  $I_{rms}$  ,  $V_{DC}$  ,  $V_{rms}$ , ripple factor without filter, efficiency ,PIV,TUF; Reduction of ac ripples using filter circuit (Qualitative analysis); Design of diode clipper and clamper circuit - explanation with example, application of Zener diode in regulator circuit. Numerical problems

**Module III: Bipolar Junction Transistor** **8**  
 Formation of PNP/NPN Transistors, energy band diagram, current conduction mechanism, CE, CB, CC configurations, transistor static characteristics in CE, CB and CC mode, junction biasing condition for active, saturation and cut-off modes, current gain  $\alpha$ ,  $\beta$  and  $\gamma$ , early effect. Biasing and bias stability; biasing circuits - fixed bias; voltage divider bias; collector to base bias, D.C. load line and Quiescent point, calculation of stability factors for different biasing circuits. BJT as an amplifier and as a switch – Graphical analysis; Numerical Problems.

**Module IV: Field Effect Transistors** **6**  
 Concept of field effect, channel width modulation Classification of FETs-JFET, MOSFET,

operating principle of JFET. drain and transfer characteristics of JFET (n-channel and p-channel), CS,CG,CD configurations, Relation between JFET parameters. FET as an amplifier and as a switch– graphical analysis. E-MOSFET (n-channel and p-channel), D-MOSFET (n-channel and p-channel), Numerical Problems

### Module V: Feedback and Operational Amplifier

8

Concept of feedback with block diagram, positive and negative feedback, gain with feedback. Feedback topologies, effect of feedback on input and output impedance, distortion, concept of oscillation and Barkhausen criterion.

Operational amplifier – electrical equivalent circuit ,ideal characteristics , Non ideal characteristics of op- amp – offset voltages ;bias current ;offset current; Slew rate ; CMRR and bandwidth, Configuration of inverting and non-inverting amplifier using Op-amp, closed loop voltage gain of inverting and non- inverting amplifier , Concept of virtual ground, Applications op-amp – summing amplifier; differential amplifier; voltage follower ; basic differentiator and integrator .

Problems on Characteristics of Op-amp, CMRR, slew rate, amplifier and application of Op-amp to be discussed. Any other relevant problems related to topic may be discussed or assigned.

### Module-VI: Cathode Ray Oscilloscope (CRO)

2

Operating principle of CRO with block diagram, measurement of voltage, frequency and phase.

#### Text Books:

1. D. Chattopadhyay, P. C. Rakshit, Electronics Fundamentals and Applications, New Age International
2. Millman & Halkias, Integrated Electronics, Tata McGraw Hill.
3. Sedra & Smith, Microelectronics Engineering

#### Reference Books:

1. John D. Ryder, Electronic Fundamentals and Applications, PHI
2. J.B.Gupta, Basic Electronics, S.K. Kataria.
3. Malvino: Electronic Principle.
4. Boyelstad & Nashelsky: Electronic Devices & Circuit Theory, McGraw Hill, 1976.

#### CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	-	-	-	-	-	-	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2
CO3	3	3	3	2	1	-	-	-	-	-	-	3
CO4	3	3	2	3	2	-	-	-	-	-	-	3

**Course Name: Programming for Problem Solving**  
**Course Code: CS 201**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credits: 3**

**Prerequisite:** Number system, Boolean Algebra

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

- CO1.** Understand and differentiate among different programming languages for problem solving.
- CO2.** Describe the way of execution and debug programs in C language.
- CO3.** Define, select, and compare data types, loops, functions to solve mathematical and scientific problem.
- CO4.** Understand the dynamic behavior of memory by the use of pointers.
- CO5.** Design and develop modular programs using control structure, selection structure and file.

### Course Content

**Module I: Fundamentals of Computer: (8L)**

History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. 3L  
 Binary and Allied number systems representation of signed & unsigned numbers, BCD, ASCII, Binary number Arithmetic – Addition and Subtraction (using 1's complement and 2's complement). 2L  
 Overview of Procedural vs Structural language, compiler and assembler (basic concepts). 1L  
 Problem solving-Algorithm & flow chart. 2L

**Module II: C Fundamentals: (28L)**

Variable and Data Types: The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements. 2L  
 C Operators & Expressions: Arithmetic operators, relational operators, logical operators, increment and decrement operators, bitwise operators, assignment operators, conditional operators, special operators - type conversion, C expressions, precedence and associativity. 3L  
 Input and Output: Standard input and output, formatted output - printf, formatted input scanf, bit fields. 1L  
 Branching and Loop Statements: Statement and blocks, if - else, switch, goto and labels, Loops - while, for, do while, break and continue. 4L  
 Fundamentals and Program Structures: auto, external, static and register variables Functions, function types, function prototypes, functions returning values, functions not returning values, scope rules, recursion, C preprocessor and macro. 5L  
 Arrays, Strings and Pointers: One dimensional arrays, Two-dimensional arrays, Multidimensional arrays. Passing an array to a function Character array and string, array of strings, Passing a string to a function, String related functions, Pointers, Pointer and Array, Pointer and String, Pointer and functions, Dynamic memory allocation. 7L  
 Structures and Unions: Basic of structures, arrays of structures, structures and pointers, structures and functions. 3L  
 Files handling with C: Formatted and unformatted files, Command line arguments, fopen, fclose, fgetc, fputc, fprintf, fscanf function. 3L

**Text books:**

1. Kerninghan B.W. & Ritchie D.M. - The C Programming Language ,PHI, 2nd Edition
2. Kanetkar Y. - Let us C, BPB Publication, 15th Edition

**Reference Books:**

1. E Balagurusamy – Programming in ANSI C, TMH, 3rd Edition
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition
3. Reema Thareja – INTRODUCTION TO C PROGRAMMING, OXFORD UNIVERSITY PRESS, 2nd Edition

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	1	-	3	3	1	1
CO2	2	2	3	3	2	2	-	-	3	3	3	3
CO3	2	2	2	2	2	1	-	-	3	3	1	3
CO4	3	2	2	2	2	3	-	-	3	3	2	3
CO5	3	3	3	3	2	3	-	-	3	3	3	3



**Course Name: Engineering Mechanics**

**Course Code: ME 201**

**Contacts: 3L:0T:0P**

**Total Contact Hours: 36**

**Credits: 3**

**Prerequisite:** Basic Concept of Physics

**Course Outcome:**

- CO1.** To understand representation of force, moments for drawing free-body diagrams and analyze friction based systems in static condition.
- CO2.** To locate the centroid of an area and calculate the moment of inertia of a section.
- CO3.** Apply of conservation of momentum & energy principle for particle dynamics and rigid body kinetics.
- CO4.** Understand and apply the concept of virtual work, rigid body dynamics and systems under vibration.

**Course Content**

**Module 1: Introduction to Engineering Mechanics:** Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy. 6L

**Module 2: Friction:** Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack. 2L

**Module 3: Basic Structural Analysis:** Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines. 3L

**Module 4: Centroid and Centre of Gravity:** Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook. 5L

**Module 5: Virtual Work and Energy Method:** Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium. 5L

**Module 6: Review of particle dynamics:** Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2<sup>nd</sup> law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). 5L

**Module 7: Introduction to Kinetics of Rigid Bodies:** Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems;

D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation. 5L

**Module8: Mechanical Vibrations:** Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums. 5L

**Text Book:**

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education

**Reference Book:**

1. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
2. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
3. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
4. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	1	-	-	-
CO2	3	3	2	2	-	-	-	-	1	-	-	1
CO3	3	2	3	2	1	-	-	-	1	-	-	1
CO4	3	3	3	3	-	-	-	-	1	-	1	-

**Course Name: Programming for Problem Solving Laboratory**  
**Course Code: CS 291**  
**Contact: 0L:0T:3P**  
**Credits: 1.5**

**Prerequisites:** Number system, Boolean Algebra

**Course Outcomes:** On completion of the course students will be able to

- CO1.** Learn the concept of DOS system commands and editor.
- CO2.** To formulate the algorithms for simple problems and to translate given algorithms to a working and correct program.
- CO3.** To be able to identify and correct syntax errors / logical errors as reported during compilation time and run time.
- CO4.** To be able to write iterative as well as recursive programs.
- CO5.** Learn the concept of programs with Arrays, Pointers, Structures, Union and Files.

**List of Experiments:**

1. Some basic commands of DOS, Windows and Linux Operating System, File handling and Directory structures, file permissions, creating and editing simple C program, compilation and execution of C program.
2. Writing C Programs on variable, expression, operator and type-casting.
3. Writing C Programs using different structures of if-else statement and switch-case statement.
4. Writing C Programs demonstrating use of loop (for loop, while loop and do-while loop) concept and use of break and continue statement.
5. Writing C Programs demonstrating concept of Single & Multidimensional arrays.
6. Writing C Programs demonstrating concept of Function and Recursion.
7. Writing C Programs demonstrating concept of Pointers, address of operator, declaring pointers and operations on pointers.
8. Writing C Programs demonstrating concept of structures, union and pointer to structure.
9. Writing C Programs demonstrating concept of String and command line arguments.
10. Writing C Programs demonstrating concept of dynamic memory allocation.
11. Writing C Programs demonstrating concept of File Programming.
12. Innovative Experiment

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	2	2	-	1	-	1	2	3
CO2	3	3	3	-	-	-	-	-	-	-	-	2
CO3	2	2	2	2	2	-	-	-	-	-	-	3
CO4	1	2	2	2	2	-	-	-	-	-	-	2
CO5	2	3	3	3	2	2	3	1	3	3	3	3

**Course Name: Physics – I Laboratory**  
**Course Code: PH 291**  
**Contact: 0L:0T:3P**  
**Credits: 1.5**

**Prerequisite:** Basic knowledge of 10+2

**Course Outcome:** Student will able to:

- CO1.** Demonstrate experiments allied to their theoretical concepts.
- CO2.** Conduct experiments using LASER, Optical fiber, Torsional pendulum, Spectrometer.
- CO3.** Participate as an individual, and as a member or leader in groups in laboratory sessions actively.
- CO4.** Analyze experimental data from graphical representations, and to communicate effectively them in Laboratory reports including innovative experiments.

**List of Experiment:**

**General idea about Measurements and Errors (One Mandatory):**

- i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.
- ii) Proportional error calculation using Carrey Foster Bridge.

**Any 7 to be performed from the following experiments**

**Experiments on Oscillations& Elasticity:**

- 1. Study of Torsional oscillation of Torsional pendulum & determination of time period using various load of the oscillator.
- 2. Experiments on Lissajous figure (using CRO).
- 3. Experiments on LCR circuit.
- 4. Determination of elastic moduli of different materials (Young's modulus and Rigidity modulus)

**Experiments on Optics:**

- 5. Determination of wavelength of light by Newton's ring method.
- 6. Determination of wavelength of light by Laser diffraction method.
- 7. Determination of numerical aperture and the energy losses related to optical fiber experiment
- 8. Measurement of specific rotation of an optically active solution by polarimeter.

**Experiments on Quantum Physics:**

- 9. Determination of Planck's constant using photoelectric cell.
- 10. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.

**\*\*In addition it is recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.**

**Innovative experiments:**

- 1. Determination of wavelength of light by Fresnel's bi-prism method (beyond the syllabus).
- 2. Study of half-wave, quarter-wave plate (beyond the syllabus)
- 3. Study of dispersive power of material of a prism.
- 4. Study of viscosity using Poiseuille's capillary flow method/using Stoke's law.

5. Measurement of nodal and antinodal points along transmission wire and measurement of wave length.
6. Any other experiment related to the theory.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	2	2	-	1	-	1	2	3
CO2	3	3	3	-	-	-	-	-	-	-	-	2
CO3	2	2	2	2	2	-	-	-	-	-	-	3
CO4	1	2	2	2	2	-	-	-	-	-	-	2

**Course Name: Basic Electronics Engineering Laboratory****Course Code: EC 291****Contact: 0L:0T:3P****Credits: 1.5**

**Prerequisite:** A basic course in electronics and Communication engineering Progresses from the fundamentals of electricity, active and passive components, basic electronics laws like Ohm's law, Ampere's law.

**Course Outcome:**

- CO1.** Knowledge of Electronic components such as Resistors, Capacitors, Diodes, Transistors measuring equipment like DC power supply, Multimeter, CRO, Signal generator, DC power supply.
- CO2.** Analyse the characteristics of Junction Diode, Zener Diode, BJT & FET and different types of Rectifier Circuits.
- CO3.** Determination of input-offset voltage, input bias current and Slew rate, Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
- CO4.** Able to know the application of Diode, BJT & OPAMP.

**List of Experiment:**

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

**Text Books:**

1. D. Chattopadhyay, P. C. Rakshit, Electronics Fundamentals and Applications, New Age International
2. Millman & Halkias, Integrated Electronics, Tata McGraw Hill.
3. Sedra & Smith, Microelectronics Engineering

**Reference Books:**

1. John D. Ryder, Electronic Fundamentals and Applications, PHI
2. J.B. Gupta, Basic Electronics, S.K. Kataria.
3. Malvino: Electronic Principle.
4. Boyelstad & Nashelsky: Electronic Devices & Circuit Theory, McGraw Hill, 1976.

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	2	2	1	2	-	-	-	-	-	-	2
<b>CO2</b>	3	3	3	2	2	-	-	-	-	-	-	2
<b>CO3</b>	3	3	3	2	1	-	-	-	-	-	-	3
<b>CO4</b>	3	3	2	3	2	-	-	-	-	-	-	3

**Course Name: Workshop/Manufacturing Practices**

**Course Code: ME 292**

**Contact: 0L:0T:3P**

**Credits: 1.5**

**Prerequisite:** Higher Secondary with Mathematics, Physics and Chemistry

**Course Outcome:** Upon completion of this laboratory course, students will be able to

- CO1.** Fabricate components with their own hands.
- CO2.** Get practical knowledge of the dimensional accuracies and tolerances applicable for different manufacturing processes.
- CO3.** Produce small devices of their interest for project or research purpose.

**Course Content:**

**(i) Theoretical discussion & videos: (6P)**

Detailed contents:

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing
8. Plastic moulding & Glass Cutting.

**(ii) Workshop Practice:**

**Module 1 - Machine shop (6P)**

Typical jobs that may be made in this practice module:

- i. To make a pin from a mild steel rod in a lathe.
- ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

**Module 2 - Fitting shop (6P)**

Typical jobs that may be made in this practice module:

- i. To make a Gauge from MS plate.

**Module 3 - Carpentry (6P)**

Typical jobs that may be made in this practice module:

- i. To make wooden joints and/or a pattern or like.

**Module 4 - Welding shop (Arc welding 3P + gas welding 3P) (6P)**

Typical jobs that may be made in this practice module:

- i. ARC WELDING (3P): To join two thick (approx 5mm) MS plates by manual metal arcwelding.
- ii. GAS WELDING (3P): To join two thin mild steel plates or sheets by gas welding.

**Module 5 - Electrical & Electronics (3P)**

House wiring, soft Soldering

**Module 6 - Smithy (3P)**

Typical jobs that may be made in this practice module:

- i. A simple job of making a square rod from a round bar or like.



**Innovative Experiments:****Module 7 - Casting**

Typical jobs that may be made in this practice module:

- i. One/ two green sand moulds to prepare, and a casting be demonstrated.

**Module 8 - Plastic moulding & Glass Cutting**

Typical jobs that may be made in this practice module:

- i. For plastic moulding, making at least one simple plastic component should be made.
- ii. At least one sample shape on glass should be made using laser cutting machine.

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

**Text Books:**

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGraw Hill House, 2017.

**Reference Books:**

1. Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.
3. Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
4. Manufacturing Science by A.Ghosh and A.K.Mallick, Wiley Eastern.
5. Principles of Metal Cutting/Principles of Machine Tools by G.C.Sen and A.Bhattacharya, New Central Book Agency, Kolkata.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	-	-	-	2	1	-	2
CO2	3	3	2	2	1	-	-	-	2	1	-	2
CO3	3	2	2	2	1	1	-	1	2	2	3	2

**Course Name: Language Laboratory**  
**Course Code: HU 291**  
**Contact: 0L:0T:2P**  
**Credit: 1**

**Pre requisite:** Basic knowledge of LSRW skills

**Course Outcome:**

- CO1.** Able to understand advanced skills of Technical Communication in English through Language Laboratory.
- CO2.** Able to apply listening, speaking, reading and writing skills in societal and professional life.
- CO3.** Able to demonstrate the skills necessary to be a competent Interpersonal communicator.
- CO4.** Able to analyze communication behaviours.
- CO5.** Able to adapt to multifarious socio-economical and professional arenas with the help of effective communication and interpersonal skills.

**Course Content:**

**Module 1: Introduction to the Language Laboratory**

- a. The Need for a Language Laboratory
- b. Tasks in the Lab
- c. Writing a Laboratory Note Book

**Module 2: Active Listening**

- a. What is Active Listening?
- b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
- c. Academic Listening vs Business Listening
- d. Listening in Business Telephony
- e. Study of Contextualized Examples based on Lab Recordings

**Module 3: Speaking**

- a. Speaking—Accuracy and Fluency Parameters
- b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
- c. Fluency-focussed activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
- d. Accuracy-focussed activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
- e. Group Discussion: Principles and Practice

**Module 4: Lab Project Work**

- a. Making a brief Animation film with voice over (5 minutes) OR
- b. Making a brief Documentary film (10 minutes)

**References:**

1. IIT Mumbai, **Preparatory Course in English** syllabus
2. IIT Mumbai, **Introduction to Linguistics** syllabus
3. Sasikumar et al. *A Course in Listening and Speaking*. New Delhi: Foundation Books, 2005.
4. Tony Lynch, *Study Listening*. Cambridge: Cambridge UP, 2004.

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	2	-	-	3	-	3	2	2	3	3	-	3
<b>CO2</b>	2	3	3	3	-	3	3	3	2	3	-	3
<b>CO3</b>	1	3	3	3	-	2	2	2	2	3	-	2
<b>CO4</b>	1	2	3	3	-	2	1	1	2	3	-	2
<b>CO5</b>	3	3	2	3	-	2	3	2	2	3	-	2

3rd Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	ES	EE 301	Electrical Circuit Analysis	3	1	0	4	4
2	PC	EE 302	Measurement and Instrumentation	3	0	0	3	3
3	PC	EE 303	Analog Electronics	3	0	0	3	3
4	BS	M(EE) 301	Mathematics – III	3	1	0	4	4
<b>Total of Theory</b>							<b>14</b>	<b>14</b>
<b>B. PRACTICAL</b>								
5	ES	EE 391	Electrical Circuit Analysis Laboratory	0	0	3	3	1.5
6	PC	EE 392	Measurement and Instrumentation Laboratory	0	0	3	3	1.5
7	PC	EE 393	Analog Electronics Laboratory	0	0	2	2	1
8	PROJ	PR 391	Project – III	0	0	2	2	1
9	PROJ*	PR 392	Innovative Activities – II	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
10	MC	MC 301	Environmental Science	3	0	0	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>27</b>	<b>19.5</b>

- \* Students may choose either to work on participation in all the activities of Institute's Innovation Council for e.g., IPR workshop/ Leadership Talks / Idea / Design / Innovation / Business Completion / Technical Expos etc.

Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

**Course Name: Electrical Circuit Analysis**

**Course Code: EE 301**

**Contact: 3L:1T:0P**

**Total Contact Hours: 48**

**Credit: 4**

**Prerequisites:** The students to whom this course will be offered must have the concept of Basic electrical engineering, Laplace transform, First order ordinary differential equation and Second order ordinary differential equation.

**Course Outcome:** On successful completion of the learning sessions of the course, the learner will be able to

- CO1.** Understand the basic concepts of electric, magnetic and filter circuits.
- CO2.** Synthesize different electrical circuits with network theorems.
- CO3.** Analyze the transient condition of electrical circuits.
- CO4.** Analyze two port circuit behaviors.

### **Course Content**

**MODULE I: Introduction (3)**  
Continuous & Discrete, Fixed & Time varying, Linear and Nonlinear, Lumped and Distributed, Passive and Active networks, Independent & Dependent sources, Step, Ramp, Impulse, Sinusoidal, Square, Saw tooth signals, Source transformation, KVL & KCL.

**MODULE II: Coupled Circuits (5)**  
Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance, Coefficient of coupling, Modelling of coupled circuits, Ideal Transformer, Solution of problems.

**MODULE III: Laplace Transform in Circuit Analysis (8)**  
Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances.

**MODULE IV: Network Theorems (8)**  
Loop variable analysis, Node variable analysis, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Millman's Theorem Solution of Problems with DC & AC sources.

**MODULE V: Graph Theory (4)**  
Concept of Tree, Branch, Tree link, Incidence Matrix, Cut Set Matrix, Tie Set Matrix, Formation of incidence, tie set, cut set matrices of electric circuits.

**MODULE VI: Two Port Network (8)**  
Open circuit Impedance & Short circuit Admittance parameter, Transmission parameter, Hybrid Parameter, Conditions Of Reciprocity And Symmetry, Interrelation between different parameters, Driving point impedance & Admittance. Interconnection Of Two Port Networks. Solution of problems.

**MODULE VII: Filter (6)**

Analysis and synthesis of Low pass, High pass, Band pass, Band reject, All pass filters (first and second order only) using operational amplifier.

**MODULE VIII: Fourier Series Analysis (6)**

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  $2\pi$ , Dirichlet's conditions, Sum of Fourier series. Theorem for the convergence of Fourier Series (statement only). 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 (statement only).

**Text Books:**

1. Sudhakar: Circuits & Networks: Analysis & Synthesis 2/e TMH
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. D. Chattopadhyay and P. C. Rakshit: Electrical Circuits

**Reference Books:**

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.
3. Sivanandam: Electric Circuits Analysis
4. V.K. Chandna, A Text Book of Network Theory & Circuit Analysis, Cyber Tech References.
5. Kuo F. F., "Network Analysis & Synthesis", John Wiley & Sons.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	-	-	1	3
CO2	3	3	3	2	2	-	-	-	-	-	1	3
CO3	3	3	3	2	2	-	-	-	-	-	2	3
CO4	3	3	3	2	2	-	-	-	-	-	2	3

**Course Name Measurement and Instrumentation****Course Code: EE 302****Contact: 3L:0T:0P****Total Contact Hours: 36****Credit: 3****Prerequisites:** Concepts of Basic Electrical Engineering.**Course Outcome:**

- CO1.** Understand the operating principles of electrical and electronic measuring instruments.
- CO2.** Identify and measure various physical parameters using appropriate measuring instruments.
- CO3.** Measure various electrical parameters.
- CO4.** Understand statistical data analysis and computerized data acquisition.

**Course Content****Module –I:**

Measurements: (4)  
 Classification of instruments, Definition of accuracy, Precision, Resolution, Speed of response, Errors in measurement. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, Cp, Cpk.

Analog meters: (6)  
 General features, Construction, Principle of operation and torque equation of Moving coil and Moving iron, Electrodynamometer, Induction instruments, Electrostatic, Thermoelectric, Rectifier type instruments, Extension of instrument ranges and multipliers. Disadvantage of shunt and multipliers

Galvanometer: (2)  
 Basic concept: Principle of operation, Advantage, Disadvantage, Error and Application.

**Module – II:**

Instrument transformer: (2)  
 Advantage of Instrument transformers, Principle of operation of Current & Potential transformer, errors.

Measurement of Power: (3)  
 Principle of operation of Electrodynamic & Induction type wattmeter. Wattmeter errors.

Measurement of Energy: (2)  
 Construction, theory and application of AC energy meter. Testing of energy meters.

**Module – III:**

Measurement of resistance: (3)  
 Measurement of medium, low and high resistances, Megger. Basic concept of Crompton's DC potentiometer Polar and Co-ordinate type AC potentiometer. Application.

AC Bridges: (4)  
Measurement of Inductance, Capacitance frequency

#### Module – IV:

Cathode ray oscilloscope (CRO): (3)  
Basic concept of Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope, Double beam CRO. Digital Storage Oscilloscope

Electronic Instruments: (3)  
Basic concept of Digital voltmeter (Electronic), Resolution and sensitivity of digital meters, Digital Multi meter Digital frequency meter, True RMS meters, Clamp-on meters

Sensors & Transducers: (4)  
Introduction to sensors & Transducers, Strain gauge, LVDT, Temperature transducers, Flow measurement using magnetic flow measurement.

#### Text Books:

1. A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & sons.
2. Electrical Measurement & Measuring Instruments, E.W. Golding & F.C. Wides, Wheeler Publishing.
3. Electronic Instruments, H.S. Kalsi, Tata Mc-Graw hill, 2nd Edition.

#### Reference Books:

1. Sensors & Transducers, D. Patranabis, PHI, 2nd edition.
2. Digital Instrumentation, A.J. Bouwens, Tata Mc-Graw hill.
3. Modern Electronic instrumentation & Measuring instruments, A.D. Heltric & W.C. Copper, Wheeler Publication.
4. Instrument transducers, H.K.P. Neubert, Oxford University press

#### CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	1	-	-	-	-	-	-	-
CO4	-	3	2	-	2	-	-	-	-	-	-	-



**Course Name: Analog Electronics**

**Course Code: EE 303**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:** Basic knowledge about electronic components(R,L,C). Network Theorems (Kirchoffs law, Thevenin's theorem, Norton's theorem, Miller theorem etc.). Basic knowledge about the operation of semiconductor devices (Diode, Transistor, JFET, MOSFET, etc.), Basic idea of integrated circuit, Voltage current equations. Basic knowledge of Differentiation, Integration, Differential equation, matrix etc.

**Course Outcome:**

- CO1.** Students will be able to design D.C power supplies.
- CO2.** Students will be able to analyze transistor amplifier circuit.
- CO3.** Students will be able to understand effects of different feedback mechanism in amplifier circuit.
- CO4.** Students will be able to analyze signal generator Circuit.
- CO5.** Student will be able to design power amplifier circuit.
- CO6.** Students will be able to understand linear and nonlinear applications of OPAMP (I.C-741).

**Course Content**

**Module – 1: Filters and Regulators** **[4L]**

Capacitor filter,  $\pi$ -section filter, ripple factor, series and shunt voltage regulator, line and load regulation, 78xx and 79xx series, concept of SMPS.

**Module – 2: Transistor Biasing and Stability** **[5L]**

Biasing technique, Q-point & its Stability, Self Bias-CE configuration, Bias Compensation techniques, h-parameter model of transistors, Expression for voltage gain, current gain, input and output impedance, power gain, Emitter follower circuit.

**Module – 3: Transistor Amplifier** **[5L]**

Different coupling techniques, RC coupled amplifier, functions of all components, derivation of voltage gain, current gain, input impedance and output impedance, High frequency model of transistors (hybrid- $\pi$  model), frequency response characteristics, Expression for lower and upper half frequencies, bandwidth, and concept of wide band amplifier.

**Module – 4: Feedback Amplifiers & Oscillators** **[5L]**

Feedback concept, negative & positive feedback, Voltage/Current & Series/Shunt Feedback Barkhausen criterion, RC Oscillators-Phase shift and Wein bridge oscillators, LC Oscillator-Colpitts, Hartley's and crystal oscillators.

**Module – 5: Operational Amplifier** **[4L]**

Ideal OPAMP, Differential amplifier, Constant current source (Current mirror etc), Level shifter, CMRR, Open & closed loop circuits, importance of feedback loop (positive & negative), inverting & non-inverting amplifiers, Voltage follower/Buffer circuits.

**Module – 6: Application of Operational amplifiers** **[5L]**

Adder & subtractor circuit, practical integrator & differentiator circuit, Instrumentation Amplifier,

Log & Anti-log amplifiers, multipliers, Precision Rectifier, Comparator & Schmitt Trigger, Voltage to current & Current to voltage converter.

**Module – 7: Power amplifiers** [3L]

Class A, B, AB, C, Conversion efficiency, Tuned amplifier.

**Module – 8: Multivibrators** [3L]

Astable, Monostable, Bistable multivibrators; Astable and Monostable operation using 555 timer.

**Module – 9: Special Function Circuits** [2L]

VCO, PLL.

**Text Books:**

1. Boylested & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI.
2. Gayakwad R.A -OpAmps and Linear IC's, PHI.
3. Sedra & Smith-Microelectronic Circuits- Oxford UP.
4. D. Roy Choudhury & B. Jain-Linear Integrated circuits, New Age Science Limited.
5. Franco-Design with Operational Amplifiers & Analog Integrated Circuits, 3/e, McGraw Hill.
6. J.B.Gupta- Electronic Devices and circuits, S.K. KATARIA & SONS.

**Reference Books:**

1. Millman & Halkias- Integrated Electronics, McGraw Hill.
2. Rashid-Microelectronic Circuits-Analysis and Design- Thomson (Cenage Learning)
3. Schilling & Belove-Electronic Circuit: Discrete & Integrated , 3/e , McGraw Hill
4. Razavi- Fundamentals of Microelectronic s- Wiley
5. Malvino-Electronic Principles , 6/e , McGraw Hill
6. Horowitz & Hill- The Art of Electronics; Cambridge University Press.
7. Bell- Operational Amplifiers and Linear ICs- Oxford UP
8. Tobey & Grame-Operational Amplifier: Design and Applications, Mc GrawHill.
9. Coughlin and Driscoll-Operational Amplifier and Linear Integrated Circuits – Pearson Education

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	2	-	3	-	-	3
CO2	3	3	3	3	2	-	2	-	3	-	-	3
CO3	3	3	3	3	2	-	2	-	3	-	-	3
CO4	3	3	3	3	2	-	2	-	3	-	-	3
CO5	3	3	3	3	2	-	2	-	3	-	-	3
CO6	3	3	3	3	2	-	2	-	3	-	-	3

**Course Name: Mathematics – III**  
**Course Code: M(EE) 301**  
**Contact: 3L:1T:0P**  
**Total Contact Hours: 48**  
**Credit:4**

**Prerequisites:** The students to whom this course will be offered must have the concept of (10+2) standard calculus, basic probability and differential equations.

**Course Outcome:** On successful completion of the learning sessions of the course, the learner will be able to:

- CO1.** Recall the underlying principle and properties numerical analysis, Statistics, partial differential equation and ordinary differential equation.
- CO2.** Exemplify the variables, functions and differential equations and find their distinctive measures using the underlying concept partial differential equation and ordinary differential equation, numerical methods and statistics.
- CO3.** Apply numerical methods used to obtain approximate solutions to intractable mathematical problems.
- CO4.** Solve partial differential equation using method of separation of variables and ordinary differential equation using techniques of series solution and special function (Legendre's and Bessel's).
- CO5.** Interpret complex statistical findings using the understanding of inferential statistics.

### Course Content

**MODULE I: Interpolation (8 Lectures)**  
 Difference Operators (Only Definition): Forward and Backward, Shift Operator, Newton forward interpolation, Newton backward interpolation, Lagrange's Interpolation.

**MODULE II: Numerical Solution of Linear and Non-linear Equations (6 Lectures)**  
**Numerical Solution of a System of Linear Equations:** Gauss elimination method, LU Factorization method, Gauss-Seidel iterative method.  
**Solution of Polynomial and Transcendental Equations:** Bisection method, Regula-Falsi, Newton-Raphson method.

**MODULE III: Numerical Integration and Numerical Solution of Differential Equation (10 Lectures)**

**Numerical Integration:** Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms.

**Numerical Solution of Ordinary Differential Equation:** Taylor series method, Euler's method, Euler's modified method, fourth order Runge-Kutta method and Milne's Predictor-Corrector methods.

**Numerical solution of partial differential equation:** Finite Difference method, Crank-Nicolson method.

**MODULE IV: Statistics (12 Lectures)**  
**Basic Statistics:** Basic statistics, measure of central tendency, mean, median, mode, dispersion, correlation coefficient and regression.

**Sampling theory:** Random sampling. Statistic and its Sampling distribution. Sampling distribution of sample mean and variance in random sampling from a normal distribution (statement only) and related problems.

**Estimation of parameters:** Unbiased and consistent estimators. Interval estimation. Maximum likelihood estimation of parameters (Binomial, Poisson). Confidence intervals and related problems

**MODULE V: Partial Differential Equation (PDE) and Series Solution of Ordinary Differential Equation (ODE) (12 Lectures)**

**Solution of PDE:** Method of Separation of Variables.

**Solution of Initial Value & Boundary Value Problem:** One Dimensional Wave Equation, One Dimensional Heat Equation, Two Dimensional Laplace Equation.

**Series solution of ODE:** General method to solve  $P_0 y'' + P_1 y' + P_2 y = 0$  and related problems to Power series method, Bessel's Function, Legendre Polynomial.

**Text Books:**

1. Jain, M. K., Iyengar, S. R. K. and Jain, R. K. *Numerical Methods (Problems and Solution)*. New age International Publisher.
2. Das, N.G. *Probability and Statistics*; The McGraw Hill Companies.
3. Gupta, S. C. and Kapoor, V. K. *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons.
4. Raisinghania, M .D. *Advanced Ordinary & Partial Differential. Equation*; S. Chand Publication.
5. Ross, S. L. *Differential Equations*, John Willey & Sons.
6. Grewal, B. S. *Higher Engineering Mathematics*, Khanna Pub.
7. Kreyszig, E. *Advanced Engineering Mathematics*, John Wiley & Sons, 2006.

**Reference Books:**

1. Lipschutz & Lipson, *Schaum's Outline in Probability (2ndEd)*, McGraw Hill Education.
2. Shastri, S. S. *Numerical Analysis*, PHI.
3. Mollah, S. A. *Numerical Analysis*, New Central Book Agency Spiegel,
4. M. R. *Theory and Problems of Probability and Statistics (Schaum's Outline Series)*, McGraw Hill Book Co.
5. Goon, A.M., Gupta M .K. and Dasgupta, B. *Fundamental of Statistics*, The World Press Pvt. Ltd.
6. Soong, T. T. *Fundamentals of Probability and Statistics for Engineers*, John Wiley & Sons Inc, 2004.
7. Delampady, M. *Probability & Statistics*, Universities Press.
8. Sneddon, I. N. *Elements of Partial Differential Equations*, McGraw Hill Book Co.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	2	2	-	-	-	-	-	-	-	-	1
CO5	3	3	2	3	-	-	-	-	-	-	-	1

**Course Name: Electrical Circuit Analysis Laboratory**

**Course Code: EE 391**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Concepts of Basic Electrical Engineering

**Course Outcome:** On successful completion of the learning sessions of the course, the learner will be able to:

- CO1.** Demonstrate transient analysis of electric circuits frequency response characteristics of Filter circuits.
- CO2.** Analyze electric circuits, signals and algorithms using mathematical tools

**List of Experiment:**

1. Familiarization with various MATLAB commands used in Electrical Engineering
2. Transient response of R-L and R-C network: simulation with PSPICE / MATLAB / Hardware
3. Transient response of R-L-C series and parallel circuit: Simulation with PSPICE / MATLAB / Hardware
4. Study the effect of inductance on step response of series RL circuit in MATLAB / HARDWARE.
5. Determination of Impedance (Z) and Admittance (Y) parameter of two port network: Simulation / Hardware.
6. Frequency response of LP and HP filters: Simulation / Hardware.
7. Frequency response of BP and BR filters: Simulation / Hardware.
8. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB in both discrete and analog form.
9. Amplitude and Phase spectrum analysis of different signals using MATLAB.
10. Verification of Network theorems using hardware components.
11. Innovative Experiments.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	1	3	-	-	-	1	1	-	-
CO2	2	-	2	1	3	--	-	-	1	1	-	-

**Course Name: Measurement and Instrumentation Laboratory**

**Course Code: EE 392**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Concepts of different measuring system.

**Course Outcome:** On successful completion of the learning sessions of the course, the learner will be able to:

- CO1.** Conduct experiment to measure of Resistance, Inductance, Capacitance, Power and Energy.

**List of Experiment:**

1. Measurement of power in polyphase circuit.
2. Measurement of power using instrument transformer.
3. Measurement of capacitance using Schering Bridge technique as well as LCR meter.
4. Calibration of Digital Energy Meter.
5. Testing of energy Meter
6. Measurement of capacitance using Anderson Bridge technique as well as LCR meter.
7. Measurement of low resistance using Kelvin Double bridge.
8. Measurement of high resistance and insulation resistance using Megger.
9. Usage of DSO to capture transient like step change in R-L-C circuit.
10. Current measurement using shunt, CT and Hall Sensor
11. Measurement of capacitance by De sauty bridge
12. Measurement of frequency by Wien Bridge.
13. Innovative Experiments.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	3	-	-	-	-	3	2	-	1

**Course Name: Analog Electronics Laboratory**

**Course Code: EE 393**

**Contact: 0L:0T:2P**

**Credit: 1**

**Prerequisites:** Knowledge in electrical circuits and electronic devices.

**Course Outcome:**

- CO1.** Able to understand, analyse the analog circuits pertaining to applications like amplifier, oscillators and timer.
- CO2.** Able to know how to interface digital circuits with ADC & DAC.
- CO3.** Able to understand the fundamental concepts and techniques used in digital electronics.
- CO4.** Able to understand and examine the structure of various number systems, De-Morgan's law, Boolean algebra and its application in digital design.
- CO5.** Able to understand, analyse the analog circuits pertaining to applications like amplifier, oscillators and timer.
- CO6.** Able to know how to interface digital circuits with ADC & DAC.

**List of Experiment:**

Any 8 Experiments has to be done

1. Design of voltage regulator circuit using zener diode.
2. Study of Switched Mode Power Supply & construction of a linear voltage regulator using regulator IC chip.
3. Design of RC coupled amplifier & study of it's gain & Bandwidth using BJT.
4. Design of RC Phase shift oscillator using BJT.
5. Design of wien bridge oscillator using BJT.
6. Study of class A & class B power amplifiers.
7. Design of Integrator using OPAMP IC 741
8. Design of Differentiator using OPAMP IC 741
9. Study of V to I and I-V converter using OPAMP IC 741
10. Design of Instrumentation Amplifier using OPAMP IC 741
11. Study of timer circuit using NE555 & configuration for monostable & astable multivibrator.
12. Study of voltage controlled oscillator.
13. Innovative Experiments.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	2	-	3	-	-	3
CO2	3	3	3	3	2	-	2	-	3	-	-	3
CO3	3	3	3	3	2	-	2	-	3	-	-	3
CO4	3	3	3	3	2	-	2	-	3	-	-	3
CO5	3	3	3	3	2	-	2	-	3	-	-	3
CO6	3	3	3	3	2	-	2	-	3	-	-	3

**Course Name: Environmental Science**

**Course Code: MC 301**

**Contact: 3:0:0**

**Pre requisites:** Basic knowledge of Chemistry

**Course Outcome:**

**CO1.** Student will be able

- To understand the natural environment and its relationships with human activities.
- To apply the fundamental knowledge of science and engineering to assess environmental and health risk.
- To develop guidelines and procedures for health and safety issues obeying the environmental laws and regulations.
- Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

**Course Contents**

- 1. General 6L**
  - 1.1. Natural Resources:** Forest Resource, water resource, mineral resource, energy resources: alternative source of energy
  - 1.2. Population Growth:** Exponential Growth, logistic growth, Maximum sustainable yield, demography
  - 1.3. Disaster Management:** Types of disasters (Natural & Man-made), Floods, Earthquake, Tsunamis, Cyclones, landslides (cause, effect & control)
  - 1.4. Ecology & Ecosystem:** Elements of ecology, definition of ecosystem- components types and function, Food chain & Food web, Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems
  - 1.5. Environmental Management:** Environmental impact assessment, Environmental laws and protection act of India( The Environment protection Act, Air pollution Act, Water Act, Wildlife Protection Act) , Hazardous waste(management and Handling) Rules.
  
- 2. Air pollution and control 6L**
  - 2.1. Sources of Pollutants:** point sources, nonpoint sources and manmade sources primary & secondary pollutant
  - 2.2. Types of air pollutants:** primary & secondary pollutant ; Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN, Smog (Photochemical smog and London smog),
  - 2.3. Effects on human health & climate:** Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion
  - 2.4. Air pollution and meteorology:** Ambient Lapse Rate, Adiabatic Lapse Rate, Atmospheric stability & Temperature inversion
  - 2.5. control of air pollution (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury)**
  
- 3. Water Pollution 6L**
  - 3.1. Classification of water (Ground & surface water)**
  - 3.2. Pollutants of water, their origin and effects:** Oxygen demanding wastes, pathogens, nutrients, Salts, heavy metals, pesticides, volatile organic compounds.
  - 3.3. Surface water quality parameters:** pH, DO, 5 day BOD test, BOD reaction rate constants,



COD. Numerical related to BOD

Lake: Eutrophication [Definition, source and effect].

- 3.4. Ground water:** Aquifers, hydraulic gradient, ground water flow (Definition only), ground water pollution (Arsenic & Fluoride; sources, effects, control)
- 3.5. Quality of Boiler fed water:** DO, hardness, alkalinity, TDS and Chloride
- 3.6. Layout of waste water treatment plant** (scheme only).

**4. Land Pollution** **2L**

- 4.1.** Types of Solid Waste: Municipal, industrial, commercial, agricultural, domestic, hazardous solid wastes (bio-medical), E-waste
- 4.2.** Solid waste disposal method: Open dumping, Land filling, incineration, composting, recycling (Advantages and disadvantages).
- 4.3.** Waste management: waste classification, waste segregation, treatment & disposal

**5. Noise Pollution** **2L**

- 5.1.** Definition of noise, effect of noise pollution on human health,
- 5.2.** Average Noise level of some common noise sources
- 5.3.** Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level,  $L_{10}$  (18 hr Index) .
- 5.4.** Noise pollution control.

**References Books:**

1. A Textbook of Environmental Studies, Shashi Chawla. Tata McGraw Hill Education Private Limited
2. Environmental Studies, Dr. J P Sharma, University Science Press
3. Environmental Engineering, J K Das Mohapatra, Vikas Publication

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	-	-	2	3	3	-	-	1	2

4th Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	BS	PH 401	Physics – II	3	0	0	3	3
2	PC	EE 401	Electrical Machines – I	3	0	0	3	3
3	PC	EE 402	Power Electronics	3	0	0	3	3
4	PC	EE 403	Digital Electronics	3	0	0	3	3
5	PC	EE 404	Electromagnetic Fields	2	0	0	2	2
6	HS	HU 401	Values and Ethics in Profession	2	0	0	2	2
<b>Total of Theory</b>							<b>16</b>	<b>16</b>
<b>B. PRACTICAL</b>								
7	BS	PH 491	Physics – II Laboratory	0	0	3	3	1.5
8	PC	EE 491	Electrical Machines – I Laboratory	0	0	3	3	1.5
9	PC	EE 492	Power Electronics Laboratory	0	0	3	3	1.5
10	PC	EE 493	Digital Electronics Laboratory	0	0	2	2	1
11	PROJ	PR 491	Project – IV	0	0	2	2	1
12	PROJ*	PR 492	Innovative Activities – III	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
13	MC	MC 481	Behavioural & Interpersonal Skills	0	0	3	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>32</b>	<b>23</b>

- \* Students may choose either to work on participation in all the activities of Institute's Innovation Council for e.g., IPR workshop / Leadership Talks / Idea / Design / Innovation / Business Completion / Technical Expos etc.

Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

**Course Name: Physics – II**

**Course Code: PH 401**

**Contact: 3L:0T:0P**

**Total Contact Hours: 40**

**Credit: 3**

**Prerequisites:** Knowledge of Physics up B.Tech 1st year Physics-I course

**Course Outcome:** After completion of this course student will be able to

- CO1.** Explain electron transport in metal-insulators and semiconductors using energy Band theory.
- CO2.** Apply Schrödinger equation in variety of atomic scale problems including nanomaterials.
- CO3.** Analyze the physics of various kinds of electric and magnetic materials
- CO4.** Justify the importance of Fermi energy level in turning electronic properties of various.

### Course Content

**Module 1: Electric and Magnetic properties of materials (10L)**

**Module 1.01: Insulating materials**

Dielectric Material: Concept of Polarization, the relation between **D**, **E** and **P**, Polarizability, Electronic (derivation of polarizability), Ionic, Orientation & Space charge polarization (no derivation), behavior of Dielectric under alternating field (qualitative discussion only), Dielectric losses, Local electric field at an atom: Lorentz field, Lorentz relation; Dielectric constant and polarizability – Clausius-Mossotti equation (with derivation); ferroelectric and piezoelectrics (Qualitative study). 5L

**Module 1.02: Magnetic materials and storage devices**

Magnetic Field & Magnetization **M**, relation between **B**, **H**, **M**. Bohr magneton, susceptibility, Diamagnetism- & Paramagnetism - Curie law (qualitative discussion), Ferromagnetism– Curie Temperature, Weiss molecular field theory (qualitative) & Curie-Weiss law, concept of  $\theta_p$ , Hysteresis, Hard ferromagnets, Comparison and applications of permanent magnets (storage devices) and Soft ferromagnets (Permalloys, Ferrites etc.) 5L

**Module 2: Quantum Mechanics – II (8L)**

Formulation of quantum mechanics and Basic postulates- superposition principle, orthogonality of wave function, expectation value; operator correspondence, Commutator. Measurements in Quantum Mechanics-Eigen value, Eigen function, Schrödinger's equation as energy eigen value equation. 4L

Application of Schrödinger equation – Particle in an infinite square well potential (1-D and 3-D potential well; Discussion on degenerate levels), 1D finite barrier problem and concept of quantum tunnelling (solve only  $E < V_0$ ). 4L

**Module 3: Statistical Mechanics (4L)**

Concept of energy levels and energy states, phasespace, microstates, macrostates and thermodynamic probability, MB, BE, FD, statistics (Qualitative discussions)- physical significance, conception of bosons, fermions, classical limits of quantum statistics, Fermi distribution at zero & non-zero temperature, Concept of Fermi level. 4L

**Module 4: Elements of solid state physics (6L)**

**Module 4.01: Free electron theory (qualitative) – Electronic conduction in solids**

Drude's theory, B Wiedemann Frantz Law, Idea of quantization of energy-Sommerfeld theory. 3L

**Module 4.02: Band theory of solids**

Bloch Theorem-statement only, Kronig-Penny model (qualitative treatment)- Energy-band (E-k) diagram, allowed and forbidden energy bands. 3L

**Module 5: Physics of Nanomaterials (4L)**

Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Quantum size effect and Quantum confinement. Carbon allotropes. Application of nanomaterials (CNT, grapheme, electronic, environment, medical). 4L

**Module 6: Nuclear energy as future energy (4L)**

Nuclear Binding Energy, Liquid drop model, Concept of Nuclear Fission, Nuclear Fusion & Energy output, Nuclear Reactor. 4L

**Books:**

1. Insulating Materials: Principles, Materials, Applications, Margit Pfundstein, Roland Gellert, Martin Spitzner & Alexander Rudolphi: Birkhauser Verlag AG; 1
2. High Voltage and Electrical Insulation Engineering, Ravindra Arora, Wolfgang Mosch: Online ISBN: 9780470947906 DOI: 10.1002/9780470947906 Series Editor(s): Mohamed E. El-Hawary
3. Physics-II, Sujay Kumar Bhattacharya and Soumen Pal, McGraw Hill Education Private Limited
4. Advanced Engineering Physics, S. P. Kuila, New Central Book Agency (P) Ltd.
5. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
6. Quantum Mechanics- Bagde Singh (S. Chand Publishers)
7. Principles of Engineering Physics Vol 1 and Vol 2; by Md. N. Khan and S. Panigrahi, Pub: Cambridge Univ. press
8. Advanced Quantum Mechanics-J. J. Sakurai (TMH)
9. Quantum Computation and Quantum Information(10th Anniversary Edition)- Nielsen & Chuang (Cambridge University Press)
10. Fundamental of Statistical Mechanics: B Laud
11. Introduction to statistical mechanics : .Pathria
12. Fundamental of Statistical and Thermal Physics: F. Reif Advanced Engineering Physics-S. P. Kuila New Central Book Agency (P)Ltd.
13. Electricity and Magnetism (In SI Units): Berkeley Physics Course - Vol.2, Edward M Purcell
14. Introduction to Electrodynamics-Griffiths David J.
15. The Feynman Lectures on Physics. 2 (2nd ed.), Feynman, Richard P Addison-Wesley. ISBN 978-0-8053-9065-0
16. Solid State Physics, A. J. Dekker, McMillan
17. Nanostructure and Nanomaterials, B.K. Parthasarathy
18. Introduction to Nanotechnology, B.K. Parthasarathy
19. Essentials of Nanotechnology, Rishabh Anand
20. Nanomaterials Handbook (Advanced Materials and Technologies)-YuryGogotsi (Editor) 1. Nuclear Physics, Irvin Keplan
21. Nuclear Physics, J. Pearson, University of Manchester, 2008
22. Nuclear and Particle Physics, Jenny Thomas - University College London, 2000.
23. Solid State Physics, S.O. Pillai.

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	1	-	-	-	-	-	-	-	-	-	1
<b>CO2</b>	3	2	-	-	-	-	-	-	-	-	-	2
<b>CO3</b>	2	3	-	-	-	-	-	-	-	-	-	1
<b>CO4</b>	1	2	2	3	-	-	-	-	-	-	-	1

**Course Name: Electrical Machines - I**

**Course Code: EE 401**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:** Knowledge of Physics up to B. Tech. 1<sup>st</sup> year Physics-I course.

**Course Outcome:**

- CO1.** Understand the operation of Transformers, D.C. Machines, Three-Phase Induction Motor.
- CO2.** Analyze the equivalent circuit of Transformers, D.C. Machines, Three-Phase Induction Motor.
- CO3.** Conduct different tests on Transformers, D.C. Machines, Three-Phase Induction Motor.

**Course Content**

<b>MODULE – I:           General Introduction to Electrical Machines</b>	<b>(3L)</b>
Faraday’s laws of electromagnetic induction, Fleming’s rule and Lenz’s Law.	1L
Concept of Electrical and Mechanical degree.	2L
<b>MODULE – II:        D.C. Machine</b>	<b>(9L)</b>
EMF generation in armature, Characteristics of D.C. Machines.	1L
Methods of building up of e.m.f., Significance of Critical resistance and Critical speed.	1L
Armature reaction and its effect, Function of Interpole and Compensating winding.	2L
Commutation method, Concept of reactance voltage.	1L
Power flow diagram, Losses and efficiency, Solution of problems.	1L
Testing of D.C. machines – Hopkinson’s, Swinburne’s test, Brake test (Tests specified as per standards).	1L
Starting and Speed Control of D.C. Motors.	2L
<b>MODULE – III:       Single-Phase Transformers</b>	<b>(5L)</b>
Core construction and different parts of transformer and their function, Materials used for core, winding and insulation, Transformer oil, Different types of cooling methods (in brief), Name plate rating.	1L
Equivalent circuit and per unit representation and its importance, Regulation, Efficiency and All day efficiency, Solution of problems.	2L
Single-phase Auto transformer – Comparison of weight, copper loss with 2-winding transformer.	1L
Sumpner Test, Applications of 2-winding transformer and Auto transformer.	1L
<b>MODULE – IV:       Three-Phase Transformers</b>	<b>(9L)</b>
Types of three-phase transformer. Construction and Different types of windings.	1L
Polarity of transformer, Vector groups for various connections.	1L
Parallel operation and load sharing, Solution of problems.	2L
Effect of unbalanced loading and neutral shifting, Tertiary windings.	1L
Scott-connected transformer and open-delta connection – working principle, connection diagram, practical application.	1L
Tap-changing methods, Tap changers – Off load and On-load type.	1L
Special Transformer: Pulse transformer, Grounding transformer.	1L
Testing of Three-phase Transformers.	1L

**MODULE – V: Three-Phase Induction Motor (10L)**

Induction motor as a transformer, Concept of rotating magnetic field, Power stages in 3-phase induction motor and their relation, power-slip characteristics. 3L

Determination of equivalent circuit parameters, Separation of losses, Efficiency, Solution of problems. 2L

Concept of Deep bar and Double cage rotor. 1L

Starting and speed control of three phase induction motor. 1L

Space harmonics: Crawling and Cogging, Brief idea of braking of induction motor. 2L

Testing and Industrial applications of 3-phase induction motor. 1L

**Text Books:**

1. Electrical Machinery, P.S. Bhimra, 6th Edition, Khanna Publishers.
2. Electric machines, D.P. Kothari & I.J Nagrath, 3<sup>rd</sup> Edition, Tata Mc Graw-Hill Publishing Company Limited.
3. Electrical Machines, P.K. Mukherjee & S. Chakrabarty, Dhanpat Rai Publication.

**Reference Books:**

1. Electric Machinery & Transformers, Bhag S. Guru and H.R. Hiziroglu, 3<sup>rd</sup> 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.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	2	-	-	2	3	3
CO2	3	3	3	3	3		-	-	2	-	3	3
CO3	3	1	2	-	-	3	-	1	2	-	3	3

**Course Name: Power Electronics**  
**Course Code: EE 402**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credit: 3**

**Prerequisites:** Concept of Basic Electronics, Electrical Circuit Analysis, Analog Electronics.

**Course Outcome:** On successful completion of the learning sessions of the course, student will be able to:

- CO1.** Demonstrate the characteristics of different power electronic switches along with their turn-on, turn-off, triggering and protection circuits.
- CO2.** Analyse various power converter circuits.
- CO3.** Understand the use of power converters in commercial and industrial applications.

### Course Content

- MODULE I: Power Electronic Switching Devices 8L**  
 Advances in Power Electronics Power Semiconductor Switches: Rectifier diodes, fast recovery diodes, Schottky barrier diode, BJT, Power MOSFET, SCR, TRIAC, IGBT, IGCT and GTO. Ratings, Static and Dynamic Characteristics, triggering and switching characteristics and cooling. SCR turn-on and turn-off methods, Triggering circuits, SCR Commutation circuits, SCR Series and Parallel operation, Snubber Circuit.
- MODULE II: Uncontrolled and Controlled Rectifiers 6L**  
 Single-Phase and Three-Phase Uncontrolled rectifiers.  
 Phase controlled Rectifiers: Principle of operation of single phase and three phase semi-controlled, full controlled converters with R, R-L and RLE loads. Effects of source inductance on the performance of converters. Performance parameters of converters, Dual converters, Solution of problems.
- MODULE III: DC-DC Converters 5L**  
 Principle of operation, control strategies, Step up and Step down choppers, Buck, Boost, Buck - Boost and Cuk Converters, Concept of Resonant Switching.
- MODULE IV: Inverters 10L**  
 Inverters: Principle of operation of single phase inverter, 120° and 180° conduction mode of operation of three phase inverter, performance parameters of inverters, PWM techniques, Sinusoidal PWM, modified Sinusoidal PWM - multiple PWM Voltage and harmonic Control, introduction to Space vector modulation method, Series resonant inverter-Current Sources Inverter.
- MODULE V: Cycloconverters and AC Voltage Regulators 5L**  
 AC Voltage Controllers, Single phase and three phase Cycloconverters, Concept of Matrix Converter.
- MODULE VI: Applications 2L**  
 UPS (Online and Offline), SMPS, Battery Chargers.

**Text Books:**

1. L. Umanand, Power Electronics: Essentials and Applications.
2. M. H. Rashid, Power Electronics, PHI/ Pearson Education.
3. P. S. Bhimra, Power Electronics, Khanna Publications.



## 4. K. Hari Babu: Power Electronics

**Reference Books:**

1. C.W. Lander, Power Electronics, McGraw Hill.
2. B. K. Bose, Modern Power Electronics, JAICO.
3. Mohan, N Undeland, TM & Robbins, WP- Power Electronics, John Wiley & Sons.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-
CO3	2	-	2	2	1	-	-	-	-	-	-	-

**Course Name: Digital Electronics**  
**Course Code: EE 403**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credit: 3**

**Prerequisites:** Knowledge of Basic Electronics and Mathematics.

**Course Outcome:** The students will be able to:

- CO1.** Acquired knowledge about solving problems related to number systems conversions and Boolean algebra and design logic circuits using logic gates to their simplest forms using De Morgan's Theorems; Karnaugh Maps.
- CO2.** Design of combinational circuits
- CO3.** Design of various synchronous and asynchronous sequential circuits using State Diagrams & Tables.
- CO4.** Understand DAC & ADC technique and corresponding circuits
- CO5.** Analyze logic family interfaces, switching circuits & memory storage devices to Plan and execute projects.

### Course Content

**Module 1:**

**11L**

Binary, Octal and Hexadecimal number system representation and their conversions; BCD, Gray codes and their conversions. Signed binary number representation with 1's, 2's, 9's and 10's complement methods, Binary arithmetic.

Boolean algebra; Various Logic gates- their truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method.

**Module 2:**

**10L**

Combinational circuits- Half Adder, Full Adder, Serial & Parallel Adder, BCD Adder, Half Subtractor, Full Subtractor circuits, Adder-Subtractor Circuit. Encoder, Decoder, Multiplexer, De Multiplexer, Adder & Subtractor Design using decoder & multiplexer, Comparator and Parity Generator-Checker.

**Module 3:**

**10L**

Sequential Circuits- latch & Flip Flops-S-R, J-K, D and T, Conversion of Flip Flops, Various types of Shift Registers-SISO, SIPO, PISO, PIPO, Bidirectional & Universal Shift. Counters-Synchronous, Asynchronous, Ring & Johnson Counter.

**Module 4:**

**5L**

Parameters of D/A & A/D Converters. Different types of A/D -Flash Type, Successive Approximation and Dual Slope and D/A -R-2R Ladder. Logic families- TTL, ECL, MOS and CMOS, their operation and specifications. TTL Equivalent Circuit.

**Text Books:**

1. A. Anand Kumar, Fundamentals of Digital Circuits-PHI
2. Morris Mano- Digital Logic Design- PHI
3. S. Salivahanan & S.Arivazhagan, Digital Circuit & Design- Bikas Publishing
4. A. K. Maini- Digital Electronics- Wiley-India

**Reference Books:**

1. Floyd & Jain- Digital Fundamentals-Pearson.

2. R.P.Jain—Modern Digital Electronics, 2/e , Mc Graw Hill
3. H.Taub & D.Shilling, Digital Integrated Electronics- Mc Graw Hill.
4. D.Ray Chaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers
5. Kharate- Digital Electronics- Oxford
6. Tocci, Widmer, Moss- Digital Systems, 9/e- Pearson

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	3	3	1	3	1	1	1	1	1	1	3
<b>CO2</b>	3	3	3	1	3	1	1	1	1	1	1	3
<b>CO3</b>	3	3	3	3	3	2	2	1	1	1	2	3
<b>CO4</b>	3	3	3	3	3	2	2	1	1	2	1	3
<b>CO5</b>	3	3	3	3	3	1	2	1	2	2	2	3

**Course Name: Electromagnetic Fields**

**Course Code: EE 404**

**Contact: 2L:0T:0P**

**Total Contact Hours: 24**

**Credit: 2**

**Prerequisites:** Concept of mathematics, physics and basic electrical engineering.

**Course Outcome:**

- CO1.** Know the orthogonal co-ordinates and their transformation to solve & analyze problems on vector calculus.
- CO2.** Know the basic laws of electrostatics and electromagnetism and define associated terms.
- CO3.** Understand Maxwell's equation in different forms.
- CO4.** Understand the propagation of EM waves associated with different Electrical Networks.

**Course Content**

**Module 1: Co-ordinate systems 3L**  
Cartesian coordinates, Circular cylindrical coordinates, Spherical coordinates and their transformation. Differential length, area and volume in different coordinate systems. Solution of problems.

**Module 2: Introduction to Vector calculus 3L**  
DEL operator, Gradient of a scalar, Divergence of a vector and Divergence theorem, Curl of a Vector and Strokes theorem, Solution of problems.

**Module 3: Electrostatic field 5L**  
Coulomb's law, field intensity, Gauss's law, Electric potential and potential gradient, Relation between E and V, Concept of Electric dipole, flux lines and Energy density in electrostatic field. Boundary conditions: Dielectric-dielectric, Conductor–dielectric, Conductor-free space. Poisson's and Laplace's equation, Solution of problems.

**Module 4: Magneto static fields 5L**  
Biot-savart's law, Ampere's circuit law, Magnetic flux density, Magnetic static and Vector potential, Forces due to magnetic field, Magnetic torque and moments, Magnetization in material, Magnetic boundary condition, Concept of Magnetic energy, Magnetostriction, Solution of problems.

**Module 5: Electromagnetic fields 3L**  
Faraday's law, Transformer and motional emf, Displacement current, Maxwell's equations, Solution of problems.

**Module 6: Electromagnetic wave propagation 5L**  
Wave equation, Wave equation in conducting medium, Wave propagation in lossy dielectric, Plane waves in loss less dielectric, Plane wave in free space, Plane wave in good and dielectric conductor, Skin effect, Skin depth, Power and Poynting vector. Solution of problems.

**Text Books:**

1. Quantum Field Theory, Lewis H. Ryder, 2<sup>nd</sup> Edition, Cambridge University Press.

2. Elements of Electromagnetic, Mathew N.O. Sadiku, 4<sup>th</sup> edition, Oxford University press.
3. Engineering Electromagnetic, W.H. Hyat & J.A. Buck, 7<sup>th</sup> Edition, TMH
4. Theory and problems of Electromagnetic, Edminister, 2<sup>nd</sup> Edition, TMH
5. Electromagnetic field theory fundamentals, Guru & Hizroglu, 2<sup>nd</sup> edition, Cambridge University Press.
6. Elements of Electromagnetic Fields, S.P. Seth, Dhanpat Rai & Sons.

**Reference Books:**

1. Electromagnetic with application, Krause, 5<sup>th</sup> Edition, TMH.
2. Elements of Engineering Electromagnetic, N.N. Rao, 6<sup>th</sup> Edition, Pearson Education.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-

**Course Name: Values and Ethics in Profession**  
**Course Code: HU 401**  
**Contact: 2L:0T:0P**  
**Total Contact Hours: 24**  
**Credit: 2**

**Prerequisites:** Basic knowledge of engineering and management.

**Course Outcome:** On Completion of this course student will be able to

- CO1.** Understand the core values that shape the ethical behavior of an engineer and Exposed awareness on professional ethics and human values.
- CO2.** Understand the basic perception of profession, professional ethics, various moral issues
- CO3.** Understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field
- CO4.** Aware of responsibilities of an engineer for safety and risk benefit analysis, professional rights and responsibilities of an engineer.
- CO5.** Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.

### **Course Content**

- Module 1: Introduction** **4L**  
 Definition, Relevance, Types of values, changing concepts of values, Concept of Morals and Ethics, Work ethic – Service learning – Civic virtue, Stress Management -Concept of stress, causes and consequences, managing stress.
- Module 2: Theories of Self Development** **4L**  
 Emotional Intelligence (EI): Concept, Importance and Measurement, Concept of Motivation, Maslow's theory, Kohlberg's theory.
- Module 3: Moral and Ethical Concerns** **4L**  
 Variety of Moral Issues, Moral Dilemmas, Nature of values, Value Crisis in contemporary society, Value Spectrum of a good life, Steven Covey's Pursuit of Excellence
- Module 4: Engineering Ethics** **4L**  
 Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals, Social and ethical responsibilities of Technologists, Codes of professional ethics, Ethical and Unethical practices – case studies, Whistle blowing and beyond, Case studies.
- Module 5: Technology and Sustainable Development** **8L**  
 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, Environmental Regulations, Environmental Ethics and appropriate Technology, Movement of Schumacher, Problems of Technology transfer, Technology assessment impact analysis, Human Operator in Engineering projects and industries, Problems of man, machine, interaction, Impact of assembly line and automation.

**Text / Reference Books:**

1. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2<sup>nd</sup> Ed)
2. Deborah Johnson: Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.
3. A N Tripathi: Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.
4. S. K. Chakraborty: Values and Ethics in Organization, OUP
5. Caroline Whitbeck: Ethics in Engineering Practice and Research, Cambridge University Press.
6. Jaysree Suresh and B.S Raghavan: Human values and Professional Ethics, S. Chand Publication

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-		-	-	-	1	1	1	1	2	-	-
CO2	-	-	-	-	-	1	1	3	1	2	-	-
CO3	-	-	-	-	-	3	2	3	-	1	-	-
CO4	-	-	-	-	-	3	2	1	-	-	-	-
CO5	-	-	-	-	-	3	2	2	-	1	3	-

**Course Name: Physics – II Laboratory**  
**Course Code: PH 491**  
**Contact: 0L:0T:3P**  
**Credit: 1.5**

**Prerequisites:** Knowledge of Physics up B. Tech. 1<sup>st</sup> year Physics-I course.

**Course Outcome:** At the end of the course students' will be able to

- CO1.** Demonstrate experiments allied to their theoretical concepts
- CO2.** Conduct experiments using semiconductors , dielectric and ferroelectrics
- CO3.** Classify various types of magnetic materials.
- CO4.** Participate as an individual, and as a member or leader in groups in laboratory sessions actively.
- CO5.** Analyze experimental data from graphical representations, and to communicate effectively them in laboratory reports including innovative experiments.

**List of Experiment:**

**Experiments on Module 1: Electric and Magnetic properties of materials (8L)**

1. Study of dipolar magnetic field behavior using deflection magnetometer.
2. Study of hysteresis curve of a ferromagnetic material using CRO.
3. Use of paramagnetic resonance and determination of Lande-g factor using ESR setup.
4. Measurement of Curie temperature of the given sample.
5. Determination of dielectric constant of given sample (frequency dependent) / Measurement of losses in a dielectric using LCR circuits.

**Experiments on Module 2: Quantum Mechanics-II (6L)**

6. Determination of Stefan's radiation constant.
7. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells & measurement of maximum workable power.
8. Measurement of specific charge of electron using CRT.

**Experiments on Module 4: Solid state physics (9L)**

9. Determination of band gap of a semiconductor using four probe method.
10. Determination of Hall co-efficient of a semiconductor and measurement of magnetoresistance of a given semiconductor
11. Study of I-V characteristics of a LED.
12. Study of Intensity-Resistance characteristics of a LDR.

**\*\*In addition to regular 7 experiments it is **recommended** that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.**

**Probable experiments beyond the syllabus:**

1. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method.
2. Determination of thermal conductivity of a good conductor by Searle's mothod.
3. Study of transducer property: Determination of the thermo-electric power at a certain temperature of the given thermocouple.
4. Innovative Experiments.



**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	2	-	-	-	-	-	-	-	-	-	-	1
<b>CO2</b>	2	1	-	3	-	-	-	-	-	-	-	-
<b>CO3</b>	-	-	2	-	-	-	-	-	-	-	-	1
<b>CO4</b>	-	-	-	-	-	-	-	-	3	-	-	-
<b>CO5</b>	-	-	-	-	-	-	-	-	-	1	-	-

**Course Name: Electrical Machines – I Laboratory**

**Course Code: EE 491**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Concept of Basic Electrical Engineering Laboratory, Electrical Measurement Laboratory.

**Course Outcomes:** After successful completion of this course, student will be able to

**CO1.** Conduct different tests on Transformers, D.C. Machines, Three-Phase Induction Motor.

**CO2.** Analyze the characteristics of Transformers, D.C. Machines, Three-Phase Induction Motor.

**List of Experiment (At least *ten* experiments to be performed):**

1. Heat-run test of a single-phase transformer.
2. Regulation and Efficiency of single-phase transformer by direct loading method.
3. Parallel operation of two single-phase transformer and find out the load sharing between them.
4. Efficiency of a single-phase transformer by Back-to-Back test.
5. Polarity test and vector grouping of a three-phase transformer.
6. Swinburne test of a D.C. shunt motor.
7. Brake test of D.C. series motor.
8. Voltage build-up of a D.C. shunt generator and find out critical resistance and critical speed.
9. Circle diagram of a three-phase Induction Motor.
10. Speed control of three-phase Induction Motor by V/f constant.
11. Separation of losses in three-phase Induction Motor.
12. Load test of a three-phase wound rotor Induction Motor.
13. Innovative Experiments.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	3	-	-	-	-	3	2	-	1
CO2	2	-	-	3	-	-	-	-	3	2	-	1

**Course Name: Power Electronics Laboratory**  
**Course Code: EE 492**  
**Contact: 0L:0T:3P**  
**Credit: 1.5**

**Prerequisites:** Concept of Basic Electronics, Electrical Circuit Analysis, Analog Electronics.

**Course Outcomes:** After successful completion of this course, student will be able to

- CO1.** The skill to analyze the response of any power electronics devices.
- CO2.** The ability to troubleshoot the operation of a power electronics circuit.
- CO3.** The ability to select suitable power electronic devices for a given application.
- CO4.** The ability to know how to control and convert output signal as per requirements.
- CO5.** The ability to construct any power electronics circuits as needed in operation.

**List of Experiment (At least *ten* experiments to be performed):**

1. Study of the characteristics of an SCR.
2. Study of the characteristics of a TRIAC
3. Study of different triggering circuits of an SCR.
4. Study of the operation of a single phase full controlled bridge converter with R and R-L load.
5. Study of performance of single phase half controlled symmetrical and asymmetrical bridge converters.
6. Study the performance of step down chopper.
7. Study the performance of step up chopper.
8. Study the performance of single-phase inverter with 180° conduction mode of operation.
9. Study the performance of SPWM controlled single-phase inverter.
10. Study of performance of single phase controlled converter with and without source inductance (Simulation).
11. Study of performance of step up and step down chopper with MOSFET, IGBT and GTO as switch (simulation).
12. Study of performance of single phase half controlled symmetrical and asymmetrical bridge converter (Simulation).
13. Study of performance of three phase controlled converter with R & R-L load (simulation).
14. Innovative Experiments.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	-	-	1	-	-	-	-	-	-	-	-
<b>CO2</b>	-	1	-	2	-	-	-	-	-	-	-	-
<b>CO3</b>	2	1	-	2	-	-	-	-	1	-	-	-
<b>CO4</b>	2	-	-	2	-	-	-	-	1	-	-	-
<b>CO5</b>	2	1	-	2	-	-	-	-	-	-	-	-

**Course Name: Digital Electronics Laboratory**  
**Course Code: EE 493**  
**Contact: 0L:0T:2P**  
**Credit: 1**

**Prerequisites:** Knowledge of Basic Electronics and Mathematics.

**Course Outcomes:**

- CO1.** Able to understand the fundamental concepts and techniques used in digital electronics.
- CO2.** Able to understand and examine the structure of various number systems, De-Morgan's law, Boolean algebra and its application in digital design.
- CO3.** Able to understand, analyse the timing properties (input setup and hold times, minimum clock period, output propagation delays) and design various combinational and sequential circuits using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power.
- CO4.** Able to understand different digital circuits using Programmable Logic Devices.
- CO5.** Able to know how to interface digital circuits with ADC & DAC.

**List of Experiment:**

1. Realization of basic gates using Universal logic gates.
2. Realization of logic gates using TTL.
3. Design the circuit of Grey to Binary and vice versa.
4. Design a circuit for BCD to 7-segment display.
5. Four-bit parity generator and comparator circuits.
6. Construction of simple Encoder & Decoder circuits using logic gates.
7. Construction of simple Multiplexer & De Multiplexer circuits using logic gates.
8. Design of Half Adder & Full Adder Circuit using Logic Gates.
9. Design Half Subtractor & Full Subtractor Circuit using Logic Gates.
10. Realization of RS, D, JK and T flip-flops using logic gates.
11. Realization of Register using flip-flops and logic gates.
12. Realization of Up/Down counters.
13. One Innovative design of Digital Circuits.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3	1	3	1	1	1	-	-	1	3
<b>CO2</b>	3	3	3	1	3	1	1	-	1	1	1	3
<b>CO3</b>	3	3	3	3	3	2	2	1	-	1	2	3
<b>CO4</b>	3	3	3	3	3	2	2	1	-	2	1	3
<b>CO5</b>	3	3	3	3	3	1	2	1	2	2	2	3

**Course Name: Behavioral & Interpersonal Skills**

**Course Code: MC 481**

**Contact: 0:0:3**

**Course Outcome:**

- CO1.** It will equip the student to handle workplace interpersonal communication in an effective manner.
- CO2.** To enable students with strong oral and written interpersonal communication skills.
- CO3.** To prepare students to critically analyze workplace situations and take appropriate decisions.
- CO4.** To make students campus ready through proper behavioral and interpersonal grooming.
- CO5.** Integration of enhanced skill set to design and frame team based Project Report and Presentation.

**MODULE I – INTERPERSONAL COMMUNICATON**

- 1. The skills of Interpersonal Communication.
- 2. Gender/Culture Neutrality.
- 3. Rate of Speech, Pausing, Pitch Variation and Tone.
- 4. Corporate Communication.
- 5. Branding and Identity.

**MODULE II- INTERPERSONAL COMMUNICATION BASED ON WORKPLACE COMMUNICATION**

- 6. Workplace Communication.
- 7. Modes of Communication (Telephone, Conference Call, Team Huddle, Public Relation etc.)
- 8. Communication with Clients, Customers, Suppliers etc.
- 9. Organizing/Participating in Business Meeting.
- 10. Note Taking.
- 11. Agenda.
- 12. Minutes.

**MODULE III – BUSINESS ETIQUETTE AND CORPORATE LIFE**

- 13. Presenting oneself in the Business Environment.
- 14. Corporate Dressing and Mannerism.
- 15. Table Etiquette (Corporate Acculturation, Office parties, Client/Customer invitations etc.)
- 16. E-mail Etiquette.
- 17. Activity based Case Study.

**MODULE IV – MOVIE MAKING: CORPORATE BUSINESS MEETING**

- 18. Team based Brainstorming.
- 19. Process Planning and Developing Plot.
- 20. People management.
- 21. Documentation and Scripting.
- 22. Shooting the Movie: Location and Camera.
- 23. Post Production and Editing.
- 24. Movie Review: Feedback and Analysis

**List of Reference:**

- 1. Interpersonal Communication, Peter Hartley, Routledge, 1993.

2. Workplace Vagabonds: Career and Community in Changing Worlds of Work, Christina Garsten, Palgrave Macmillan, 2008.
3. Transnational Business Cultures Life and Work in a Multinational Corporation, Fiona Moore, Ashgate, 2005.
4. Global Business Etiquette: A Guide to International Communication and Customs, Jeanette S. Martin and Lillian H. Chaney, Praeger Publishers, 2006.
5. Making Teams Work: 24 Lessons for Working Together Successfully, Michael Maginn, McGraw-Hill, 2004.
6. Corporate Communications: Convention, Complexity, and Critique, Lars Thøger Christensen, Mette Morsing and George Cheney, SAGE Publications Ltd., 2008.
7. The Business Meetings Sourcebook: A Practical Guide to Better Meetings and Shared Decision Making, Eli Mina, AMACOM, 2002.
8. Moving Images: Making Movies, Understanding Media, Carl Casinghino, Delmar, 2011.

5th Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	PC	EE 501	Electrical Machines – II	3	0	0	3	3
2	PC	EE 502	Power System – I	3	0	0	3	3
3	PC	EE 503	Control System – I	3	0	0	3	3
4	OE	EE 504	D. Data Structure	3	0	0	3	3
			E. Computer Network					
			F. Internet of Things					
5	PE	EE 505	E. Electrical Energy Conservation and Auditing	3	0	0	3	3
			F. Electromagnetic Waves					
			G. Illumination Engineering					
			H. Power Plant Engineering					
<b>Total of Theory</b>							<b>15</b>	<b>15</b>
<b>B. PRACTICAL</b>								
6	PC	EE 591	Electrical Machines – II Laboratory	0	0	3	3	1.5
7	PC	EE 592	Power System – I Laboratory	0	0	3	3	1.5
8	PC	EE 593	Control System – I Laboratory	0	0	3	3	1.5
9	OE	EE 594	D. Data Structure Laboratory	0	0	3	3	1.5
			E. Computer Network Laboratory					
			F. Internet of Things Laboratory					
10	PROJ	PR 591	Project – V	0	0	2	2	1
11	PROJ*	PR 592	Innovative Activities – IV	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
12	MC	MC 501	Constitution of India	3	0	0	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>32</b>	<b>22.5</b>

\* Students may choose either to work on participation in Hackathons etc. Development of new product / Business Plan / registration of start-up.

Students may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry / NGO's / Government organizations / Micro / Small / Medium enterprises to make themselves ready for the industry / Long Term goals under rural Internship. (Duration 4-6 weeks)

Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

**Course Name: Electrical Machines - II**  
**Course Code: EE 501**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credit: 3**

**Prerequisites:** Knowledge of Physics up to B. Tech. 1<sup>st</sup> year Physics-I course and Electrical Machines – I.

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

- CO1.** Demonstrate the applications of synchronous machine and fractional kW motors based on different types of requirement.
- CO2.** Understand the principle of operation and know performance of synchronous machine and fractional kW motors.
- CO3.** Illustrate different tests on electrical machine and determine the performance machines.

### Course Content

<b>MODULE – I: Synchronous Machines</b>	<b>(21L)</b>
Construction of 3-phase Synchronous Machines, Description of salient & non-salient rotor, Advantages of Stationary armature and Rotating field system, Name plate rating.	1L
Methods of excitation systems: Static excitation, Brushless excitation, DC generator.	1L
Armature reaction at various p.f, concept of Synchronous reactance.	2L
Phasor diagrams of alternator at lagging, leading and unity p.f. loads.	1L
Voltage regulation of alternator by synchronous impedance method, Solution of problems.	2L
Open circuit characteristics, Short circuit characteristics of alternator and determination of synchronous reactance.	1L
Theory for salient pole machine, Two reaction theory, phasor diagram at different loads.	2L
Power angle characteristics of Synchronous machines, Solution of problems.	1L
Short circuit ratio (SCR) – concept and significance.	1L
Method of control of Active & Reactive Power of an alternator.	1L
Reasons and advantages of Parallel operation.	1L
Synchronization of two or more alternators: Three lamps method, Synchroscope.	1L
Parallel operation of (i) an alternator and infinite bus and (ii) Between two alternators and Load sharing between them. Solution of problems.	2L
Methods of starting of Three-Phase Synchronous Motor: by auxiliary motor and Damper winding.	1L
Effect of variation of excitation at infinite bus (over and under excitation) – V curves and inverted Vcurves.	1L
Hunting and its prevention.	1L
Applications of synchronous motor, Synchronous condenser.	1L
<b>MODULE – II: Single-Phase Induction Motor</b>	<b>(11L)</b>
Construction, Concept of Pulsating Torque, Double-revolving field theory.	2L
Development of equivalent circuit, Determination of equivalent circuit parameters, Solution of problems.	2L
Methods of starting using auxiliary winding, Selection of capacitor value during starting and running, Solution of problems.	2L
Speed-Torque characteristics, Phasor diagram, Condition of Maximum torque.	2L
Constructional features and performance characteristics of Universal Series Motors, Compensated	



and uncompensated motors. 2L  
 Testing of Single phase motors and Applications. 1L

**MODULE – III: Special Machines (4L)**

Principle and construction of switched Reluctance motor, Permanent magnet machines, Brushless DC machines, Hysteresis motor, Stepper Motor. 2L

Construction and Operational characteristics of Induction generator and Linear Induction motor. 2L

**Text Books:**

1. Electrical Machines, Nagrath & Kothary, TMH
2. The performance and design of Alternating Current machines, M. G. Say, C.B.S Publishers & Distributors
3. Electrical Machinery, P.S. Bhimra, Khanna Publishers.
4. Electrical Machines, Ashfaq Husain, Dhanpat Rai & Co.
5. Electrical Machines, S.K.Bhattacharya, T.M.H Publishing Co. Ltd.

**Reference Books:**

1. Electrical Machines, Theory & Applications, M.N. Bandyopadhyay, PHI
2. Electrical Technology, H.Cotton, C.B.S. Publisher New Delhi
3. Electric Machinery & Transformes, Irving L. Kosow, PHI
4. Electric Machinery, A.E.Fitzgerald, Charles Kingsley, Jr. & Stephen D. Umans, 6<sup>th</sup> Edition, Tata McGraw Hill Edition.
5. Problems in Electrical Engineering, Parker smith, 9<sup>th</sup> Edition, CBS publishers & distributors.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	-	-	2	-	-	-	-	-	-	-	-

**Course Name: Power System - I**

**Course Code: EE 502**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:** Concepts of basic electrical engineering, circuit theory and electrical machine.

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

- CO1.** Understand the concept of power system, know various power system components and define associated terms.
- CO2.** Know different type of power generation.
- CO3.** Understand basic performances of power system.

### Course Content

- Module 1: Basic Concept of Electrical Supply System** **1L**  
Structure of Power system, basic idea of transmission, distribution, tie lines, Grid networks etc.
- Module 2: Generation of Electric Power** **3L**  
General layout of a typical coal fired power station, Hydroelectric power station, and Nuclear power station, their components and working principles, comparison of different methods of power generation, Introduction to Solar and Wind energy system.
- Module 3: Mechanical Design of Overhead Transmission Line** **6L**  
Design of Conductors, Line supports: Towers, Poles, Insulators: Types, Voltage distribution across a suspension insulator string, String efficiency, Arching shield and rings, Methods of improving voltage distribution across Insulator strings, Electrical tests on line Insulators Sag, Tension and Clearance, Effect of Wind and Ice on Sag, Stringing Chart Dampers.
- Module 4: Electrical Design of Overhead Transmission Line** **8L**  
Choice of frequency, Choice of voltage, Types of conductors, Inductance and Capacitance of a single phase and three phases' symmetrical and unsymmetrical configurations. Bundle conductors. Transposition. Concept of GMD and GMR. Influence of Earth on conductor capacitance.
- Module 5: Corona** **3L**  
Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona. Methods of reduction of Corona.
- Module 6: Cables** **5L**  
Types of cables, cable components, capacitance of single core and 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle.
- Module 7: Performance of Lines** **8L**  
Short, medium (nominal  $\pi$ , T) and long lines and their representation. ABCD constants, Voltage regulation, Ferranti effect, Power equations and line compensation, Power Circle diagrams.
- Module 8: Tariff** **2L**  
Introduction of Economics of power. Guiding principle of Tariff, different types of tariff. Indian Electricity Rule-1956 and 2003: General Introduction.

**Text Books:**

1. Electrical Power System, Subir Roy, Prentice Hall
2. Power System Engineering, Nagrath & Kothery, TMH
3. Elements of Power System Analysis, C.L. Wadhwa, New Age International.
4. Electrical Power System, Ashfaq Hussain, CBS Publishers & Distributors
5. Principles of Power System, V.K.Mehta and Rohit Mehta, S.Chand.

**Reference Books:**

1. Electric Power Transmission & Distribution, S.Sivanagaraju, S.Satyanarayana, Pearson Education.
2. A Text book on Power system Engineering, Soni, Gupta, Bhatnagar & Chakrabarti, Dhanpat Rai & Co.
3. Power System Protection and Switchgear, Badri Ram, TMH
4. Electric Power Distribution System Engineering, 2<sup>nd</sup> Edition, T. Gonen, CRC Press.
5. [www.powermin.nic.in/acts\\_notification/pdf/ier1956.pdf](http://www.powermin.nic.in/acts_notification/pdf/ier1956.pdf)

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	1
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-

**Course Name: Control System - I**  
**Course Code: EE 503**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credit: 3**

**Prerequisites:** Concept of Basic Electrical Engineering, Circuit Theory and Engineering Mathematics.

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

- CO1.** Get knowledge of basic structure of control systems, define basic terminologies, components.
- CO2.** Modelling physical systems using transfer function to analyse system dynamic and steady state behaviour.
- CO3.** Understand the concept of feedback system and controllers, design compensators in frequency domain.

### **Course Content**

**Module 1: Introduction to Control System** **2L**  
 Concept of feedback and Automatic control, Types and examples of feedback control systems, Definition of transfer function .Poles and Zeroes of a transfer function.

**Module 2: Mathematical Modelling of Dynamic Systems** **6L**  
 Writing differential equations and determining transfer function of model of various physical systems including - Translational & Rotational mechanical systems, Basic Electrical systems and transfer function, Liquid level systems, Electrical analogy of Spring – Mass Dashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula.

**Module 3: Control System Components** **2L**  
 Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tachogenerators, Actuators.

**Module 4: Time Domain Analysis** **8L**  
 Time domain analysis of a standard second order closed loop system. Determination of time-domain specifications of systems. Step and Impulse response of first and second order systems. Stability by pole location. Routh-Hurwitz criteria and applications. Control Actions: Basic concepts of PI, PD and PID control, Steady-state error and error constants.

**Module 5: Stability Analysis by Root Locus Method** **4L**  
 Root locus techniques, construction of Root Loci for simple systems. Effects of gain on the movement of Pole and Zeros.

**Module 6: Frequency Domain Analysis of Linear System** **8L**  
 Bode plots, Polar plots, Nichols chart, Concept of resonance frequency of peak magnification. Nyquist criteria and Nyquist plots, measure of relative stability, phase and gain margin. Determination of margins in Bode plot.

**Module 7: Control System Performance** **4L**  
 Improvement of system performance through compensation, Lead, Lag and Lead-Lag compensation.

**Module 8: Case-studies****4L**

Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator.

Numerical problems to be solved in the tutorial classes.

**Text Books:**

1. Modern Control Engineering, K. Ogata, 4th Edition, Pearson Education.
2. Control System Engineering, I. J. Nagrath & M. Gopal. New Age International Publication.
3. Control System Engineering, D. Roy Choudhury, PHI
4. Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 8th Edition, PHI

**Reference Books:**

1. Control Engineering Theory & Practice, Bandyopadhyaya, PHI
2. Control systems, K.R. Varmah, Mc Graw Hill
3. Control System Engineering, Norman Nise, 5th Edition, John Wiley & Sons
4. Modern Control System, R.C. Dorf & R.H. Bishop, 11<sup>th</sup> Edition, Pearson Education.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1

**Course Name: Data Structure**

**Course Code: EE 504A**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:**

1. Familiarity with the fundamentals of C or other programming language.
2. A solid background in mathematics, including probability, set theory.

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

- CO1.** Differentiate how the choices of data structure and algorithm methods impact the performance of program.
- CO2.** Solve problems based upon different data structure and also write programs.
- CO3.** Identify appropriate data structure and algorithmic methods in solving problem.
- CO4.** Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing.
- CO5.** Compare and contrast the benefits of dynamic and static data structures implementations.

**Course Content**

<b>Module I: Linear Data Structure</b>	<b>10L</b>
<b>Introduction:</b>	<b>2L</b>
Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.	
Algorithms and programs, basic idea of pseudo-code.	1L
Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.	1L
<b>Array:</b>	<b>2L</b>
Different representations – row major, column major.	1L
Sparse matrix - its implementation and usage, Array representation of polynomials.	1L
<b>Linked List:</b>	<b>6L</b>
Singly linked list – operations, Doubly linked list – operations.	4L
Circular linked list – operations, Linked list representation of polynomial and applications.	2L
<b>Module II: Linear Data Structure</b>	<b>6L</b>
<b>Stack and Queue:</b>	<b>4L</b>
Stack and its implementations (using array and linked list)	1L
Applications (infix to Postfix, Postfix Evaluation)	1L
Queue, circular queue, de-queue	1L
Implementation of queue- linear and circular (using array and linked list)	1L
<b>Recursion:</b>	<b>2L</b>
Principles of recursion - use of stack, tail recursion.	1L
Applications - The Tower of Hanoi	1L
<b>Module III: Nonlinear Data structures</b>	<b>12L</b>
<b>Trees:</b>	<b>8L</b>
Basic terminologies, forest, tree representation (using array and linked list)	1L
Binary trees - binary tree traversal (pre-, in-, post- order)	1L
Threaded binary tree	1L
Binary search tree- operations (creation, insertion, deletion, searching)	1L
Concept of Max-Heap and Min-Heap (creation, deletion)	1L
Height balanced binary tree – AVL tree (insertion with examples only)	1L

Height balanced binary tree – AVL tree (deletion with examples only)	1L
m –Way Search Tree, B Tree – operations (insertion, deletion with examples only)	1L
<b>Graphs:</b>	<b>4L</b>
Graph theory review	1L
Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) - concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge)	2L
Minimal spanning tree – Prim’s algorithm, Kruskal’s algorithm (basic idea of greedy methods)	1L

<b>Module IV: Searching, Sorting</b>	<b>8L</b>
<b>Sorting Algorithms:</b>	<b>4L</b>
Bubble sort, Insertion sort, Selection sort – with notion of complexity	1L
Quick sort, Merge sort – with complexity	2L
Radix sort – with complexity	1L
<b>Searching:</b>	<b>2L</b>
Sequential search – with complexity	1L
Binary search, Interpolation Search– with complexity	1L
<b>Hashing:</b>	<b>2L</b>
Introduction to Hashing and Hashing functions	1L
Collision resolution techniques	1L

**Text Books:**

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications.
2. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2<sup>nd</sup> Edition, Universities Press.

**Reference Books:**

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1<sup>st</sup> Edition, Pearson.
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited.
3. Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2<sup>nd</sup> Edition, Pearson.
4. Data Structures in C by Aaron M. Tenenbaum, 1<sup>st</sup> Edition, Pearson.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	2	3	3	3	2	3
CO2	3	2	2	2	2	2	3	2	2	3	3	2
CO3	3	3	3	2	3	3	3	2	2	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

**Course Name: Computer Network**  
**Course Code: EE 504B**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credit: 3**

**Prerequisites:**

1. Familiarity and knowledge of Operating Systems and Computer Architecture
2. Also require little bit programming languages concepts like C, Java

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

- CO1.** Understand OSI and TCP/IP models.
- CO2.** Analyze MAC layer protocols and LAN technologies.
- CO3.** Design applications using internet protocols.
- CO4.** Implement routing and congestion control algorithms.
- CO5.** Develop application layer protocols and understand socket programming.

**Course Content**

<b>Module I: Introduction</b>	<b>6L</b>
Introduction: Computer Network, data communication, topology, OSI and TCP/IP Reference Models, layers and characteristics, Wireless Network, comparison to wired and wireless network.	3L
Physical Layer: Overview of data (analog and digital), signal (analog and digital), transmission (analog and digital) and transmission media (guided and unguided); Circuit switching: time division and space division switch, TDM bus; Telephone Network.	3L
<b>Module II: Data Link Layer</b>	<b>10L</b>
Framing, Error Control, Error Detection and Correction, Flow Control, Data Link Protocols, Simple Stop-and-Wait Protocol, ARQ mechanism, Sliding Window Protocols, One-Bit Sliding Window Protocol, Go-Back-N and Selective Repeat, HDLC, PPP Medium Access Control Sub-layer, The Channel Allocation.	5L
Multiple Access Protocols : ALOHA, Carrier Sense Multiple Access Protocols, IEEE 802.x Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, Wireless LANs - IEEE 802.xx , Bluetooth, RFID, Bridges, Virtual LANs, Switching.	5L
<b>Module III: Network Layer</b>	<b>10L</b>
IP Addressing, IPv <sub>4</sub> and IPv <sub>6</sub> . Difference IPv <sub>4</sub> and IPv <sub>6</sub> , Conversion of IPv <sub>4</sub> and IPv <sub>6</sub> , Subnetting, Supernetting, Design Issues, Store-and-Forward Packet Switching, Virtual-Circuit and Datagram Networks, ARP, IP, ICMP, IPV6, BOOTP and DHCP-Delivery protocols Other Protocols such as mobile IP in wireless Network.	5L
Routing: Shortest Path Algorithms, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing, : RIP, OSPF, BGP; Routing for Mobile Hosts.	5L
<b>Module IV: Transport layer</b>	<b>6L</b>
Process to Process delivery; UDP; TCP, SCTP, TCP RENO, TCP/IP in Wireless environment, Congestion control in TCP :Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm.	5L
Advanced topic such as Remote Procedure Call, Delay Tolerant Networks.	1L



**Module V: Application Layer****3L**

Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW: Cryptography (Public, Private Key based), Digital Signature, Firewalls

**Module VI: Socket Programming****1L**

Introduction to Socket Programming, UDP socket and TCP Socket

**Text Books:**

1. B. A. Forouzan – “Data Communications and Networking (3rd Ed.)” – TMH
2. S. Tanenbaum – “Computer Networks (4th Ed.)” – Pearson Education/PHI
3. W. Stallings – “Data and Computer Communications (5th Ed.)” – PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP

**Recommended Books:**

1. Kurose and Rose – “Computer Networking -A top down approach featuring the internet” – Pearson Education
2. Leon, Garica, Widjaja – “Communication Networks” – TMH
3. Walrand – “Communication Networks” – TMH.
4. Comer – “Internetworking with TCP/IP, vol. 1, 2, 3 (4th Ed.)” – Pearson Education/PHI

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	2	-	-	-	-	2	-	-	-
CO2	-	2	-	-	-	-	-	-	2	-	-	-
CO3	2	2	-	-	2	-	-	-	2	-	-	-
CO4	2	2	-	-	2	2	-	-	2	-	-	-
CO5	3	3	-	-	3	-	-	-	2	-	-	-

**Course Name: Internet of Things**

**Course Code: EE 504C**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:** Fundamental knowledge in computer networking and wireless sensor network.

**Course Outcome:** On completion of the course students will be able

- CO1.** To understand the concepts of Internet of Things.
- CO2.** To analyze basic protocols in wireless sensor network.
- CO3.** To design IoT applications in different domain and be able to analyze their performance.
- CO4.** To implement basic IoT applications on embedded platform.

### Course Content

- Module I: Fundamental of IoT** **7L**  
 The Internet of Things , Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other challenges.
- Module II: IoT and M2M** **7L**  
 A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.
- Module III: Wireless Sensor Network** **6L**  
 Network and Communication aspects, Wireless medium access issues, MAC protocol , routing protocols, Sensor deployment and Node discovery, Data aggregation and dissemination.
- Module IV: IoT Architecture** **7L**  
 Introduction, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.
- Module V: IoT Applications for Value Creations** **5L**  
 Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, Real-time monitoring and control of processes - Deploying smart machines, smart sensors, and smart controllers with proprietary communication and internet technologies, Maximize safety, security and reliability through high precision automation and control, Advanced Metering Infrastructure (AMI), Smart Inverters, Remote control operation of energy consuming devices.

**Module VI: Internet of Things Privacy, Security and Governance****4L**

Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security.

**Text Books:**

1. Vijay Madiseti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

**Reference Books:**

1. Cuno Pfister, Getting Started with the Internet of Things, O’Reilly Media, 2011, ISBN: 978-1-4493-9357-1
2. Walteneus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice".

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	1	-	-	-	-	2
CO2	3	3	2	2	2	1	1	-	-	-	-	2
CO3	3	2	3	2	3	3	3	-	1	2	2	2
CO4	3	2	3	1	3	3	3	-	1	2	2	2

**Course Name: Electrical Energy Conservation and Auditing**

**Course Code: EE 505A**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:**Electrical Machines and Power Systems.

**Course Outcome:**

- CO1.** Identify the demand supply gap of energy in Indian scenario.
- CO2.** Carry out energy audit of an industry/Organization.
- CO3.** Draw the energy flow diagram of an industry and identify the energy wasted or a waste stream.
- CO4.** Select appropriate energy conservation method to reduce the wastage of energy.
- CO5.** Evaluate the techno economic feasibility of the energy conservation technique adopted.

**Course Content**

**Module 1:**

**5L**

**Energy Conservation and Environment:** Electricity Act 2003, Integrated Energy Policy. Energy and environment, Air pollution, Climate change, United Nations Framework Convention on climate change (UNFCCC), Montreal Protocol, Kyoto Protocol, Clean Development Mechanism (CDM), CDM methodology and Procedures, Sustainable development.

**Module 2:**

**9L**

**Electrical Systems:** Supply and Demand Side, Economic operation, Input-Output curves, Load profiling, Electricity tariff types;

**Energy auditing:** Necessity of Energy audit, Types of energy audit, Energy audit instruments and intervals of EA regulation. Energy Conservation Act-2001 and its features, Notification Under the act, Designated agencies, Schemes of Bureau of Energy Efficiency (BEE);

**Energy Economics:** Economic assessment and Economic methods for specific energy analysis.

**Module 3:**

**6L**

**Electric motors:** Energy efficient controls and starting efficiency-Motor Efficiency and Load Analysis- Energy efficient /high efficient Motors-Case study; Load Matching and selection of motors.

Variable speed drives; Pumps and Fans-Efficient Control strategies- Optimal selection and sizing – Optimal operation and Storage; Case study

**Module 4:**

**7L**

**Electrical Demand Side:** Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation, case study. Reactive Power management-Capacitor Sizing-Degree of Compensation, Peak Demand controls-Methodologies-Types of Industrial loads-Optimal Load scheduling-case study; Lighting-Energy efficient light sources-Energy conservation in Lighting Schemes- Electronic ballast-Power quality issues-Luminaries, case study;

**Module 5:**

**9L**

**Cogeneration:** Types and Schemes;

**Electric loads and Energy conservation measures:** Air conditioning and Refrigeration, Cold storage-Types-Optimal operation-case study; Electric water heating-Geysers-Solar Water Heaters-

Power Consumption in Compressors, Energy conservation measures; Electrolytic Process;  
**Computer Controls:** Hardware, Software-EMS.

**Text Books:**

1. Leon K. Kirchmayer, “Economic Operation of power system”, Wiley India Pvt Ltd, July 2010.
2. Jean-Claude SabonnadiAre, “Low emission power generation technologies and energy management”, John Wiley & Sons, August 2010.
3. Ursula Eicker, “Low energy cooling for sustainable buildings”, John Wiley & Sons, August 2010
4. Timothy J. E. Miller, “Reactive power control in electric systems”, Wiley edition, August 2010
5. Paul C. Crause, Oleg Wasynczuk, Scott D.sudhoff, “Analysis of electric machinery and drive system”, Wiley 2nd Edition, August 2010.
6. Albert Thumann, P.W. “Plant Engineers and Managers Guide to Energy Conservation” TWI Press Inc, Terre Haute, 9<sup>th</sup> edition, 2008
7. Francois, Leveque, “Transport pricing of electricity networks”, Springer 2003.
8. Parasiliti F., P. Bertoldi, “Energy Efficiency in motor driven systems”, Springer, 2003.

**Reference Books:**

1. Turner, Wayne C., “Energy Management Handbook”, Lilburn, The Fairmont Press, 2001
2. Donald R. W., “Energy Efficiency Manual”, Energy Institute Press,2000
3. Giovanni Petrecca, “.Industrial Energy Management: Principles and Applications”, The Kluwer international series -207, 1999 Springer 2000.
4. Anthony J. Pansini, Kenneth D. Smalling, “Guide to Electric Load Management”, Pennwell Pub,1998
5. Albert Thumann , “Handbook of Energy Audits”, Fairmont Pr; 5th edition,1998
6. Howard E. Jordan, “Energy-Efficient Electric Motors and Their Applications”, Plenum Pub Corp; 2<sup>nd</sup> edition 1994
7. Petrecca, Giovanni, “Industrial Energy Management”, Springer 1993
8. IEEE Bronze Book- “Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities”, IEEE Inc, USA.,1985
9. NESCAP-Guide Book on Promotion of Sustainable Energy Consumption.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	1	-	-	-	-	-	-	-
CO4	-	-	2	2	-	-	-	-	-	-	-	-
CO5	2	1	2	-	1	-	-	-	-	-	-	-

**Course Name: Electromagnetic Waves**

**Course Code: EE 505B**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:** Concept of Physics, Mathematics and Basic Electrical Engineering.

**Course Outcome:**

- CO1.** Understand the propagation of EM waves associated with different Electrical Networks.
- CO2.** Apply Maxwell's equations to solutions of problems relating to transmission lines and uniform plane wave propagation.
- CO3.** Analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications.
- CO4.** Apply concepts of Antenna Engineering and its applications.

**Course Content**

- Module 1: Electromagnetic Waves** **6L**  
 Maxwell's equations, 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 and Poynting vector, Reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence, Polarisation. Solution of problems.
- Module 2: Transmission Lines** **4L**  
 Concept of lumped and distributed parameters, Line parameters, Transmission line equation and solutions, Physical significance of solutions, Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation. Solution of problems
- Module 3: Waveguides** **3L**  
 Parallel planes waveguides, Rectangular waveguides, Circular waveguides, Power transmission in waveguides, Dielectric slab waveguides, Application of waveguides.
- Module 4: Antenna Parameters and Characteristics** **5L**  
 Antenna Concepts, Antenna Characteristic; Hertzian dipole (Radiation Fields, Radiation Resistance, Radiation patterns, Directive Gain); Properties and typical applications of Half-wave dipole, Yagi-Uda array, Array Antennas.
- Module 5: Radio Wave Propagation** **3L**  
 Different modes of propagation, Tilt, Sky wave propagation, MOF maximum Ustable frequency, Skip distance, Critical frequency, Virtual height.
- Module 6: Space Wave Propagation** **3L**  
 Space wave propagation, Modified refractive index, Diffraction, Anomalous propagation, Duct propagation, Tropospheric propagation.

**Text Books:**

1. Quantum Field Theory, Lewis H. Ryder, 2<sup>nd</sup> Edition, Cambridge University Press.
2. Elements of Electromagnetic, Mathew N.O. Sadiku, 4<sup>th</sup> edition, Oxford University press.
3. Engineering Electromagnetic, W.H. Hyat & J.A. Buck, 7<sup>th</sup> Edition, TMH
4. Theory and problems of Electromagnetic, Edminister, 2<sup>nd</sup> Edition, TMH

5. Electromagnetic field theory fundamentals, Guru & Hizroglu, 2<sup>nd</sup> edition, Cambridge University Press.
6. Elements of Electromagnetic Fields, S.P. Seth, Dhanpat Rai & Sons

**Reference Books:**

1. Electromagnetic with application, Krause, 5<sup>th</sup> Edition, TMH.
2. Elements of Engineering Electromagnetic, N.N. Rao, 6th Edition, Pearson Education.
3. Electromagnetic Theory & Applications, A. K. Saxena, Narosa Publishing House Pvt. Ltd.
4. Electromagnetic Waves and Transmission Lines- by G.Prasad, J.Prasad and J.Reddy- Scitech.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-

**Course Name: Illumination Engineering**

**Course Code: EE 505C**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:** Concept of Physics, Basic Electrical Engineering.

**Course Outcome:**

- CO1.** Analyse the fundamentals of illumination and its measurements with different apparatus.
- CO2.** Explain the characteristics of various types of lamp with their accessories and their control circuits.
- CO3.** Demonstrate the interior and exterior lighting.

**Course Content**

**Module 1: Fundamentals of Light**

**5L**

Types of illumination, Theory of gas discharge and production of light, Perception of light and colour, Radiation of energy, Electromagnetic radiation and Electromagnetic spectrum, Human eye as an optical system, Spectral sensitivity of human eye, Visual characteristics and Visual performance.

**Module 2: Measurement of Light**

**7L**

Definition of luminous flux, Luminous intensity, Lumen, Candle power, Illumination, M.H.C.P, M.S.C.P, M.H.S.C.P, Lamp efficiency, Brightness or luminance, Photometry – Fundamentals of detector, Application of Polar Photometer and Goniophotometer, Calculation of luminance and illumination, Luxmeter, CIE standard source of illuminant, Colorimetry –Source colour and Object colour. Colorimetric instrument, Colour rendering index.

**Module 3: Lamp, Accessories and Luminaries**

**9L**

Lamp materials – glass, filament, phosphor coating, ceramics, electrodes, gases, capping cement etc., Theory and basic properties of low and high pressure gas discharge. Theory of operation, Life, Characteristics and Application of - High and Low pressure sodium vapour, High and Low pressure mercury vapour, Metal halide, Fluorescent lamp, LED, LASER, Luminaire – Types of luminaire, Design consideration, Indian standard recommendation.

**Module 4: Illumination Control and Control circuits**

**6L**

Purpose of lighting control in view of energy conservation, Operation of Electromagnetic and Electronic ballast and their comparison in light control, Function of Ignitor in lamps, Control circuits and operation of Fluorescent lamp circuit, Low pressure sodium vapour lamp circuit, High pressure sodium vapour lamp circuit.

**Module 5: Interior Lighting**

**6L**

National standards of interior lighting calculation, Design considerations for interior lighting of Residential complex, Commercial complex, Industrial premises, Day lighting – Sky luminance pattern, Daylight factor, estimation of average daylight factor, window design considerations for maximum day lighting, Application of daylight in interior lighting, Use of photocell, occupancy sensor in lighting controls, Concept of Isolux contour in lighting design.



**Module 6: Exterior Lighting****3L**

Lighting calculations of exterior lighting, Calculation of lighting and design considerations for exterior lighting of Road lighting, Flood lighting, Industrial complex, Commercial complex, Sports complex, National and CIE standards of exterior lighting calculation.

**Text Books:**

1. Generation, Distribution and Utilization of Electrical Energy, C.L. Wadha, New Age International Ltd.
2. Applied Illumination Engineering, Jack L. Lindsey, The Fairmont Press Inc.
3. Art and Science of Utilization of Electrical Energy, H. Partab, Dhanpat Rai & Sons.
4. Standard Hand Book for Electrical Engineers, Fink & Beaty, McGraw Hill International.

**Reference Books:**

1. Utilization of Electric Power, C.L. Wadha, New Age International Ltd.
2. Handbook of Applied Photometry, Casimer M Decusatis, Springer.
3. Light Engineering: Applied calculations, R.H. Simons, Robert Bean, Architectural Press.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	3	2	-	-	-	3	3
CO2	3	2	1	3	3	3	-	-	-	-	3	3
CO3	3	1	2	-	3	3	-	-	-	-	3	3

**Course Name: Power Plant Engineering**

**Course Code: EE 505D**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:** Concept of Energy Conversion.

**Course Outcome:**

- CO1.** Understand the principles of operation for different power plants.
- CO2.** Understand the economics of operation for different power plants.
- CO3.** Analyse the interconnection between different power plants.

### Course Content

**Module 1: Basics of Power Generation** **2L**  
Importance of electrical power in daily life, Different forms of energy, Comparison of different energy sources, Power crisis in India and Future Trend, Overview of method of electrical power generation.

**Module 2: Coal Based Thermal Power Plants** **8L**  
List of thermal power stations in the state with their capacities, basic Rankine cycle and its modifications, Selection of site for thermal power stations, Layout of modern coal power plant, Quality of fuel and its effect on quality of power generation, Operation of different components – Super critical boilers, FBC boilers, Economizer, Air pre heater, Super-heaters and re-heaters, Steam turbines, Condensers, Spray ponds and cooling towers, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems, Merits and demerits of Thermal Power Plants.

**Module 3: Nuclear Power Stations** **6L**  
Basics of nuclear energy conversion, Selection of site for Nuclear Power plants, Block diagram and working of Nuclear Power station, Fuels used in Nuclear Power Station, subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants, Merits and demerits of Nuclear Power Plants, List of Nuclear power stations in state and county with their capacities.

**Module 4: Hydro Power Stations** **5L**  
Selection of site and classification of Hydroelectric Power Plants, Layout and working of Hydro Power Station, Types of Turbines and generators used, Pumped storage Power Plant, Merits and demerits of Hydro Power Station, List of Hydro Power stations with their capacities and number of units in the state.

**Module 5: Gas Turbine Power Plants** **3L**  
Selection of site for Gas Turbine Power Station, Fuels for gas turbine, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems, Merits, demerits and application Gas turbine power plants.

**Module 6: Diesel Electric Power Stations** **3L**  
Selection of site for Diesel Electric Power Station, Elements of diesel Electric power plants and

their working, Operation, maintenance & trouble shooting, chart of diesel Electric plant, Merits, demerits and applications of diesel electric power stations, Performance and thermal efficiency of Diesel Electric Power Plant.

**Module 7: Non-Conventional Energy Sources**

**3L**

Principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

**Module 8: Economics of Power Generation**

**3L**

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, firm power, cold reserve, hot reserve, spinning reserve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

**Module 9: Interconnected Power Systems**

**3L**

Advantages of Interconnection, Base load and peak loads, load allocation among various types of power stations, Load sharing and transfer of load between power stations, Inter connection of power stations at state and national level.

**Text Books:**

1. P.K. Nag – Power plant Engineering, Tata McGraw – Hill.
2. T. C. Elliot, K. Chen and R. C. Swanekamp, Power Plant Engineering, 2<sup>nd</sup> ed., McGraw Hill, 1998.
3. M. M. El Wakil, Power Plant Technology, Tata McGraw Hill, 2010.
4. Arora and Domkundwar – A course in Power plant Engineering, Dhanpat Rai & Sons.

**Reference Books:**

1. Godfrey Boyle, Renewable Energy, Oxford University Press.
2. Soni, Gupta and Bhatnagar, A course in Electrical Power, Dhanpatrai & Sons.
3. Dr. S. L. Uppal, Electrical Power, Khanna Publishers.
4. Umesh Rathore, Energy Management, S.K.Katharia & Sons
5. K.K. Ramalingam, Power Plant Engineering, Scitech Publication (India) Pvt. Ltd.
6. S P Sukhatme, Solar Energy, Tata McGrawhill Publishing co. Ltd.
7. A.K.Raja, M. Dwibedi and A.P.Srivastava, Introduction to Non-conventional Energy sources, Scitech Publication (India) Pvt. Ltd.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	3
CO2	3	-	3	-	-	-	-	-	-	-	2	-
CO3	2	-	3	-	-	-	2	-	-	-	2	-

**Course Name: Electrical Machines – II Laboratory**

**Course Code: EE 591**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Concepts of Electrical Machine.

**Course Outcomes:** After successful completion of this course, student will be able to

- CO1.** Perform different tests on Three-Phase A.C. Generators, Synchronous Motors and Single-Phase Induction Motor.
- CO2.** Interpret the observed result using theoretical knowledge and hence calculate unknown parameters.

**List of Experiment (At least *ten* experiments to be performed):**

1. To observe the effect of excitation and speed on induced e.m.f of a three-phase alternator and plot the O.C.C. of the alternator.
2. Determination of regulation of Synchronous machine by
  - a) Potier reactance method.
  - b) Synchronous Impedance method.
3. To determine the direct axis resistance [ $X_d$ ] and quadrature reactance [ $X_q$ ] of a 3-phase synchronous machine by slip test.
4. Parallel operation of three-phase Synchronous generators.
5. V-curve of Synchronous motor.
6. Determination of equivalent circuit parameters of a single-phase Induction motor.
7. Load test on single-phase Induction motor to obtain the performance characteristics.
8. To study the performance of Three-Phase Induction generator.
9. To study the effect of capacitor on the starting and running condition of a Single-Phase Induction motor and to determine the method of reversing the direction of rotation.
10. Innovative Experiments.

*N.B.: Experiment No. 2(a) and 2(b) may be considered as separate experiment.*

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	3	-	-	-	-	3	2	-	-
CO2	2	-	-	3	-	-	-	-	3	2	-	-

**Course Name: Power System – I Laboratory**

**Course Code: EE 592**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Concepts of Power System.

**Course Outcomes:** After successful completion of this course, student will be able to

- CO1.** Able to estimate performance of Transmission Line and Distribution line.
- CO2.** Able to select line support for a particular Transmission Line.
- CO3.** Able to explain methods of active and reactive power control.
- CO4.** Able to test the reliability of different components of Transmission Line and Distribution Line.

**List of Experiment:**

1. Draw the Schematic diagram of structure of power system and power transmission line and Symbol of Electrical Equipment.
2. Simulation of DC distribution by network analyzer.
3. Measurement of earth resistance by earth tester.
4. Dielectric strength test of insulating oil, solid Insulating Material.
5. Different parameter calculation by power circle diagram.
6. Study of different types of insulator.
7. Determination of the generalized constants A, B, C, D of long transmission line.
8. Active and reactive power control of alternator.
9. Study and analysis of an electrical transmission line circuit with the help of software.
10. Dielectric constant, tan delta, resistivity test of transformer oil.
11. Any Innovative experiment according to knowledge of power System – I.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	3	-	-	-	-	3	2	-	-
CO2	2	-	-	3	-	-	-	-	3	2	-	-
CO3	2	-	-	3	-	-	-	-	3	2	-	-
CO4	2	-	-	3	-	-	-	-	3	2	-	-

**Course Name: Control System – I Laboratory**

**Course Code: EE 593**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Concept of Simulation Software and Control System.

**Course Outcomes:** After successful completion of this course, student will be able to

**CO1.** Simulate, analyze system behaviour using software simulator/hardware.

**CO2.** Design compensators, controllers to meet desired performance of system.

**List of Experiment:**

1. Familiarization with MATLAB control system tool box, MATLAB simulink tool box and PSPICE.
2. Determination of Step response for first order and Second order system with unity feedback on CRO and calculation of control system specification like Time constant, % peak overshoot, settling time etc. from the response.
3. Simulation of Step response and Impulse response for Type-0, Type-1 and Type-2 system with unity feedback using MATLAB and PSPICE.
4. Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system tool box for 2<sup>nd</sup> order system and determination of different control system specification from the plot.
5. Determination of PI, PD and PID controller action of first order simulated process.
6. Determination of approximate transfer functions experimentally from Bode plot.
7. Evaluation of steady state error, setting time, percentage peak overshoot, gain margin, phase margin with addition of Lead.

**Reference Books:**

1. MATLAB and Simulink for Engineers, Agam Kumar Tyagt, Oxford.
2. Modeling and Simulation Using MATLAB - Similink, Dr. S. Jain, Wiley India.
3. MATLAB and Its Application in Engineering, Raj K Bansal, A.K. Goel and M.K. Sharma, Pearson.
4. MATLAB programming for Engineers, S.J. Chapman, 3<sup>rd</sup> Edition, Cengage.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	3	-	-	-	-	3	2	-	-
CO2	2	-	-	3	-	-	-	-	3	2	-	-

**Course Name: Data Structure Laboratory**

**Course Code: EE 594A**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Computer Fundamentals and Principal of Computer Programming Laboratory.

**Course Outcomes:** After successful completion of this course, student will be able to

- CO1.** Choose appropriate data structure as applied to specified problem definition.
- CO2.** Handle operations like searching, insertion, deletion, traversing mechanism on various data structures.
- CO3.** Have practical knowledge on the applications of data structures.
- CO4.** Able to store, manipulate and arrange data in an efficient manner.
- CO5.** Able to implement queue and stack using arrays and linked list. Implementation of queue, binary tree and binary search tree.

**List of Experiment:**

1. Write a C program to implement Single Link List.
2. Write a C program to implement Double Link List.
3. Write a C program to implement Single Circular Link List.
4. Write a C program to implement Double Circular Link List.
5. Write a C program to implement Polynomial addition and Polynomial multiplication using Linked List.
6. Write a C program to convert a given infix expression into its postfix Equivalent.
7. Write C programs to implement a queue ADT using i) array and ii) doubly linked list respectively.
8. Write a C program to implement Binary Search Tree (BST).
9. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order:
  - a) Insertion sort
  - b) Merge sort
10. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order:
  - a) Quick sort
  - b) Selection sort
11. Write C programs for implementing the following searching methods:
  - a) Linear Search
  - b) Binary Search
 Write a C program to implement all the functions of a dictionary (ADT) using hashing.
12. Write C programs for implementing the following graph traversal algorithms:
  - a) Depth first search
  - b) Breadth first search

**Text Books:**

1. Data Structures using C, R. Thareja, 2<sup>nd</sup> Edition, Oxford University Press.
2. Data Structures Using C E. Balagurusamy, Mcgraw Hill

**Reference Books:**

1. Data Structures in C by Aaron M. Tenenbaum, 1st Edition, Pearson
2. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications

3. Data structures using C, A.K.Sharma, 2<sup>nd</sup> Edition, Pearson
4. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2<sup>nd</sup> Edition, Universities Press

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	3	2	2	2	2	1	1	-	1	-	-
<b>CO2</b>	3	2	2	-	2	2	1	-	-	1	-	2
<b>CO3</b>	2	1	1	-	-	-	-	1	-	-	-	-
<b>CO4</b>	3	2	-	2	-	1	1	-	1	-	1	-
<b>CO5</b>	1	-	2	1	2	-	-	1	1	-	1	2



**Course Name: Computer Network Laboratory**  
**Course Code: EE 594B**  
**Contact: 0L:0T:3P**  
**Credit: 1.5**

**Prerequisites:**

1. Familiarity and knowledge of Computer Network and Computer Architecture
2. Also require strong knowledge of programming languages like C, Java and UNIX or Linux environment.

**Course Outcomes:** After successful completion of this course, student will be able to

- CO1.** Demonstrate the socket program using TCP and UDP.
- CO2.** Develop simple applications using TCP and UDP.
- CO3.** Develop the code for Data link layer protocol simulation.
- CO4.** Examine the performances of Routing protocol.
- CO5.** Experiment with congestion control algorithm using network simulator.

**List of Experiment:**

1. Familiarization of UNIX or Linux environment, UNIX or Linux general Commands specially Network Commands. Familiarization of Internetworking - Network Cables - Color coding - Crimping. Internetworking Operating Systems - Configurations. 6L
2. Socket Programming using TCP and UDP. 18L
3. Implementing routing protocols such as RIP, OSPF. 2L
4. Familiarization of advanced simulators like Packet Tracer, NS2/NS3, OMNET++, TinyOS. 4L
5. Server Configuration: only web server (If time permit..instructor can do more than that). 6L

**Text Books:**

1. TCP sockets in C programs-Practical guide for Programmers By Micheal J Donahoo and Kenneth L Calvert.
2. Socket Programming by Rajkumar Buyaa.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	2	1	-	3	2	2	3
CO2	3	3	3	2	3	3	2	3	3	2	2	3
CO3	3	3	3	2	2	1	2	1	3	2	2	3
CO4	3	3	3	1	2	2	1	3	3	2	2	3
CO5	3	3	3	2	2	2	1	2	3	2	2	3

**Course Name: Internet of Things Laboratory**

**Course Code: EE 594C**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:**

1. Fundamental knowledge in computer networking and wireless sensor network.
2. Basic Programming Knowledge.

**Course Outcomes:** After successful completion of this course, student will be able

- CO1.** To understand the concepts of Internet of Things.
- CO2.** To explain the IoT tools like Arduino Uno, Raspberry Pi.
- CO3.** To design IoT applications in different domain and be able to analyze their performance.
- CO4.** To implement basic IoT applications on embedded platform.

**Major Equipment:**

1. Raspberry pi.
2. Arduino.

**List of Experiment:**

1. Introduction to various sensors and various actuators and its Application. Perform experiment using Arduino Uno using following Ultrasonic Sensor: [9L]
  - a) PIR Motion Sensor.
  - b) Rain Drop Sensor.
  - c) Moisture Sensor.
  - d) Temperature Sensor.
  - e) Touch Sensor.
  - f) Infrared Sensor.
  - g) Servo Moto.
  - h) RFID Sensor.
  - i) Bluetooth Module.
  - j) Wi-Fi Module.
2. Getting Started with ESP8266 Wi-Fi SoC and hands on. [6L]
3. Demonstrate NodeMCU and its working principal. [3L]
4. Create a circuit using Arduino and sensors. Perform experiment using Arduino Uno to Learn Working of Servo Motor. [6L]
5. Define and Explain Eclipse IoT Project, List and summarize few Eclipse IoT Projects. [3L]
6. Creating a webpage and display the values available through Arduino. [3L]
7. Demonstration of Setup & Working principal of Raspberry Pi. [6L]
8. Connect Raspberry Pi with your existing system components. [3L]

**Text books:**

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1<sup>st</sup> Edition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

**Reference books:**

1. Cuno Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1-4493-9357-1.

2. Walteneagus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks: Theory and Practice”.

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	3	2	2	2	1	1	--	--	--	--	2
<b>CO2</b>	3	3	2	2	2	1	1	--	--	--	--	2
<b>CO3</b>	3	2	3	2	3	3	3	--	1	2	2	2
<b>CO4</b>	3	2	3	1	3	3	3	--	1	2	2	2

**Course Name: Constitution of India**

**Course Code: MC 501**

**Contact: 3L:0T:0P**

**Prerequisites:** NA.

**Course Outcome:**

- CO1.** Develop human values, create awareness about law ratification and significance of Constitution.
- CO2.** Comprehend the Fundamental Rights and Fundamental Duties of the Indian Citizen to implant morality, social values and their social responsibilities.
- CO3.** Create understanding of their Surroundings, Society, Social problems and their suitable solutions.
- CO4.** Familiarize with distribution of powers and functions of Local Self Government.
- CO5.** Realize the National Emergency, Financial Emergency and their impact on Economy of the country.

**Course Content**

1.	Meaning of the constitution law and constitutionalism	2L
2.	Historical perspective of the Constitution of India	2L
3.	Salient features and characteristics of the Constitution of India	1L
4.	Scheme of the fundamental rights	2L
5.	The scheme of the Fundamental Duties and its legal status	2L
6.	The Directive Principles of State Policy – Its importance and implementation	2L
7.	Federal structure and distribution of legislative and financial powers between the Union and the States	3L
8.	Parliamentary Form of Government in India – The constitution powers and status of the President of India	2L
9.	Amendment of the Constitutional Powers and Procedure	2L
10.	The historical perspectives of the constitutional amendments in India	2L
11.	Emergency Provisions: National Emergency, President Rule, Financial Emergency	3L
12.	Local Self Government – Constitutional Scheme in India	3L
13.	Scheme of the Fundamental Right to Equality	2L
14.	Scheme of the Fundamental Right to certain Freedom under Article 19	2L
15.	Scope of the Right to Life and Personal Liberty under Article 21.	2L

**Text Books:**

1. Introduction to Constitution of India, D.D. Basu, Lexis Nexus
2. The Constitution of India, PM Bhakshi, Universal Law

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	2	3	-	-	-	2
CO2	-	-	-	-	-	3	2	3	-	-	-	2
CO3	-	-	-	-	-	3	2	3	-	1	-	2
CO4	-	-	-	-	-	3	2	3	-	1	-	2
CO5	-	-	-	-	-	3	2	3	-	1	-	2

6th Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	PC	EE 601	Microprocessor and Microcontroller	3	0	0	3	3
2	PC	EE 602	Power System – II	3	0	0	3	3
3	PC	EE 603	Control System – II	3	0	0	3	3
4	OE	EE 604	D. Data Base Management System	3	0	0	3	3
			E. Embedded Systems					
			F. Software Engineering					
5	PE	EE 605	D. Digital Signal Processing	3	0	0	3	3
			E. High Voltage Engineering					
			F. Computer Architecture					
<b>Total of Theory</b>							<b>15</b>	<b>15</b>
<b>B. PRACTICAL</b>								
6	PC	EE 691	Microprocessor and Microcontroller Laboratory	0	0	2	2	1
7	PC	EE 692	Power System – II Laboratory	0	0	3	3	1.5
8	PC	EE 693	Control System – II Laboratory	0	0	3	3	1.5
9	OE	EE 694	D. Data Base Management System Laboratory	0	0	3	3	1.5
			E. Embedded Systems Laboratory					
			F. Software Engineering Laboratory					
10	PROJ	PR 691	Project – VI	0	0	2	2	1
11	PROJ*	PR 692	Innovative Activities – V	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
12	MC	MC 681	Technical Lecture Presentation & Group Discussion – I	0	0	3	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>31</b>	<b>22</b>

\* Students may choose either to work on participation in all the activities of Institute's Innovation Council for e.g., IPR workshop / Leadership Talks / Idea / Design / Innovation / Business Completion / Technical Expos etc.

Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

**Course Name: Microprocessor and Microcontroller**  
**Course Code: EE 601**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credit: 3**

**Prerequisites:** Knowledge in Digital Electronics.

**Course Outcome:**

- CO1.** Able to correlate the architecture, instructions, timing diagrams, addressing modes, memory interfacing, interrupts, data communication of 8085.
- CO2.** Able to interpret the 8086 microprocessor-Architecture, Pin details, memory segmentation, addressing modes, basic instructions, interrupts.
- CO3.** Recognize 8051 micro controller hardware, input/output pins, ports, external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts.
- CO4.** Apply instructions for assembly language programs of 8085, 8086 and 8051.
- CO5.** Design peripheral interfacing model using IC 8255, 8253, 8251 with IC 8085, 8086 and 8051.

**Course Content**

- Module 1: 8085 Microprocessor** [6]  
 Introduction to Microcomputer based system, Evolution of Microprocessor and microcontrollers and their advantages and disadvantages, Architecture of 8085 Microprocessor, Address / Data Bus multiplexing and demultiplexing, Status and Control signal generation, Instruction set of 8085 Microprocessor, Classification of instructions, addressing modes, timing diagram of the instructions, Memory interfacing , IO interfacing, ADC / DAC interfacing, Stack and Subroutine, Delay Calculation, Interrupts of 8085 processor, classification of interrupts, Serial and parallel data transfer – Basic concept of serial I/O, DMA, Asynchronous and synchronous serial transmission using SID and SOD pins of 8085.
- Module 2: Assembly language programming with 8085** [2]  
 Addition, Subtraction, Multiplication, Block Transfer, ascending order, descending order, Finding largest & smallest number, Look-up table etc. Programming using interrupts (programming using INTR is not required).
- Module 3: 8086 Microprocessor** [8]  
 8086 Architecture, Pin details, memory segmentation, addressing modes, Familiarization of basic Instructions, Interrupts & Direct Memory Access, Memory interfacing, ADC / DAC interfacing.
- Module 4: Assembly language programming with 8086** [3]  
 Addition, Subtraction, Multiplication, Block, Transfer, ascending order, descending order, Finding largest & smallest number etc.
- Module 5: 8051 Microcontroller** [7]  
 8051 architecture, hardware, input/output pins, ports, internal and external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts, Memory interfacing, ADC / DAC interfacing.
- Module 6: Assembly language Programming using 8051** [4]

Moving data: External data moves, code memory read only data moves, PUSH and POP opcodes, data exchanges; Logical operations: Byte-level, bit-level, rotate and swap operations; Arithmetic operations: Flags, incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic; Jump and call instructions: Jump and call program range, jumps, calls and subroutines, interrupts and returns.

**Module 7: Support IC chips**

[6]

8255, 8253 and 8251: Block Diagram, Pin Details, Modes of operation, control word(s) format. Interfacing of support IC chips with 8085, 8086 and 8051.

**Text Books:**

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar, Penram International
2. The 8051 microcontroller - K. Ayala, Thomson
3. Microprocessors & interfacing – D. V. Hall, Tata McGraw-hill
4. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH
5. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley, Pearson
6. An Introduction to Microprocessor and Applications –Krishna Kant,Macmillan

**Reference Books:**

1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford university press
2. 8086 Microprocessor –K Ayala, Cengage learning
3. The 8051 microcontrollers – Uma Rao and Andhe Pallavi, Pearson

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	3	1	1	1	1	1	1	3
CO2	3	3	3	1	3	1	1	1	1	1	1	3
CO3	3	3	3	3	3	2	2	1	1	1	2	3
CO4	3	3	3	3	3	2	2	1	1	2	1	3
CO5	3	3	3	3	3	1	2	1	2	2	2	3

**Course Name: Power System – II**  
**Course Code: EE 602**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credit: 3**

**Prerequisites:** Basic Electrical Engineering, Circuit Theory, Electrical Machines – II, Power System – I.

**Course Outcome:** On successful completion of the course, the learner will be able to

- CO1.** Learn about advance structure of Power System.
- CO2.** Get depth knowledge of different types of power system protection, fault, stability analysis and load flow method.
- CO3.** Design and analysis of different types of substation and implement these ideas in industry or real life problem solve.

### Course Content

**MODULE – I: Representation of Power System Components [4L]**  
 Single-phase representation of balanced three phase networks, the one-line diagram and the Impedance or reactance diagram, per unit (PU) system.

Distribution substation: Types of substations, location of substations, substation equipments and accessories, Earthing (system and equipment), feeder and distributors, radial and loop systems.

**MODULE – II: Basic Idea of Real and Reactive Power Control [2L]**  
 Introduction to Real and Reactive Power Control (SMIB) Single machine connected to Infinite Bus.

**MODULE – III: Load Flow Studies [7L]**  
 Network model formulation, formation of Ybus, load flow problem, Gauss-Siedel method, Newton-Raphson method, Decoupled load flow studies with flowchart, comparison of load flow methods.

**MODULE – IV: Power System Stability [4L]**  
 Steady state stability, transient stability, equal area criteria, swing equation, multi machine Stability concept, Introductory idea of Voltage Stability and Voltage Collapsed.

**MODULE – V: Faults in Electrical Systems [7L]**  
 Transient on a transmission line, short circuit of a synchronous machine under no load and Loaded condition. Symmetrical component transformation, sequence impedance and sequence network of power system, synchronous machine, transmission lines and transformers. Symmetrical component analysis of unsymmetrical faults, L-G fault, L-L fault, L-L-G fault.

**MODULE – VI: Power System Protection [12L]**  
**i) Operating Principles and Relay Constructions: 6L**

Functions of Protective Relaying, different terminologies used in protective relaying, Basic Operation of Relay, Electromagnetic Attraction Relays (Plunger Type, Hinged Armature Type, Balanced Beam Type, Polarized Moving Iron Type), Advantages and Disadvantages, Applications of Electromagnetic Attraction Relays, Electromagnetic Induction Type Relays, Theory of Induction Relay Torque, Induction Type Over Current Relay (Non-Directional), Induction Type Directional Power Relay, Directional Over Current Relay, Distance Relay (Impedance Relays, Reactance Relay, MHO Relay), Differential Relay (Current Differential Relay, Voltage Balance Differential Relay) Translay Relay, Directional Relay (Single Phase Directional Relays), Negative Sequence



Relays, Under Frequency Relays, Over Current Relays, Static Relays (Transductor Relays, Rectifier Bridge Relays, Transistors Relays, Hall Effect Relays, Gauss Effect Relays). Over Current Relays (Static Time Over Current Relays, Directional Static Over Current Relay), Static Differential Relay, Static Distance Relays, Microprocessor Based Relays, Universal Relay Torque Equations, Protection Scheme for Transformer, Generators and Motors, Bus Zone Protection, Protection of Transmission Lines, C.T.s and P.T.s and their applications in the protective schemes. Static Relays and Numerical Protections.

**ii) Construction and operating principle of circuit Breaker: 6L**

Brief description of Circuit Breakers, Operating principle of Circuit Breaker, Arc Phenomenon, Principles of Arc Extinction, Methods of Arc Extinction, Voltage Breaking Transients, Transient Recovery Voltage, Current Chopping and Resistance Switching, Circuit Breaker Rating, Arc and Arc Extinction, Circuit Breaker Types, Oil Circuit Breaker, Vacuum Circuit Breaker, Air Blast Circuit Breaker, SF<sub>6</sub> Circuit Breaker and Operating Mechanism, Advantages and Disadvantages of Different Types of Circuit Breakers. Testing of Circuit Breakers.

**Text Books:**

1. Electrical Power System, Subir Roy, Prentice Hall
2. Power System Engineering, Nagrath & Kothary, TMH
3. Elements of power system analysis, C.L. Wodhwa, New Age International.
4. Electrical Power System, Ashfaq Hussain, CBS Publishers & Distributors
5. Principles of Power System, V.K. Mehta and Rohit Mehta, S.Chand.
6. A Course in Power Systems, J.B. Gupta, S.K. Kataria & Sons.

**Reference Books:**

1. Electric Power transmission & Distribution, S.Sivanagaraju, S.Satyanarayana, Pearson Education.
2. A Text book on Power system Engineering, Soni, Gupta, Bhatnagar & Chakrabarti, Dhanpat Rai & Co.
3. Power System Protection and Switchgear, Badri Ram, TMH
4. Electric Power distribution system Engineering, 2<sup>nd</sup> Edition, T. Gonen, CRC Press.
5. [www.powermin.nic.in/acts\\_notification/pdf/ier1956.pdf](http://www.powermin.nic.in/acts_notification/pdf/ier1956.pdf)

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	3	-	-	-	-	-	-	-	1
CO2	-	3	2	3	-	-	-	-	-	-	-	1
CO3	3	-	2	-	-	2	-	-	-	-	-	1

**Course Name: Control System – II**

**Course Code: EE 603**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:** Any introductory course on Matrix Algebra, Calculus, Engineering Mechanics.

**Course Outcome:**

- CO1.** Express and Solve system equations in state-variable form (state variable models).
- CO2.** Students will be able to analyze and design of discrete time control systems using z transform.
- CO3.** Students will be able to examine the stability of nonlinear systems using appropriate methods.

**Course Content**

**MODULE – I: State Variable Model of Continuous Dynamic Systems [13L]**

Converting higher order linear differential equations into state variable form. Obtaining SV model from transfer functions. Obtaining characteristic equation and transfer functions from SV model. Obtaining SV equations directly for R-L-C and spring-mass-dashpot systems. Concept and properties associated with state equations. Linear Transformations on state variables. Canonical forms of SV equations. Companion forms. Solutions of state equations, state transition matrix, properties of state transition matrix. Controllability and observability. Linear State variable feedback controller, the pole allocation problems. Linear system design by state variable feedback.

**MODULE – II: Analysis of Discrete Time (Sampled Data) Systems Using Z-Transform [10L]**

Difference Equations. Inverse Z transform. Stability and damping in z-domain. Practical sampled data systems and computer control. Practical and theoretical samplers. Sampling as Impulse modulation. Sampled spectra and aliasing. Anti-aliasing filters. Zero order hold. Approximation of discrete (Z domain) controllers with ZOH by Tustin transform and other methods. State variable analysis of sampled data system. Digital compensator design using frequency response.

**MODULE – III: Introduction to Non-Linear Systems [13L]**

Block diagram and state variable representations. Characteristics of common nonlinearities. Phase plane analysis of linear and non-linear second order systems. Methods of obtaining phase plane trajectories by graphical method – isoclines method. Qualitative analysis of simple control systems by phase plane methods. Describing Function method. Limit cycles in non-linear systems. Prediction of limit cycles using describing function. Stability concepts for nonlinear systems. BIBO vs. State stability. Lyapunov's definition. Asymptotic stability, Global asymptotic stability. The first and second methods of Lyapunov methods to analyze nonlinear systems.

**Text Books:**

1. Gopal M : Digital Control and State Variable Methods, 2e, – TMH
2. Roy Choudhuri, D., Control System Engineering, PHI
3. Nagrath I J & Gopal M : Control Systems Engg. - New Age International
4. Anand,D.K, Zmood, R.B., Introduction to Control Systems 3e, (Butterworth-Heinemann), Asian Books

**Reference Books:**

1. Goodwin, Control System Design, Pearson Education
2. Bandyopadhyaya, Control Engg. Theory and Practice, PHI
3. Kuo B.C. : Digital Control System, Oxford University Press.
4. Houpis, C.H, Digital Control Systems, McGraw Hill International.
5. Ogata, K., Discrete Time Control Systems, Prentice Hall, 1995
6. Jury E.I. : Sampled Data Control System- John Wiley & Sons Inc.
7. Umez-Eronini, Eronini., System Dynamics and Control, Thomson
8. Dorf R.C. & Bishop R H. Modern Control System- Pearson Education.
9. Ramakalyan, Control Engineering, Vikas
10. Natarajan A/Reddy, Control Systems Engg., Scitech
11. Lyshevski, Control System Theory with Engineering Applications, Jaico
12. Gibson J E : Nonlinear Control System - McGraw Hill Book Co.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	1	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1

**Course Name: Data Base Management System**

**Course Code: EE 604A**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:**

1. Logic of programming language
2. Basic concepts of data structure and algorithms

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

- CO1.** Apply the knowledge of Entity Relationship (E-R) diagram for an application.
- CO2.** Create a normalized relational database model.
- CO3.** Analyze real world queries to generate reports from it.
- CO4.** Determine whether the transaction satisfies the ACID properties.
- CO5.** Create and maintain the database of an organization.

**Course Content**

**Module 1: Introduction [3L]**  
 Concept and Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

**Module 2: Entity-Relationship and Relational Database Model [11L]**  
 Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.

**Module 3: SQL and Integrity Constraints [6L]**  
 Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

**Module 4: Relational Database Design [8L]**  
 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 , Case Study

**Module 5: Internals of RDBMS [9L]**  
 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, Dead Lock handling

**Module 6: File Organization and Index Structures [6L]**  
 File and Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes

**Text Books:**

1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin

Cummings Publishing Company.

3. Ramakrishnan: Database Management System , McGraw-Hill
4. Gray Jim and Reuter Address, “Transaction Processing : Concepts and Techniques”, Moragan Kauffman Publishers.
5. Ullman JD., “Principles of Database Systems”, Galgottia Publication.

**Reference Books:**

1. Jain: Advanced Database Management System CyberTech
2. Date C. J., “Introduction to Database Management”, Vol. I, II, III, Addison Wesley.
3. “Fundamentals of Database Systems”, Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition
4. “Database Management Systems”, Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	2	1	1	2	2	3	3
CO2	2	3	3	3	3	1	1	1	2	2	3	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3

**Course Name: Embedded Systems**  
**Course Code: EE 604B**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credit: 3**

**Prerequisites:** Concept of Digital Electronics, Microprocessor and Microcontrollers.

**Course Outcome:**

- CO1.** To familiarize with concepts related to the fundamental principles embedded systems design, explain the process and apply it.
- CO2.** To understand knowledge of the advanced Embedded technology both for hardware and software.
- CO3.** To understand Hardware/Software design techniques for microcontroller-based embedded systems and apply techniques in design problems.
- CO4.** To develop Embedded System programming in C and assembly language using Integrated Development Environments and using debugging technique.

**Course Content**

**Module I: Introduction to Embedded System [12L]**

Basics of Embedded computer Systems, Microprocessor and Microcontroller difference, Hardware architecture and software components of embedded system List of various applications [Mobile phones, RFID, WISENET, Robotics, Biomedical Applications, Brain machine interface etc.], Difference between embedded computer systems and general-purpose computer Systems. Characteristics of embedded systems, Classifications of embedded system.

**Module II: Hardware Software Co-Design [16L]**

Co-Design Types: Microprocessors/Microcontrollers/DSP based Design, FPGA/ASIC/pSOC based Design, Hybrid Design. Methodology: i) System specifications; ii) co-specifications of hardware and software; iii) System Design Languages (capturing the specification in a single Description); iv) System modelling/simulation; v) Partitioning (optimizing hardware/software partition); vi) Co-verification (simulation interaction between custom hardware and processor) f) Co-implementation; vii) Embedded Systems Design development cycle. Programming concepts and embedded programming in C.

**Module III: Real Time Operating System (RTOS) [8L]**

Introduction, Types, Process Management, Memory Management, Interrupt in RTOS, Task scheduling, Basic design using RTOS; Basic idea of Hardware and Software testing in Embedded Systems

**Text Books:**

1. Embedded system Design: Peter Marwedel, Springer
2. Embedded Systems - Raj Kamal
3. Embedded Systems - K. Shibu

**Reference Books:**

1. M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, 2007.
2. R. Kamal, "Embedded System", McGraw Hill Education, 2009.
3. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	3	2	-	1	-	-	-	1	1	-	1
<b>CO2</b>	3	2	2	-	-	-	-	1	2	1	-	1
<b>CO3</b>	3	2	1	2	1	1	-	-	2	1	-	-
<b>CO4</b>	3	2	2	1	1	1	-	1	2	1	-	1

**Course Name: Software Engineering**

**Course Code: EE 604C**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:**

1. An understanding of basic computer software.
2. Object Oriented programming skills.

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

- CO1.** Understand the structure and behaviour a software system the UML class diagrams and state diagrams.
- CO2.** Understand common lifecycle processes including waterfall (linear), incremental approaches (such as Unified process), and agile approaches.
- CO3.** Apply software testing and quality assurance techniques at the module level, and understand these techniques at the system and organization level.
- CO4.** Work collaboratively in a small team environment to develop a moderate-sized software system from conceptualization to completion, including requirements elicitation, system modelling, system design, implementation, unit and system testing, integration, source code management configuration management, and release management.
- CO5.** Prepare technical documentations and make presentations on various aspects of a software development project, including the technical aspects (architecture, design, quality assurance) as well as the managerial aspects (planning, scheduling, and delivery).

**Course Content**

- Module I: Introduction** **3L**  
 Definition of SE, Software crisis, Evolution of technology- Hype curve, Exploratory style of Software development vs SE, Human cognition mechanism, SE principle- abstraction and decomposition.
- Module II: Software life-cycle models** **4L**  
 Water fall model, V Model, Prototyping Model, Spiral Model, RAD Agile Model.
- Module III: Software Project Management** **10L**  
 Responsibility of a project manager, Project planning, Metrics for project size estimation, Project estimation techniques, COCOMO model, Halstead's Software Science, Scheduling- CPM, PERT, Gantt chart, Risk management, Software configuration management, Staffing and team leader project and planning.
- Module IV: Requirement analysis and specification** **4L**  
 SRS, Requirement gathering and specification, Functional requirement, Traceability, 4GL.
- Module V: Software Design** **7L**  
 Characteristics of a good software, Cohesion and coupling, Function oriented design- DFD, Structure chart. Object oriented design- class and relationship, Design phase in life cycle, System Design Definitions, Concept and methodologies, data flow oriented Design, Program Design and the requirements



**Module VI: Coding and Testing****10L**

Coding Standard, software documentation, Testing- unit testing, black box testing- equivalence class partitioning, boundary value analysis, white box testing- McCabe's Cyclomatic Complexity, Mutation Testing, Debugging, Program analysis tool, Integration Testing, Grey box testing, System testing- Smoke and performance testing.

**Module VII: Software Reliability and Quality Management****5L**

Reliability, Hazard, MTTF, Repair and Availability, Software quality, SEI CMM and ISO-9001. Software reliability and fault-tolerance, Six sigma

**Module VIII: Computer-aided software engineering (CASE)****4L**

Environment and benefit, Function point methods (FSM, ISO, OMG) & Metrics. Standards: Capability Maturity Model Integration, ISO 9001.

**Text Books:**

1. Rajib Mall: Software Engineering, PHI
2. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Seventh Edition, McGraw-Hill International Edition.

**Reference Books:**

1. Ian Sommerville, "Software Engineering", 9<sup>th</sup> Edition, Pearson Education Asia, 2011.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	1	1	-	-	-	-	-	3
CO2	3	3	-	3	-	-	2	-	1	2	2	3
CO3	3	3	2	3	3	2	-	-	-	3	3	3
CO4	3	3	1	2	-	-	-	-	2	-	2	3
CO5	3	3	-	1	2	-	1	-	-	1	3	3

**Course Name: Digital Signal Processing**

**Course Code: EE 605A**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:**

Prerequisites for Digital signal Processing are required a thorough understanding of various signals, systems, and the methods to process a digital signal and also the knowledge of arithmetic of complex numbers and a good grasp of elementary calculus. The questions reflect the kinds of calculations that routinely appear in Signals. The candidates are expected to have a basic understanding of discrete mathematical structures.

The candidates required the concept of Z-transform, Relation between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Initial value theorem and final value theorem, stability considerations for LTI systems using Z-transform, Parseval's relation, Inverse Z-transform by Residue method, power series & partial-fraction expansions.

**Course Outcome:**

- CO1.** Able to define discrete systems in the Frequency domain using Fourier analysis tools like DFT, FFT.
- CO2.** Able to interpret the properties of discrete time signals in time domain and frequency domain.
- CO3.** Able to describe finite word length effects and digital filters.
- CO4.** Able to analyse convolution for long sequences of data.
- CO5.** Able to implement digital filters.

**Course Content**

**MODULE – I: Discrete-time Signals and Systems**

**6L**

**i) Discrete-time signals:**

Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, sampling theorem, sequences, -periodic, energy, power, unit-sample, unit step, unit ramp and complex exponentials, arithmetic operations on sequences.

**ii) LTI systems:**

Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercise, properties of convolution, interconnection of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems.

**MODULE – II: Z-Transforms**

**4L**

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 ROC, convolution, correlation and multiplication using Z-transform, initial value theorem, Parseval's relation, inverse Z-transform by contour integration, power series and partial-fraction expansions with examples and exercises.

**MODULE – III: Fourier Transforms**

**10L**

**i) Discrete Time Fourier Transform (DTFT):**

Concept of frequency in discrete and continuous domain and their relationship (radian and radian/sec), freq. response in the discrete domain. Discrete system's response to sinusoidal/complex inputs (DTFT), Representation of LTI systems in complex frequency domain.

**ii) Discrete Fourier Transform:**

Concept and relations for DFT/IDFT, Relation between DTFT and DFT. Twiddle factors and their properties, computational burden on direct DFT, DFT/DFT as linear transformation, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circulation 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.

**iii) Fast Fourier Transforms:**

Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal, examples for DIT and DIF FFT, Butterfly computations and exercises.

**MODULE – IV: Filter Design****10L**

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Bandstop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

**MODULE – V: Digital Signal Processor****6L**

Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713 processor, writing of small programs in assembly Language to measure A.C. and D.C. voltage, current, power and energy.

**Text Books:**

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis & D.G.Manolakis, Pearson Ed.
2. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co.
3. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
4. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co.

**Reference Books:**

1. Digital Signal Processing; Spectral Computation and Filter Design Chi-Tsong Chen, Oxford University Press
2. Texas Instruments DSP Processor user manuals and application notes.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	2	-	2	2	2	2	3
CO2	3	2	2	1	2	3	-	2	2	1	2	3
CO3	3	3	1	3	2	3	1	2	2	1	2	3
CO4	3	2	1	3	-	3	1	3	1	1	1	3
CO5	3	2	-	1	-	-	1	1	1	2	2	1

**Course Name: High Voltage Engineering**

**Course Code: EE 605B**

**Contact: 3L:0T:0P**

**Total Contact Hours: 36**

**Credit: 3**

**Prerequisites:** Concept of Basic Physics, Measurement and Instrumentation, Fundamentals of Power System, Switchgear, Travelling waves.

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

- CO1.** Understand the basic physics associated with various breakdown processes in different insulating materials.
- CO2.** Knowledge of generation and measurement of A. C., D.C., Impulse voltages and currents.
- CO3.** Knowledge of tests on H.V. equipment and on insulating materials, as per the standards.
- CO4.** Knowledge of the causes of Overvoltages in power system and Insulation Coordination in a substation.

### Course Content

**MODULE – I: Breakdown Occurrences 13L**

***i) Breakdown of Gases:***

Ionization processes and de-ionization processes, Types of Discharge, Charge multiplication, Secondary emission, Townsend's Theory, Streamer Mechanism, Paschen's Law, Gases as insulating materials, Determination of Minimum breakdown voltage, Breakdown in uniform and non-uniform gaps, Corona discharge.

***ii) Breakdown of Liquid:***

Breakdown in pure and commercial liquids, Cavitation Theory, Suspended Particle Theory.

***iii) Break Down of Solids:***

Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown, Streamer Breakdown.

***iv) Partial Discharge:***

Definition and development in solid dielectrics and composite dielectrics.

***v) Breakdown in Vacuum:***

Non-metallic electron emission mechanism, Clump mechanism, Effect of pressure on breakdown voltage.

**MODULE – II: Generation of High Voltages and Currents 6L**

***i) Generation of High Alternating Voltages and Currents:***

Testing transformer, Cascaded transformer, Series resonant circuit, single stage and multi stage. Advantages of Series Resonant Circuit in testing of cables.

***ii) Generation of High D.C. Voltages and Currents.:***

Cockcroft Walton doubler and multistage circuit, Electrostatic generator.

Definition of Impulse Voltage and current as per Indian Standard Specification, Wave front and wave tail time, Generation of Impulse Voltage, Multistage Impulse generator, tripping and control of impulse generators.

**MODULE – III: Measurement of High Voltages and Currents 4L**

Peak voltage, impulse voltage and high direct current measurement method as per Indian Standard Specifications, cathode ray oscillographs for impulse voltage and current measurement, Sphere gap voltmeter, Resistance and Capacitance Potential dividers, Peak voltmeters for measurement of high

A.C. voltage in conjunction with capacitance dividers. Capacitance Voltage Transformer, Rotating Voltmeter for the measurement of D.C. high voltage, partial discharge measurements, Electrostatic Voltmeter.

**MODULE – IV: Lightning and Switching Over-voltages 8L**

Lightning Phenomena, Charge formation in the Clouds, Development of Lightning Stroke, lightning induced over voltage, direct stroke, indirect stroke. Protection of Electrical Apparatus against over voltage, Lightning Arrestors, Valve Type, Metal Oxide arresters, Expulsion type. Effect of location of lightning arresters on protection of transformer. Protection of substation, Ground wires, Surge diverters, Surge absorbers, Insulation Coordination, Basic Insulation level. Basic Impulse level, Switching Impulse level. Volt time characteristics of protective devices, Determination of Basic Impulse level of substation equipment.

**MODULE – V: High Voltage Testing of Electrical Apparatus and High Voltage Laboratories 5L**

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, induced over voltage and impulse test on transformers, Power frequency dry and wet withstand test of insulators, Impulse test on insulators, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H.V. Laboratories.

**Text Books:**

1. High Voltage Engineering, C.L. Wadhwa, New Age International Publishers.
2. High Voltage Engineering, M.S. Naidu & V. Kamaraju, Tata McGraw Hill publication.
3. Extra High Voltage AC Transmission Engineering, R.D. Bgamudre, New Age Internal Publishers.
4. D. V. Razevig (Translated by Dr. M. P. Chourasia), “High Voltage Engineering Fundamentals”, Khanna Publishers.

**Reference Books:**

1. High Voltage Engineering, M.A. Salem, H. Anis, A. E. Morahedy, R. Radwan, Marcel Dekker, Inc.
2. E. Kuffel, W. S. Zaengl and J. Kuffel, “High Voltage Engineering Fundamentals”, Newnes Publication.
3. R. Arora and W. Mosch “High Voltage and Electrical Insulation Engineering”, John Wiley & Sons.
4. Various IS standards for HV Laboratory Techniques and Testing.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	-	-	-	-	-	-	-	2	3
CO2	3	3	1	-	-	-	-	-	-	-	2	3
CO3	3	2	2	-	-	-	-	-	-	-	2	3
CO4	3	3	2	-	-	-	-	-	-	-	2	3

**Course Name: Computer Architecture**  
**Course Code: EE 605C**  
**Contact: 3L:0T:0P**  
**Total Contact Hours: 36**  
**Credit: 3**

**Prerequisites:** Digital Electronics and Computer Organization.

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

- CO1.** Learn pipelining concepts with a prior knowledge of stored program methods.
- CO2.** Learn about memory hierarchy and mapping techniques.
- CO3.** Study of parallel architecture and interconnection network.

### Course Content

<b>Module – 1: Introduction</b>	<b>[5L]</b>
Introduction to basic computer architecture.	1L
Stored Program Concepts: Von Neumann & Havard Architecture	1L
RISC VS CISC	1L
Amdahl's law.	1L
Performance Measure: MIPS, Benchman Programs (SPECINT,SPECFP).	1L
<b>Module – 2: Pipelining</b>	<b>[6L]</b>
Pipelining: Basic concepts, Linear vs. Non Linear, Static vs. Dynamic, Unifunction vs. Multifunction.	2L
Instruction Pipeline.	1L
Arithmetic pipeline.	1L
Hazards: Data hazards, control hazards and structural hazards.	1L
Techniques for handling hazards.	1L
<b>Module – 3: Instruction-level parallelism</b>	<b>[4L]</b>
Instruction-Level Parallelism: Basic Concepts	1L
Techniques For Increasing ILP, Superscalar, Super Pipelined	1L
VLIW Processor Architectures	1L
Array and Vector Processors	1L
<b>Module – 4: Memory</b>	<b>[5L]</b>
Memory Hierarchy: Internal Memory, Main Memory, Cache Memory, Secondary memory.	2L
Mapping Technique in cache memory: Direct, Full Associative and Set Associative.	2L
Performance Implementation in Cache Memory.	1L
<b>Module – 5: Multiprocessor Architecture</b>	<b>[16L]</b>
Introduction to Parallel Architecture-Different Classification scheme, Performance of Parallel Computers, PRAM model (EREW, CREW, CRCW)	6L
Interconnection Network (Omega, Baseline, Butterfly, Crossbar)	6L
Multi-Core Processor with case study (INTEL)	2L
Different Classification scheme: Serial Vs. Parallel, Pipeline vs. Parallel	2L

**Text Books:**

1. Patterson D.A. and Hennessy , J.L. “Computer architecture a quantitative approach”, 2<sup>nd</sup> ed., Morgan Kaufman, 1996

2. Stone, H.S., “Advanced Computer”, Addison Wesley, 1989
3. Siegel, H.J., “Interconnection Network for Large Scale parallel Processing”, 2<sup>nd</sup> Ed., McGraw Hill, 1990

**Reference Books:**

1. Hwang & Briggs—Computer Architecture & Parallel Processing, TMH
2. Hayes J. P., “Computer Architecture & Organisation”, McGraw Hill
3. Design and Analysis of Prallel Algorithm-Schim G. Akl

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	-	-	-	-	-	-	-	-
CO2	3	-	2	-	-	-	-	-	-	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-

**Course Name: Microprocessor and Microcontroller Laboratory**

**Course Code: EE 691**

**Contact: 0L:0T:2P**

**Credit: 1**

**Prerequisites:** Knowledge in Digital Electronics.

**Course Outcomes:**

- CO1.** Able to handle arithmetic and Logical operations, using assembly language programming in 8085 & 8086 Trainer Kits.
- CO2.** Able to Program using arithmetic, logical and bit manipulation instructions of 8051.
- CO3.** Able to validate the interfacing technique of 8255 Trainer kit with 8085 & 8086 through Subroutine Call and IN/OUT instructions like glowing LEDs accordingly, to control stepper motor rotation, interfacing Seven Segment Display and to display a string etc.
- CO4.** Able to program and verify Timer/Counter and Interrupt handling in 8051.

**List of Experiment:**

***Demonstration Programs for 8085 Trainer Kit***

1. Familiarization with 8085 register level architecture, the basic instruction sets (data transfer, arithmetic, logical, branching) and the trainer kit components including the memory map.
2. Familiarization with the process of storing, executing and viewing the contents of memory as well as registers in the trainer kit 8085 and simulator through small assignments.
3. Programming using 8085 kit and simulator for: Addition, Subtraction, Multiplication by repeated addition method, Square, Complement, look up table, copying a block of memory, Shifting, Packing and unpacking of BCD numbers, Addition of BCD numbers, Binary to ASCII conversion.

***Demonstration Programs for 8086 Trainer Kit***

4. Addition, Subtraction, Multiplication & division of two 16-bit numbers using 8086 trainer kit
5. Factorial of two 16-bit numbers using 8086 trainer kit
6. Smallest and Largest number from an array of numbers, Ascending order, Descending Order, String Matching, Multiplication using shift and add method using 8086 trainer kit.

***Interfacing with 8086***

7. Interfacing Stepper motor with 8086 trainer kit using 8255
8. Interfacing Seven Segment Display using 8086 trainer kit and to display a string

***Interfacing with 8051***

9. Programming using arithmetic, logical and bit manipulation instructions of 8051
10. Program and verify Timer/Counter in 8051
11. Program and verify Interrupt handling in 8051

***Additional Programs***

12. Read a character from a keyboard and display it on Screen
13. Display a string on screen
14. To check for a Password



**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	3	3	1	3	1	1	1	1	1	1	3
<b>CO2</b>	3	3	3	1	3	1	1	1	1	1	1	3
<b>CO3</b>	3	3	3	3	3	2	2	1	1	1	2	3
<b>CO4</b>	3	3	3	3	3	2	2	1	1	2	1	3

**Course Name: Power System – II Laboratory**

**Course Code: EE 692**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Circuit Theory, Electrical Machines – I, Power System – I.

**Course Outcomes:** On completion of the course students will be able to

- CO1.** Analyse the testing, operation and response of protection of electrical instruments.
- CO2.** Conduct experimental investigation and gain knowledge of various parts of relays and its operation.
- CO3.** Able to incorporate the measuring error with actual value and calibrate the instrument transformers.
- CO4.** Enhance the capability of software analysis by load flow solution in ETAP, MATLAB etc.

**List of Experiment:**

1. Study on (i) on load Time Delay Relay (ii) off load Time Delay Relay
2. Polarity, Ratio and Magnetization Characteristics Test of CT & PT
3. Testing on (i) Under Voltage Relay and (ii) Earth Fault Relay
4. Study on D C Load Flow
5. Study of A C Load Flow Using Gauss – Seidel Method
6. Study of A C Load Flow Using Newton – Raphson Method
7. Study of IEEE 30, 66 bus Load Flow by Software Simulation (ETAP, MAT Lab or others)
8. Study on Economic Load Dispatch by software
9. Study of Transformer Protection by Simulation
10. Study of Generator Protection by Simulation
11. Study of Motor Protection by Micon Relay
12. Study of Different Characteristics of Over Current Relay.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	-	-	-	1	-	-	-	-	-	-
CO2	-	3	3	-	-	1	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-	-	-	-
CO4	3	-	3	2	-	-	-	-	-	-	-	-

**Course Name: Control System – II Laboratory**  
**Course Code: EE 693**  
**Contact: 0L:0T:3P**  
**Credit: 1.5**

**Prerequisites:** Knowledge of MATLAB.

**Course Outcomes:** On completion of the course students will be able to

- CO1.** Conduct experiments on Position Control with proper tuning of P, PI and PID controller.
- CO2.** Demonstrate Lead-Lag Compensators.
- CO3.** Investigate the response of a Real Time System using State Variable Analysis.
- CO4.** Analyse Performance of Discrete-Time System an Non-Linear System.

**List of Experiment:**

- 1. Study of a Practical Position Control System:**  
Obtaining closed step responses for gain setting corresponding to over-damped and under-damped responses. Determination of rise time and peak time using individualized components in SIMULINK. Determination of un-damped natural frequency and damping ratio from the experimental data.
- 2. Tuning of P, PI and PID Controller for First Order Plant with Dead Time using Z-N Method:**  
Process parameters (time constant and delay/lag) will be provided, the students would compute controller gains by using Z-N method. Steady state and transient performance of the closed loop plant with and without steady disturbances will have to be noted. Theoretical phase and gain margins will have to be manually computed for each gain settings.
- 3. Design of Lead and Lag Compensation Using Cacsad Tools:**  
Plant transfer function will be provided. Step response is to be obtained. (PSPICE, MATLAB, SciLab may be used).
- 4. State Variable Analysis using Cacsad Command Tool:**  
Familiarization and use of CACSAD command for state variable analysis. Obtaining transfer function from SV model and vice versa. Obtaining step response for a SISO system given in SV form. (PSPICE, MATLAB, SciLab may be used).
- 5. State Variable Analysis using Cacsad Block Diagram Tool:**  
Familiarization and use of CACSAD BLOCK DIAGRAM TOOL for state variable analysis. Obtaining step response and initial condition response for a single input, two output system given in SV form. (PSPICE, MATLAB, SciLab may be used).
- 6. Performance Analysis of a Discrete Time System using Cacsad Tool:**  
Familiarization and use of CACSAD block diagram tool for Digital Control System. Study of closed response of a continuous system with a digital controller with sample and hold. (PSPICE, MATLAB, SciLab may be used).
- 7. Studying The Effects of Nonlinearity in a Feedback Controlled System using Time Response:**

Determination of step response with a limiter nonlinearity introduced into the forward path of 2nd order unity feedback control systems. The open loop plant will have one pole at the origin and the other pole will be in LHP or RHP. To verify that (i) with open loop stable pole, the response is slowed down for larger amplitude input and (ii) for unstable plant, the closed loop system may become oscillatory with large input amplitude. (PSPICE, MATLAB, SciLab may be used).

**8. Studying The Effects of Nonlinearity in a Feedback Controlled System using Phase Plane Plots:**

Determination of phase plane trajectory and possibility of limit cycle of common nonlinearities. CACSAD block diagram tool will be used (PSPICE, MATLAB, SciLab may be used).

*Note: From the list of experiments a minimum of 7 (seven) experiments shall have to be performed by each student.*

**Reference Books:**

1. Herniter, Programming in MATLAB, Vikas
2. Ogata K : Modern Control Engg. 4e, Pearson/PHI

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	-	-	2	1	3	3
CO2	3	3	2	3	2	1	-	-	2	-	1	2
CO3	3	3	3	3	3	2	-	-	2	-	1	2
CO4	3	3	2	3	3	2	-	-	2	2	3	3

**Course Name: Data Base Management System Laboratory**

**Course Code: EE 694A**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:**

1. Logic of programming language
2. Basic concepts of data structure and algorithms

**Course Outcomes:** On completion of the course students will be able to

- CO1.** Understand the basic concepts regarding database, know about query processing and techniques involved in query optimization and understand the concepts of database transaction and related database facilities including concurrency control, backup and recovery.
- CO2.** Understand the introductory concepts of some advanced topics in data management like distributed databases, data warehousing, deductive databases and be aware of some advanced databases like partial multimedia and mobile databases.
- CO3.** Differentiate between DBMS and advanced DBMS and use of advanced database concepts and become proficient in creating database queries.
- CO4.** Analyse database system concepts and apply normalization to the database.
- CO5.** Apply and create different transaction processing and concurrency control applications.

**List of Experiment:**

- A. Structured Query Language
  1. Creating Database
    - a) Creating a Database
    - b) Creating a Table Specifying Relational Data Types
    - c) Specifying Constraints Creating Indexes
  2. Table and Record Handling
    - a) INSERT statement
    - b) Using SELECT and INSERT together
    - c) DELETE, UPDATE, TRUNCATE statements
    - d) DROP, ALTER statements
  3. Retrieving Data from a Database
    - a) The SELECT statement
    - b) Using the WHERE clause
    - c) Using Logical Operators in the WHERE clause
    - d) Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause Using Aggregate Functions
    - e) Combining Tables Using JOINS
    - f) Sub-queries
  4. Database Management
    - a) Creating Views
    - b) Creating Column Aliases
    - c) Creating Database Users
    - d) Using GRANT and REVOKE
- B. PL/SQL
- C. Database design using E-R model and Normalization
- D. Design and implementation of some on line system [Library Management System]

**Text Book:**

1. SQL, PL/SQL by Ivan Bayross, BPB Publications
2. Oracle PL/SQL Programming, 6th Edition - O'Reilly Media By Steven Feuerstein, Bill Pribyl

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	2	1	1	2	2	3	3
CO2	2	3	3	3	3	1	1	1	2	2	3	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3

**Course Name: Embedded Systems Laboratory**

**Course Code: EE 694B**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Concept of Digital Electronics Lab, Microprocessor and Microcontroller Lab.

**Course Outcomes:**

- CO1.** Familiarization with PIC Microcontroller, ARM Microcontroller, FPGA and their interfacing.
- CO2.** Design of different types real time projects with digital controllers.

**List of Experiment:**

**1. PIC based experiment (Any Five)**

- a) Familiarization of PIC kit.
- b) Interface and control a LED, LCD, Keyboard, ADC & DAC using PIC.
- c) Connect two PIC kit and transfer data serially.
- d) Design a Digital watch based on PIC.
- e) Control a stepper motor and display temperature from a temperature sensor on a LCD.

**2. ARM based experiment (Any Four)**

- a) Familiarization with ARM evaluation system
- b) Familiarization with Raspberry Pi
- c) Interfacing with a real time clock using a serial port to display time.
- d) Interface a Keyboard and display the keystrokes on a LCD, LED.
- e) Familiarization of image processing using ARM

**3. FPGA based experiment**

- a) Design a 3 to 8 decoder circuit.
- b) Design an UP/DOWN counter and display the count on a 7-segment display.
- c) Designing an ALU and verify with mathematical operations.
- d) Innovative Project.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	2	3
CO2	3	3	3	3	3	1	-	-	3	1	3	3

**Course Name: Software Engineering Laboratory****Course Code: EE 694C****Contact: 0L:0T:3P****Credit: 1.5**

**Prerequisites:** For Software Engineering Lab, design a project proposal which will be used throughout the lab for performing different experiments using CASE Tools.

**Course Outcomes:**

- CO1.** To handle software development models through rational method.
- CO2.** To prepare SRS document, design document, test cases and software configuration management and risk management related document.
- CO3.** To Develop function oriented and object oriented software design using tools like rational rose.
- CO4.** To perform unit testing and integration testing.
- CO5.** To apply various white box and black box testing techniques.

**Assignments to be given from the following:**

1. Preparation of requirement document for standard application problems in standard format. (e.g. Library Management System, Railway Reservation system, Hospital management System, University Admission system) .DFD of standard application problems.
2. Project Schedule preparation. Software Requirement Analysis: Describe the individual Phases/ modules of the project, Identify deliverables.
3. Use Case diagram, Class Diagram, Sequence Diagram, Activity Diagram and prepare Software Design Document using tools like Rational Rose.( For standard application problems)
4. Software Development and Debugging. Estimation of project size using Function Point (FP) for calculation.
5. Design Test Script/Test Plan(both Black box and White Box approach)
6. Compute Process and Product Metrics (e.g Defect Density, Defect Age, Productivity, Cost etc.) Cost Estimation models. COCOMO

**Recommended Books:**

1. Software Engineering: Apractitioner’s approach – Pressman (TMH)
2. Software Engineering – Pankaj Jalote (Wiley-India)

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	1	1	-	-	-	-	-	3
CO2	3	3	-	3	-	-	2	-	1	2	2	3
CO3	3	3	2	3	3	2	-	-	-	3	3	3
CO4	3	3	1	2	-	-	-	-	2	-	2	3
CO5	3	3	-	1	2	-	1	-	-	1	3	3



7th Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	PC	EE 701	Electrical Drives	3	0	0	3	3
2	OE	EE 702	D. Object Oriented Programming using JAVA	3	0	0	3	3
			E. Big Data Analysis					
			F. Digital Image Processing					
3	PE	EE 703	D. Power System – III	3	0	0	3	3
			E. Restructured Electrical Power System					
			F. Computer Applications in Power System					
4	PE	EE 704	D. Power System Dynamics and Control	3	0	0	3	3
			E. Power Quality and FACTS					
			F. HVDC Transmission Systems					
5	HS	HU 703	Industrial and Financial Management	2	0	0	2	2
<b>Total of Theory</b>							<b>14</b>	<b>14</b>
<b>B. PRACTICAL</b>								
6	PC	EE 791	Electrical Drives Laboratory	0	0	3	3	1.5
7	OE	EE 792	D. Object Oriented Programming Laboratory	0	0	3	3	1.5
			E. Big Data Analysis Laboratory					
			F. Digital Image Processing Laboratory					
8	PROJ	PR 791	Project – VII	0	0	0	6	3
9	PROJ*	PR 792	Innovative Activities – VI	0	0	0	0	0.5
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
10	MC	MC 781	Technical Lecture Presentation & Group Discussion – II	0	0	3	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>29</b>	<b>20.5</b>

\* Students may choose either to work on participation in Hackathons etc. Development of new product / Business Plan / registration of start-up.

Students may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry / NGO's / Government organizations / Micro / Small / Medium enterprises to make themselves ready for the industry / Long Term goals under rural Internship. (Duration 4-6 weeks)

Innovative activities to be evaluated by the Programme Head / Event Coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

**Paper Name: Electrical Drives**  
**Paper Code: EE 701**  
**Contact: 3L:0T:0P**  
**Credit: 3**

**Prerequisites:** Concept of Electrical Machines, and Power Electronics.

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

- CO1.** Analyse the characteristics of electric motors required for a particular drive.
- CO2.** Describe different types of braking and speed-control of electric motors for various applications.
- CO3.** Apply power electronic converters for various kinds of drive operations.

### Course Content

- Module – I: Fundamental Concept of Electric Drive 3L**  
 Definition of electric drive, type of drives; Speed torque characteristic of driven unit/loads, motors, Concept of Multi-quadrant operation, Classification and components of load torque; Equivalent value of drive parameters for loads with rotational and translational motion.
- Module – II: Electric Braking 3L**  
 Electric Braking of DC motor during lowering of loads and stopping, Regenerative braking, AC and DC rheostatic braking.
- Module – III: Selection of motor power rating 2L**  
 Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, Load equalization
- Module – IV: DC Motor Drives 7L**  
 Ward-Leonard System, Single phase and three phases controlled DC drives, Dual converter control of DC drives. Chopper controlled DC drives, Close loop control of DC drive.
- Module – V: Induction Motor Drives 8L**  
 Review of three phase Induction Motor analysis and performance, Stator voltage control, V/f controlled induction motors, Slip power recovery, CSI fed induction motor drives.
- Module – VI: Synchronous Motor Drives 10L**  
 Introduction, Sinusoidal SPM machine drives, synchronous reluctance machine drives, wound field synchronous motor drive, Load-commutated Synchronous Motor Drives, Model of PMSM.
- Module – VII: Application and Energy conversion Drives 3L**  
 Introduction to Battery Powered Drive for Solar System, Stepper motor Drive, Steel Mills, Paper Mills, Coal Mining, Energy Efficient operation and power factor improvement of drives.

#### **Text Books:**

1. G. K. Dubey, “Fundamentals of Electrical Drives”, Narosa, 2001.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, PHI-India, 2005.
3. N. K. De and P. K. Sen, “Electric Drives”, Prentice Hall of India Private Limited, 2006.
4. S. K. Pillai, “A First Course on Electrical Drives”, New Age International.
5. S. B. Dewan, G. R. Slemon and A. Straughen, “Power Semiconductor Drives”, John Wiley and Sons, New York 1984.

**Reference Books:**

1. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall international, New Jersey, 1989.
2. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia, 2003.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	3	2	-	1	-	-	-	1	-	-	1
CO3	1	3	2	-	1	-	-	-	1	-	-	1

**Paper Name: Object Oriented Programming using JAVA**

**Paper Code: EE 702A**

**Contact: 3L:0T:0P**

**Credit: 3**

**Prerequisites:**

1. Computer Fundamentals.
2. Basic understanding of Computer Programming and related Programming Paradigms.
3. Problem Solving Techniques with proper logic Implementation.

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

- CO1.** Design the process of interaction between Objects, classes & methods w.r.t. Object Oriented Programming.
- CO2.** Acquire a basic knowledge of Object Orientation with different properties as well as different features of Java.
- CO3.** Analyze various activities of different string handling functions with various I/O operations.
- CO4.** Discuss basic code reusability feature w.r.t. Inheritance, Package and Interface.
- CO5.** Implement Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.

**Course Content**

**Module 1: Introduction**

**5L**

Object Oriented Analysis and Design-Concepts of object oriented programming language, Object, Class; Relationships among objects and classes-Generalization, Specialization, Aggregation, Association, Composition, links, Meta-class; Object Oriented Programming concepts - Difference between OOP and other conventional programming – advantages and disadvantages. Class, object, Method; Properties of OOP- message passing, inheritance, encapsulation, polymorphism, Data abstraction; Difference between different OOPs Languages.

**Module 2: Java Basics**

**9L**

Basic concepts of java programming - Advantages of java, Byte-code and JVM, Data types, Different types of Variables; Access specifiers, Operators, Control statements and loops; Array; Creation of class, object, method; Constructor - Definition, Usage of Constructor, Different types of Constructor; finalize method and garbage collection, Method and Constructor overloading; this keyword, use of objects as parameter & methods returning objects; Call by value & call by reference; Static variables & methods. Nested & inner classes.

**Module 3: Basic String handling & I/O**

**4L**

Basic string handling concepts- Concept of mutable and immutable string, Methods of String class- charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length(), substring(); toCharArray(), toLowerCase(), toString(), toUpperCase() , trim() , valueOf() methods, Methods of String buffer class- append(), capacity(), charAt(), delete(), deleteCharAt(); ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString(); Command line arguments, basics of I/O operations – keyboard input using BufferedReader & Scanner classes.

**Module 4: Inheritance and Java Packages**

**8L**

Inheritance - Definition, Advantages, Different types of inheritance and their implementation; Super and final keywords, super() method; Method overriding, Dynamic method dispatch; Abstract

classes and methods; Interface - Definition, Use of Interface; Multiple inheritance by using Interface; Java Packages - Definition, Creation of packages; Importing packages, member access for packages.

**Module 5: Exception handling, Multithreading and Applet Programming 10L**

Exception handling - Basics, different types of exception classes. Difference between Checked & Unchecked Exception; Try & catch related case studies; Throw, throws & finally; Creation of user defined exception; Multithreading - Basics, main thread, thread life cycle; Creation of multiple threads-yield(), suspend(), sleep(n), resume(), wait(), notify(), join(), isAlive(); Thread priorities, thread synchronization; Interthread communication, deadlocks for threads; Applet Programming - Basics, applet life cycle, difference between application & applet programming; Parameter passing in applets.

**Text Books:**

1. Herbert Schildt – "Java: The Complete Reference " – 9th Ed. – TMH
2. E. Balagurusamy – " Programming With Java: A Primer " – 3rd Ed. – TMH.

**Reference Books:**

1. R. K. Das – " Core Java for Beginners " – VIKAS PUBLISHING.
2. Rambaugh, James Michael, Blaha – " Object Oriented Modelling and Design " – Prentice Hall, India.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	-	1	-	-	1
CO2	3	2	2	-	1	-	-	-	1	-	-	2
CO3	2	3	2	3	-	-	-	-	2	-	-	-
CO4	1	-	-	-	-	-	-	-	1	2	-	2
CO5	2	1	1	-	1	-	-	-	2	-	-	2

**Paper Name: Big Data Analysis**  
**Paper Code: EE 702B**  
**Contact: 3L:0T:0P**  
**Credit: 3**

**Prerequisites:** Familiarity and knowledge of Database Management Systems.

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

- CO1.** Identify the difference between structured, semi-structured and unstructured data.
- CO2.** Summarize the challenges of big data and how to deal with the same.
- CO3.** Explain Hadoop Ecosystem.
- CO4.** Identify the difference between Pig and Hive.

### Course Content

#### **Module I: Data and Big Data Analytics 8L**

##### **Introduction:**

**Types of digital data:** Structured: Sources of structured data and Ease with Structured data Semi-Structured: sources of semi-structured data Unstructured: sources of unstructured data: Issues with terminology, dealing with unstructured data. 2L

**Big data analytics-1:** Characteristics of data-Definition of big data-Challenges of big data Traditional BI vs. Big data-A typical BI environment-A big data environment-Big data stack. 2L

**Big data analytics-2:** Classification of analytics-Top challenges facing big data-Data science. 2L

**Terminologies used in big data environment:** In memory analytics-In database processing. Massively parallel processing-Parallel vs distributed systems-Shared Memory architecture CAP (Consistency, Availability, Partition Tolerance) theorem explained- BASE (Basically Available Soft State Eventual Consistency)-Few top Analytics tools. 2L

#### **Module II: Big Data Technology and Hadoop 9L**

**The big data technology landscape:** NoSQL-Types of NoSQL databases-Why NoSQL - Advantages of NoSQL- What we miss with NoSQL?-NoSQL Vendors SQL Vs. NoSQL. NewSQL - Comparison of SQL, NoSQL and NewSQL. 1L

**Hadoop:** Features of Hadoop- Key advantages of Hadoop- Versions of Hadoop-Hadoop 1.0 Hadoop2.0- Overview of Hadoop Ecosystems- Hadoop Vs. SQL- Integrated Hadoop systems offered by leading market vendors-Cloud based Hadoop solutions. 2L

**Introducing Hadoop:** Why not RDBMS-Distributed Computing Challenges. Hadoop Overview:Hadoop Components-High Level Architecture of Hadoop. Hadoop Distributed File System: HDFSArchitecture-Daemons Related to HDFS- Working with HDFS Command-Special Features of Hadoop. 2L

**Processing Data With Hadoop:** Introduction-How Map Reduce Works-Map Reduce Example. WordCount Example using Java. 2L

**Managing Resources and Applications with YARN:** Introduction-Limitation of Hadoop 1.0-Hadoop2: HDFS-Hadoop 2: YARN-Business Intelligence on Hadoop. 2L

#### **Module III: Hadoop Hive 10L**

**Introduction to Hive - The Problem Solution:** Hive Use Case- Data Growth- Schema Flexibility and Evolution- Extensibility. What is Hive: History of Hive and Recent Releases of Hive-Hive Features-HiveIntegration and Work Flow- Hive Data Units.Hive Architecture-Hive Primitive Data Types and Collection Types-Hive File Formats-Hive QueryLanguage Statements: DDL-DML. Hive Partitions-Bucketing-Views-Sub Query-Joins Hive User Defined. 4L

Function-Aggregations in Hive-Group by and Having-Serialization and Deserialization-Hive AnalyticFunctions. 6L

**Module IV: Hadoop – Pig** 9L

**Hadoop – Pig:** Introducing Pig: History and Anatomy of Pig-Pig on Hadoop-Pig Features-PigPhilosophy-Word count example using Pig-Use Case for Pig-Pig Primitive Data Types, Collection Typesand NULL. 2L

**Pig Latin Overview:** Pig Latin Grammar - Comments, Keywords, Identifiers-Case sensitivity in Pig-Common Operators in Pig. 1L

**Pig Statements:** LOAD-STORE-DUMP-Interactive Shell – GRUNT: FILTER- SORTGROUP BY-ORDER BYJOIN-LIMIT. 2L

**Pig Latin Script:** Local Mode-Map Reduce Mode-Running Pig Script. Working with: Field Tuple-Bag. User Defined Function-Parameters in Pig. 2L

**Jasper Report using Jasper soft studio:** Introduction to Jasper Report using Jasper Soft Studio Reportingusing MongoDB-Reporting using Cassandra. 2L

**Text Books:**

1. Mark Dexter, Louis Landry, “Joomla Programming”, 2012 Pearson Education.
2. SeemaAcharya and Subhashini C, “Big Data and Analytics”, Wiley Publication, 2015

**Reference Books:**

1. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman, “Big data for dummies”, Wiley Publication, 2013.
2. Tom White, “Hadoop: The Definitive Guide”, O’Rilly Publication, 2015.
3. Chuck Lam, “Hadoop in action”, Dreamtech Press, 2011.
4. Dirk Deroos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown, “Hadoop for dummies”, Wileypublication, 2015.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	1	-	-	1	1	1	1
CO2	2	2	2	2	3	1	-	-	1	1	1	1
CO3	2	2	2	2	3	1	-	-	1	1	1	1
CO4	2	3	2	2	3	1	-	-	1	1	1	1

**Paper Name: Digital Image Processing**

**Paper Code: EE 702C**

**Contact: 3L:0T:0P**

**Credit: 3**

**Prerequisites:** Basic concept of vectors and matrices (relation between a column matrix and vector), inner product of two vectors, matrix multiplication, inversion, extracting Eigenvectors and Eigen values of a matrix, covariance matrix. Perception of dimensionality and hyper plane. Distance measures in Euclidean space between two points (e.g. Euclidean distance) and a point with a group of points (Mahalanobis distance). Knowledge about statistical distributions (e.g. Normal/ Gaussian), statistical independence, probability distribution function, condition probability, the law of total probability and Bayes rule.

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

- CO1.** Explain the structure of human eye, image formation, Brightness, sensing and acquisition, storage, Processing, Communication, Display Image Sampling and quantization, spectrum analysis.
- CO2.** Illustrate image Enhancement in the Spatial and Frequency Domain, image transformations, Histogram processing, time and Spatial filtering.
- CO3.** Evaluate Image and video Data Compression, Redundancies.
- CO4.** Develop Morphological Processed Image using Dilation, Erosion, Opening, closing, Hit -or-miss transformation.
- CO5.** Evaluate Image Segmentation by detection of discontinuities, Edge linking and Boundary detection, Thresholding, Image Representation schemes, Boundary descriptors, and Regional descriptors.

### Course Content

<b>Module 1: Digital Imaging Fundamentals and Its Transform</b>	<b>7L</b>
<b>Digital Imaging Fundamentals:</b>	
Basic idea of Digital image, Image formation in human eye, Pixel, Mathematical operation of Digital Image, Sampling, Quantization, application of digital Image Processing.	3L
<b>Transform of Digital Images:</b>	
Importance of Digital Image Transform, Fourier Transform of Digital Image (DFT), Inverse Fourier Transform (IDFT), Fast Fourier Transform, Inverse Fast Fourier Transform, Application of Digital Image Transform in different area.	4L
<b>Module 2: Digital Image Enhancement</b>	<b>6L</b>
Importance of Digital Image enhancement, enhancement in spatial and frequency domain, Bit plane slicing, Histogram, Histogram Equalization , Mean and Median filtering in Digital Images, Frequency domain filtering in Digital Images – LPF, HPF and BPF.	
<b>Module 3: Digital Image Compression</b>	<b>6L</b>
Importance of Digital Image Compression, Types of Image Compression, example of lossless and lossy compression, Image compression standards, Compression in spatial domain, compression using Huffman coding, DCT and Wavelet based Digital image compression.	
<b>Module 4: Digital Image Restoration and Segmentation</b>	<b>8L</b>
<b>Digital Image Restoration:</b>	



Application and Importance of Digital Image Restoration, Reason for Image degradation, Inverse filtering. 3L

**Segmentation of Digital Images:**

Importance and applications of Digital Image Segmentation, Detection of discontinuities, Edge linking and Boundary detection, Thresholding, Segmentation based on Region Growing, Watershed algorithm. 5L

**Module 5: Edge Detection and Security**

8L

**Edge Detection in Digital Image Processing:**

Importance of Edge detection in Digital Image Processing, Types of Edge Detection, Mathematical Equation of each operator. 4L

**Security in Digital Image Processing:**

Importance of Digital Image Security, Watermarking, Image encryption in spatial and frequency domain, Steganography. 4L

**Text Books:**

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
2. S. Annadurai, R. Shanmugalakshmi, "Fundamentals of Digital Image Processing", Pearson Education, 2006.

**Reference Books:**

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
3. William K Pratt, "Digital Image Processing", John Willey, 2002.
4. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	2	2	2	2	2	2	2
CO2	3	3	3	3	2	3	2	2	2	2	2	2
CO3	3	3	2	2	3	2	2	2	2	2	1	2
CO4	3	3	2	2	2	3	2	2	1	2	2	2
CO5	3	3	3	3	2	2	2	2	2	2	2	2

**Paper Name: Power System – III**

**Paper Code: EE 703A**

**Contact: 3L:0T:0P**

**Credit: 3**

**Prerequisites:** Electrical Machines – II, Power Systems – I, Power Systems – II, Control Systems – I, Control Systems – II.

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

- CO1.** Demonstrate various power systems components, models and their operation, optimization of cost criteria.
- CO2.** Apply fundamentals and concepts to analyze, formulate and solve complex problems of electrical power systems and its components and control of frequency and voltages.
- CO3.** Analyze advanced techniques, skills and modern scientific and engineering tools for professional practice for power system to enhanced power quality, Stability, reliability, security and load ability.

### Course Content

**Module 1: Objectives of Power System Operation** **5L**  
Power Systems in Restructured Environment; Distributed and Dispersed Generation; Environment Aspects of Electric Power Generation.

**Module 2: Economic Operation of Energy Generation Systems** **9L**  
Generation Cost Curves; Economic Operation of Thermal System; Plant Scheduling; Transmission Loss and Penalty Factor; Hydro-Thermal Scheduling; Concept of Reserves and Constraints; Unit Commitment.

**Module 3: Automatic Generation Control** **7L**  
Concept of AVR and ALFC Loops, Significance of Double Loop in ALFC; Exciter and VAR Control; Single Area Load Frequency Control; Two Area Load Frequency Control; Frequency Response.

**Module 4: Compensation in Power System** **8L**  
Reactive Power Sensitivity and Voltage Control; Load Compensation with Capacitor Banks; Line Compensation with Reactors; Shunt and Series Compensation; Fixed Series Capacitors; Thyristor Controlled Series Capacitors (TCSC); Introduction to SVC and STATCOM, UPFC.

**Module 5: Power System Transients** **7L**  
Types of System Transients; Overvoltage in Transmission Lines; Propagation of Surges and Travelling Waves; Protection against Lightning and Surges.

#### **Text Books:**

1. Kothari and Nagrath, “Power System Engineering”, McGraw Hill.
2. John J. Granger and William D. Stevenson, “Power System Analysis”, McGraw Hill.
3. Allen J. Wood and Bruce F. Woolenberg, “Electric Power Generation, Operation and Control”, Willey.

#### **Reference Books:**

1. Prabha Kundur, “Power System Stability and Control”, McGraw Hill.

2. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill.
3. T. K. Nagsarkar and M. S. Sukhija, "Power System Analysis", Pearson.
4. Abhijit Chakrabarti and Sunita Halder, "Power System Analysis, Operation and Control", PHI.
5. Elgerd, Olle Ingemar, "Electric Energy Systems Theory: An Introduction", McGraw Hill.

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	3	2	-	2	-	-	1	1	-	1	3
<b>CO2</b>	3	2	3	2	-	-	-	-	2	-	-	3
<b>CO3</b>	3	2	3	3	-	-	-	-	2	-	1	3

**Paper Name: Restructured Electrical Power System**

**Paper Code: EE 703B**

**Contact: 3L:0T:0P**

**Credit: 3**

**Prerequisites:** Power System – I and Power System – II.

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

- CO1.** Understand the need for restructuring of Power Systems, discuss different market models, different stakeholders and market power.
- CO2.** Understand and generalize the functioning and planning activities of Independent System Operator (ISO).
- CO3.** Understand transmission open access pricing issues and congestion management.
- CO4.** Define transfer capability and estimate the transfer capability of small power systems with numerical examples.
- CO5.** Define ancillary services and understand reactive power as ancillary service and management through synchronous generator.

### **Course Content**

**Module 1: Introduction to restructuring of power industry** **8L**

Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process, Introduction to issues involved in deregulation, Reasons and objectives of deregulation of various power systems across the world.

**Module 2: Power System Operation** **8L**

Introduction, need for operational reliability, value of reliability, cost of reliability, procuring reliability resources, operational issues, balancing resources, effect of generation from stochastic renewable sources, limits on power transfer, voltage control and reactive support, stability services, system restoration, co-optimization of energy and reserve in a centralized electricity market, allocation of transmission capacity between energy and reserve, allocating the costs, who should pay for reserve.

**Module 3: Transmission Congestion Management** **7L**

Introduction, Classification of congestion management methods, Calculation of ATC, Non-market methods, Market based methods, Nodal pricing, Price area congestion management.

**Module 4: Pricing of transmission network usage and loss allocation** **8L**

Introduction to transmission pricing, Principles of transmission pricing, Classification of transmission pricing methods, Rolled-in transmission pricing methods, Marginal transmission pricing paradigm, Composite pricing paradigm, Merits and de-merits of different paradigms, Debated issues in transmission pricing, Introduction to loss allocation, Financial markets associated with electricity markets, Introduction to optimal bidding by a generator company, Optimal bidding methods.

**Module 5: Investing in Transmission** **8L**

Nature of transmission business, cost based transmission expansion, allocating the cost of transmission, optimal transmission capacity, effect of load fluctuation, load duration curve, the transmission demand function, recovery of variable transmission investment cost, sharing reserve, sharing generating capacity margin.

**Text Books:**

1. Daniel Kirschen and Goran Strbac, "Fundamentals of Power System Economics", John Wiley & Sons Ltd, 2004.

**Reference Books:**

1. Sally Hunt, "Making competition work in electricity", John Wiley & Sons, Inc., 2002.
2. Kankar Bhattacharya, Jaap E. Daadler, Math H. J. Bollen, "Operation of Restructured Power Systems", Kluwer Academic Pub., 2001.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	-	-	-	-	-	-	-	-
CO2	3	2	3	3	-	-	-	-	-	-	-	2
CO3	3	3	3	3	1	2	-	-	-	-	-	3
CO4	3	3	2	3	1	-	-	-	-	-	-	3
CO5	3	3	2	3	-	-	-	-	-	-	-	3

**Paper Name: Computer Applications in Power System**

**Paper Code: EE 703C**

**Contact: 3L:0T:0P**

**Credit: 3**

**Prerequisites:** Numerical Methods, Power System – I and Power System – II.

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

- CO1.** Develop proper mathematical models for analysis of a selected problem like load flow study or fault analysis.
- CO2.** Prepare the practical input data required for load flow or fault calculations.
- CO3.** Select and identify the most appropriate algorithm for load–flow and short circuit studies.
- CO4.** Develop power system software for static power system studies.

### Course Content

- Module 1: Network Formulation and Graph Theory** **5L**  
 Introduction, Network Equations, Graph Theory, Development of Network Matrices from Graph Theoretic Approach, Augment Cut-set Incidence Matrix Cut-set and Circuit Equations, Building Algorithm for the Bus Impedance Matrix Modification of  $Z_{BUS}$  matrix due to changes in the primitive network
- Module 2: Load Flow Studies** **4L**  
 Introduction, Different techniques such as Gauss Soidal method, Newton Raphson method, De-Coupled method, Fast Decoupled method, Modified Fast Decoupled, Concept of Optimal Power Flow, Solution of Optimal power flow by Gradient method, Solution of Optimal power flow by Newton's method Linear Programming Methods, DC load flow, Continuation Power flow
- Module 3: Sensitivity Analysis** **6L**  
 Sensitivity analysis- General sensitivity relations, generation shift distribution factors, line outage distribution factors, compensated shift factors, sensitivity associated with voltage-VAR, sensitivities relating load bus voltage changes in terms of PV bus voltage changes, sensitivity relating changes in reactive power generation for changes in PV Bus Voltage.
- Module 4: Power System Security** **7L**  
 Introduction, Factors Affecting Power System Security, Short Circuit Studies of a Large Power System Networks, Symmetrical Fault Analysis Using Bus Impedance Matrix, Algorithm for Formation of Bus Impedance Matrix, Contingency Analysis: Detection of Network Problems, Overview of security analysis, Linear Sensitivity Factors, Contingency Selection, Concentric Relaxation, Bounding
- Module 5: Introduction to State Estimation in Power Systems** **8L**  
 Introduction, Power system state estimation, Maximum Likelihood Concept, Weighted Least Squares Estimation, Introduction, Matrix Formulation, State Estimation of an AC network, Development of Method, State Estimation by Orthogonal Decomposition, An Introduction to Advanced topics in state estimation, Detection and Identification of Bad measurements, Estimation of quantities not being measured, Network Observability and Pseudo measurements, Application of Power Systems State Estimation
- Module 6: Numerical Integration Techniques** **6L**

Numerical integration techniques: One step methods, Taylor series based methods, Forward - Euler's method, Runge-Kutta methods, Trapezoidal method, backward-Euler's method, Accuracy and error analysis, Numerical stability analysis, Stiff systems, Step-size selection, Differential algebraic systems, triangular factorization, Power system applications: Transient stability analysis.

**Text Books:**

1. Computer Methods in Power System Analysis, Glenn Stagg and El-abiad, McGraw-Hill.
2. Power System Analysis, Stevenson and Grainger, TATA McgrawHill.
3. Computational Methods for Electric Power Systems, Mariesa Crow, CRC press.
4. Computer-Aided Power Systems Analysis, George Kusic, CRC Press – Indian Edition.

**Reference Books:**

1. Computer Modelling of Electrical Power System, J. Arrilaga and N. R. Wattson, Wiley 2001.
2. Computational Methods for Large Sparse Power System Analysis – An Object Oriented Approach, S. A. Soman, S. A. Khaparde, Kluwer Academic Publishers.
3. Power System Analysis, Hadi Saadat, Tata Mcgraw Hill, New Delhi.
4. Large Networks by Matrix Methods, H. E. Brown, John Wiley.
5. Power Generation Operation & Control, A. J. Wood and B. F. Wollenberg, John Wiley & Sons, Inc.
6. AC-DC Power System Analysis, Jos Arrillaga and Bruce Smith, IEE London UK.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	2	-	-	-	-	-	2
CO2	3	3	3	3	-	1	-	-	-	-	-	3
CO3	3	3	3	3	-	1	-	-	-	-	-	3
CO4	3	3	3	2	3	2	-	-	-			2

**Paper Name: Power System Dynamics and Control**

**Paper Code: EE 704A**

**Contact: 3L:0T:0P**

**Credit: 3**

**Prerequisites:** Numerical Methods, Electrical Machines, Power Systems and Control Systems.

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

- CO1.** Understand the problem of power system stability and its impact on the system.
- CO2.** Analyse linear dynamical systems and use of numerical integration methods.
- CO3.** Understand the methods to improve stability.

### Course Content

**Module 1: Introduction to Power System Operations** **3L**  
Introduction to power system stability, Stability problems in Power System. Impact on Power System Operations and control.

**Module 2: Analysis of Linear Dynamical System and Numerical Methods** **5L**  
Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysis using Numerical Integration Techniques. Issues in Modelling: Slow and Fast Transients, Stiff System.

**Module 3: Modelling of Synchronous Machines and Associated Controllers** **12L**  
Modelling of synchronous machine: Physical Characteristics. Rotor position dependent model. d-q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modelling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

**Module 4: Stability Analysis** **11L**  
Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi-machine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs.

**Module 5: Enhancing System Stability** **5L**  
Planning Measures. Stabilizing Controllers (Power System Stabilizers). Operational Measures Preventive Control. Emergency Control.

**Text Books:**

1. K. R. Padiyar, “Power System Dynamics, Stability and Control”, B. S. Publications, 2002.
2. Prabha Kundur, “Power System Stability and Control”, McGraw Hill, 1995.
3. P. Sauer and M. A. Pai, “Power System Dynamics and Stability”, Prentice Hall, 1997.

**Reference Books:**

1. A. J. Wood and B. F. Wollenberg, “Power Generation Operation & Control”, John Wiley & Sons, Inc.
2. A. Chakrabarti and S. Halder, “Power System Analysis, Operation and Control”, PHI.



**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	3	3	2	-	2	-	-	-	-	-	2
<b>CO2</b>	3	3	3	3	-	1	-	-	-	-	-	3
<b>CO3</b>	3	3	3	3	-	1	-	-	-	-	-	3

**Paper Name: Power Quality and FACTS**

**Paper Code: EE 704B**

**Contact: 3L:0T:0P**

**Credit: 3**

**Prerequisites:** Power Electronics, Synchronous Machine, Power Systems and Control Systems.

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

- CO1.** Describe the characteristics of ac transmission and the effect of shunt and series reactive compensation.
- CO2.** Demonstrate the working principles of FACTS devices and their operating characteristics.
- CO3.** Illustrate the basic concepts of power quality.
- CO4.** Categorize the working principles of devices to improve power quality.

### **Course Content**

**Module 1: Transmission Lines and Series/Shunt Reactive Power Compensation 4L**  
Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

**Module 2: Thyristor-based Flexible AC Transmission Controllers (FACTS) 6L**  
Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Harmonics and control of SVC and TCSC. Fault Current Limiter.

**Module 3: Voltage Source Converter based (FACTS) controllers 9L**  
Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control.

**Module 4: Application of FACTS 4L**  
Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

**Module 5: Power Quality Problems in Distribution Systems 4L**  
Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

**Module 6: DSTATCOM 9L**  
Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.

**Text Books:**

1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999.
2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
3. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.

**References Books:**

1. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983.
2. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	-	-	-	-	2	3
CO2	3	2	3	-	3	-	-	-	-	-	-	3
CO3	3	2	3	-	-	-	-	-	-	-	-	3
CO4	3	3	3	3	3	3	-	-	-	-	2	3

**Paper Name: HVDC Transmission Systems**

**Paper Code: EE 801A**

**Contact: 3L:0T:0P**

**Credit: 3**

**Prerequisites:** Concept of Power System and Power Electronics.

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

- CO1.** Describe HVDC converters and HVDC transmission.
- CO2.** Formulate and solve mathematical problems related to rectifier and inverter control methods and learn about different control schemes as well as starting and stopping of DC links.
- CO3.** Analyze the different harmonics generated by the converters and their variation with the change in firing angles.
- CO4.** Distinguish the nature of faults on the converters and their protection schemes.
- CO5.** Demonstrate the existing HVDC systems along with MTDC systems and modern transmission system.

### **Course Content**

- Module 1: Introduction** **4L**  
Introduction of DC power transmission technology, comparison of AC and DC transmission, limitation of HVDC transmission, reliability of HVDC systems, application of DC transmission, description of DC transmission system, planning for HVDC transmission, modern trends in DC transmission.
- Module 2: Analysis of HDVC Converters** **6L**  
Choice of converter configuration, simplified analysis of Graetz circuit, converter bridge characteristics, Characteristics of a twelve pulse converter, detailed analysis of converters.
- Module 3: Control of HVDC Converter and Systems** **8L**  
Necessity of control of a DC link, rectifier control, compounding of rectifiers, power reversal of DC link, voltage dependent current order limit(VDCOL) characteristics of the converter, inverter extinction angle control, pulse phase control, starting and stopping of DC link, constant power control, control scheme of HVDC converters.
- Module 4: Harmonics and Filters** **10L**  
Generation of harmonics by converters, characteristics of harmonics on DC side, characteristics of current harmonics, characteristic variation of harmonic currents with variation of firing angle and overlap angle, effect of control mode on harmonics, non-characteristic harmonic. Harmonic model and equivalent circuit, use of filter, filter configuration, design of band-pass and high pass filter, protection of filters, DC filters, power line communication and RI noise, filters with voltage source converter HDVC schemes.
- Module 5: Fault and Protection Schemes in HVDC Systems** **4L**  
Nature and types of faults, faults on AC side of the converter stations, converter faults, fault on DC side of the systems, protection against over currents and over voltages, protection of filter units.
- Module 6: Multiterminal HVDC Systems** **8L**  
Types of multiterminal (MTDC) systems, parallel operation aspect of MTDC Series and shunt devices and principle of operation and control, UPFC and IPFC, modelling of FACTS devices for power system studies.

**Text Books:**

1. S. Kamakshaiah and V. Kamaraju, "HVDC Transmission", Tata McGraw Hill Education.
2. K. R. Padiyar, "HVDC Power Transmission System", Wiley Eastern Limited.
3. J. Arrillaga, "High Voltage Direct Current Transmission", The Institution of Electrical Engineers.

**Reference Books:**

1. Prabha Kundur, "Power System Stability and Control", McGraw Hill.
2. Abhijit Chakrabarti and Sunita Halder, "Power System Analysis: Operation and Control", PHI Learning Pvt. Ltd.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-	-
CO4	-	-	2	-	1	-	-	-	-	-	-	-
CO5	-	-	1	2	-	-	-	-	-	-	-	-

**Paper Name: Industrial and Financial Management**  
**Paper Code: HU 703**  
**Contact: 2L:0T:0P**  
**Credit: 2**

**Prerequisites:** Basic Mathematics.

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

- CO1.** Explain and describe various technology-based business models and the dynamics of value creation, value proposition, and value capture in industrial enterprises.
- CO2.** Select, interpret and use different costing techniques as a basis for decisions in various business situations.
- CO3.** Understand the basic principles of financial accounting and reporting.
- CO4.** Explain how the industrial company markets and price its products considering GST.

### Course Content

**Module 1: Introduction to Accounting** **10L**  
 Important Definitions, Basic concepts and conventions, Types of Accounts with Golden Rule of Accounting, Journal, Ledger and Trial Balance, Preparation of Trading Account, Profit & Loss A/C and Balance Sheet for business organizations.

**Module 2: Financial Management** **8L**

***Introduction to Financial Management:***

Introduction, Definition and concept, scope, objective, functions of Finance Manager.

***Ratio Analysis:***

Definition, Objectives, Advantages & Disadvantages, Classification of Ratios: Liquidity ratios, Capital Structure ratios, Activity ratios & Profitability Ratios.

***Capital Budgeting:***

Nature of Investment Decision, Importance of Capital Budgeting, capital budgeting process, Investment criteria, payback period, Rate of return, cash flow, discounting cash flow NPV method and IRR method, Benefit cost ratio, ARR.

**Module 3: Cost Accounting and Budget** **4L**

***Cost Accounting:***

Introduction to cost accounting cost sheet, Marginal cost & C-V-P analysis with BEC.

***Budget and Budgetary Control:***

Concepts of Budget, Budgeting and budgetary control, Master Budget, Zero Based Budget, Cash budget, Flexible budget.

**Module 4: Working capital management** **2L**

Introduction-working capital concept-financing working capital-importance of working capital-

**Text Books:**

1. Financial Management, Khan & Jain, S. Chand.
2. Management Accounting, Khan & Jain, S. Chand.
3. Modern Accountancy, Haniff & Mukherjee, TMH.

**Reference Books:**

1. An Introduction to Accountancy, S. N. Maheswari, Vikas publication.

2. Cost Accounting: Theory and Practices, B. Banerjee, PHI.
3. Financial Management, IM Pandey, Vikas.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	1	2	-	2	-	-	-	-	-	-
CO2	-	-	-	-	3	1	2	-	-	-	1	-
CO3	3	-	-	-	-	2	-	-	-	-	3	-
CO4	-	2	-	-	1	-	1	-	-	-	-	-

**Course Name: Electrical Drives Laboratory**

**Course Code: EE 791**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Concept of Electrical Machines and Power Electronics.

**Course Outcomes:** On completion of the course students will be able to

**CO1.** Apply power electronic converters for motor speed control.

**CO2.** Analyze the characteristics of electric motors for different type of loads.

**List of Experiment:**

1. Study of single-phase fully controlled DC Drive.
2. Study of Chopper fed DC Drive.
3. Study of AC Single phase motor-speed control using TRIAC.
4. PWM Inverter fed three-phase Induction Motor control.
5. VSI fed Induction motor Drive analysis.
6. CSI fed Induction motor Drive analysis.
7. Study of V/f control operation of three-phase induction motor drive.
8. Study of permanent magnet synchronous motor drive fed by PWM Inverter.
9. Regenerative or Dynamic braking operation for DC Motor.
10. Regenerative or Dynamic braking operation of AC motor.
11. AC and DC Drive Applications using PLC.
12. Introduction to Industrial Automation.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	-	3	3	2	-	-	-	-	-	1
CO2	-	1	-	3	3	2	-	-	-	-	-	1



**Course Name: Object Oriented Programming Laboratory**

**Course Code: EE 792A**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:**

1. Computer Fundamentals.
2. Basic understanding of Computer Programming and related Programming Paradigms.
3. Problem Solving Techniques with proper logic Implementation.

**Course Outcomes:** On completion of the course students will be able to

- CO1.** Create the procedure of communication between Objects, classes & methods.
- CO2.** Understand the elementary facts of Object Orientation with various characteristics as well as several aspects of Java.
- CO3.** Analyze distinct features of different string handling functions with various I/O operations.
- CO4.** Discuss simple Code Reusability notion w.r.t. Inheritance, Package and Interface.
- CO5.** Apply Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.

**List of Experiment:**

**Module 1: Java Basics**

1. Simple Java programming using operators, control statements & loops, array.
2. Programming on class, object, and method, access specifier.
3. Programming on constructor, method/constructor overloading.
4. Programming on this keyword, call by value & call by reference, static variables & methods, inner classes.

**Module 2: Basic String handling & I/O**

1. Programming to show the use of String class methods - charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring(), toCharArray(), toLowerCase(), toString(), toUpperCase(), trim(), valueOf() methods.
2. Programming to show the use of StringBuffer class methods - append(), capacity(), charAt(), delete(), deleteCharAt(),ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods.
3. Programming on Command line arguments.
4. Programming using keyboard input by implementing BufferedReader& Scanner classes.

**Module 3: Inheritance, Interface and Java Packages**

1. Programming on Simple Inheritance, super and final keywords, super() method.
2. Programming on method overriding, dynamic method dispatch,abstract classes & methods, multiple inheritance by using interface.
3. Programming on importing system package, creating user-defined package, importing user- defined package, using protected access specifier, subclassing an imported class of a package, using same names for classes of different packages, adding multiple public classes to a package.

**Module 4: Exception handling, Multithreading and Applet Programming**

1. Programming on exception handling using try-catch block, implementing throw and throws keywords, using finally block, creating user-defined exception.

2. Programming on creating child threads i) by extending thread class ii) by implementing runnable interface, creating child threads by assigning thread priorities.
3. Programming on creating simple applet to display some message, creating applet two add 2 integers, creating applet to do GUI based programming.

**Text Books:**

1. Herbert Schildt – "Java: The Complete Reference " – 9th Ed. – TMH
2. E. Balagurusamy – " Programming With Java: A Primer " – 3rd Ed. – TMH.

**Reference Books:**

1. R.K Das – " Core Java for Beginners " – VIKAS PUBLISHING.
2. Rambaugh, James Michael, Blaha – " Object Oriented Modelling and Design " – Prentice Hall, India.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	1	-	-	2	-	2	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	2	-	-	-	2	2	2	-

**Course Name: Big Data Analysis Laboratory**

**Course Code: EE 792B**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Familiarity and knowledge of Database Management Systems.

**Course Outcomes:** On completion of the course students will be able to

- CO1.** Process big data using Hadoop framework.
- CO2.** Build and apply linear and logistic regression models.
- CO3.** Perform data analysis with machine learning methods.
- CO4.** Perform graphical data analysis.
- CO5.** Implement clustering techniques.

**List of Experiment:**

**Hadoop:**

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an MR program that processes a weather dataset

**R:**

1. Implement Linear and logistic Regression
2. Implement SVM / Decision tree classification techniques
3. Implement clustering techniques
4. Visualize data using any plotting framework
5. Implement an application that stores and retrieves big data in Hbase / MongoDB / Pig using Hadoop / R.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	1	-	-	1	1	1	1
CO2	2	2	2	2	3	1	-	-	1	1	1	1
CO3	2	2	2	2	3	1	-	-	1	1	1	1
CO4	2	2	2	2	3	1	-	-	1	1	1	1
CO5	2	3	2	2	3	1	-	-	1	1	1	1

**Course Name: Digital Image Processing Laboratory**

**Course Code: EE 792C**

**Contact: 0L:0T:3P**

**Credit: 1.5**

**Prerequisites:** Knowledge in DSP, algorithm, MATLAB Programming.

**Course Outcomes:** On completion of the course students will be able to

- CO1.** Build knowledge on Digital Imaging fundamentals and Digital Image Transform.
- CO2.** Understanding Digital Image enhancement techniques in spatial and frequency domain.
- CO3.** Explaining the requirements and types of Image Compression and its standards.
- CO4.** Demonstrate the Digital Image Restoration and Segmentation of Digital Images.
- CO5.** Build ideas on Edge detection techniques and concepts on Digital Image security.

**List of Experiment:**

1. Convert RGB Digital Images into Grayscale Images and show result.
2. Transform a grayscale image into frequency domain and show its magnitude and phase angle.
3. Display histogram of a digital image and equalized the image.
4. Apply LPF and HPF in a Grayscale Digital Image and display result.
5. Apply Mean and Median filtering in a Grayscale Digital Image and display result.
6. Compress and reconstruct a Grayscale Digital Images in spatial domain.
7. Compress and reconstruct a Grayscale Digital Image in frequency domain.
8. Apply segmentation technique (any one) in a Digital Image and display result.
9. Apply Edge detection technique in a Digital Image and display result.
10. Apply any cryptography or watermarking technique for image encryption and display result.
11. Innovative experiment.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	2	2	2	2	2	2	2
CO2	3	3	3	3	2	3	2	2	2	2	2	2
CO3	3	3	2	2	3	2	2	2	2	2	1	2
CO4	3	3	2	2	2	3	2	2	1	2	2	2
CO5	3	3	3	3	2	2	2	2	2	2	2	2

8th Semester								
Sl No	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
<b>A. THEORY</b>								
1	PE	EE 801	D. Wind and Solar Energy Systems	2	0	0	2	2
			E. Utilization of Electric Power					
			F. Line Commutated and Active Rectifiers					
2	PE	EE 802	D. Advanced Electric Drives	3	0	0	3	3
			E. Control Systems Design					
			F. Industrial Electrical System					
3	HS	HU 801	Principles of Management	2	0	0	2	2
<b>Total of Theory</b>							<b>7</b>	<b>7</b>
<b>B. PRACTICAL</b>								
4	PROJ	PR 891	Project – VIII	0	0	8	8	4
<b>C. MANDATORY ACTIVITIES / COURSES</b>								
5	MC	MC 804	Essence of Indian Knowledge Tradition	3	0	0	3	0
<b>Total of Theory, Practical &amp; Mandatory Activities / Courses</b>							<b>18</b>	<b>11</b>

**Paper Name: Wind and Solar Energy Systems**

**Paper Code: EE 801A**

**Contact: 2L:0T:0P**

**Credit: 2**

**Prerequisites:** Concept of Basic Physics, Power Electronics and Electrical Machines.

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

- CO1.** Analyze the fundamental principle of wind and solar power generation.
- CO2.** Categorize different types wind generators and solar power plants.
- CO3.** Apply power electronic interfaces for wind and solar generation.

### Course Content

- Module 1: Introduction to Wind Power** **3L**  
History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.
- Module 2: Wind Generator Classifications** **4L**  
Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.
- Module 3: Solar Radiation** **3L**  
The sun to earth transaction of solar energy, Study of wavelength Of solar radiation spectra, Solar Spectrum Electromagnetic Radiation, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability
- Module 4: Solar Photovoltaic System** **5L**  
Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms, Converter Control.
- Module 5: Grid Integration of Wind and Solar Power** **7L**  
Constant- Voltage, Constant Frequency Generation, Single output system, Double Output System with Current Converter and voltage source inverter, Variable-voltage, Variable frequency generation, Circuit Model of Self Excited Induction Generator, Effect of Wind Generator on a power network.  
Solar PV and wind farm behaviour during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.
- Module 6: Solar Thermal Power Generation** **1L**  
Technologies involved in solar thermal generation, Analysis of Parabolic trough, central receivers, parabolic dish, Concept of solar pond.

**Text Books:**

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.

2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.
3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.

**Reference Books:**

1. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
2. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
3. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3	-	-	-	2	2
CO2	3	3	3	3	3	3	3	-	-	-	2	2
CO3	3	3	3	3	3	3	3	-	-	-	2	2

**Paper Name: Utilization of Electric Power**  
**Paper Code: EE 801B**  
**Contact: 2L:0T:0P**  
**Credit: 2**

**Prerequisites:** Basic Electrical Engineering and Electrical Machines.

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

- CO1.** Demonstrate the working of traction motor and their control under different working conditions.
- CO2.** Analyze illumination level for a given application and select the suitable specification for installation.
- CO3.** Illustrate the working of Electric Heating, welding processes.
- CO4.** Explain the process of electrolysis.

### Course Content

#### **Module – 1: Electric Traction**

**9L**

Requirement of an ideal traction system, Supply system for electric traction, Train movement (speed time curve, simplified speed time curve, average speed and schedule speed), Mechanism of train movement (energy consumption, tractive effort during acceleration, tractive effort on a gradient, tractive effort for resistance, power and energy output for the driving axles, factors affecting specific energy consumption, coefficient of adhesion).

##### ***Electric traction motor & their control:***

Parallel and series operation of Series and Shunt motor with equal and unequal wheel diameter, effect of sudden change of in supply voltage, Temporary interruption of supply, Tractive effort and horse power. Use of AC series motor and Induction motor for traction.

##### ***Traction motor control:***

DC series motor control, Multiple unit control, Braking of electric motors, Electrolysis by current through earth, current collection in traction system, Power electronic controllers in traction system.

#### **Module – 2: Illumination**

**6L**

The nature of radiation, Polar curve, Law of illumination, Photometry (Photovoltaic cell, distribution photometry, integrating sphere, brightness measurement).

##### ***Types of Lamps:***

Conventional and energy efficient, Basic principle of light control, Different lighting scheme and their design methods, Flood and Street lighting.

#### **Module – 3: Electric Heating and Welding**

**4L**

Types of heating, Resistance heating, Induction heating, Arc furnace, Dielectric heating, Microwave heating.

#### **Module – 4: Electrolytic Processes**

**3L**

Basic principles, Faraday's law of Electrolysis, Electro deposition, Extraction and refining of Metals, Power supply of Electrolytic processes.

#### **Text Books:**

1. T. Starr, "Generation, Transmission and Utilization of Electrical Power", Pitman.
2. J. B. Gupta, "Utilization of Electric Power & Electric Traction", S. K. Kataria & Sons.
3. C. L. Wadhawa, "Generation Distribution and Utilization of Electrical Energy", New Age International Publishers.



**Reference Books:**

1. H. Partab, "Art and Science of Utilization of Electrical Energy", Dhanpat Rai & Sons.
2. E. Openahaw Taylor, Orient Longman, "Utilisation of Electric Energy".

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-
CO3	-	-	3	3	-	-	-	-	-	-	-	-
CO4	-	-	2	3	-	-	-	-	-	-	-	-

**Paper Name: Line Commutated and Active Rectifiers**  
**Paper Code: EE 801C**  
**Contact: 2L:0T:0P**  
**Credit: 2**

**Prerequisites:** Concept of Transformers and Power Electronic Converters.

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

- CO1.** Analyse controlled rectifier circuits.
- CO2.** Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.
- CO3.** Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor model.

### Course Content

**Module 1: Diode and Phase-Controlled Rectifiers with passive filtering** **7L**  
 single-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape. single-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape.

**Module 2: Multi-Pulse converter** **4L**  
 Review of transformer phase shifting, generation of 6-phase AC voltage from 3-phase AC, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

**Module 3: Single-phase AC-DC single-switch boost converter** **3L**  
 Review of DC-DC boost converter, power circuit of single-switch AC-DC converter, steady state analysis, unity power factor operation, closed-loop control structure.

**Module 4: AC-DC bidirectional boost converter** **4L**  
 Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes.

**Module 5: Isolated single-phase AC-DC flyback converter** **6L**  
 DC-DC flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of AC-DC flyback converter, steady state analysis, unity power factor operation.

#### **Text Books:**

1. G. De, “Principles of Thyristorised Converters”, Oxford & IBH Publishing Co, 1988.
2. J. G. Kassakian, M. F. Schlecht and G. C. Verghese, “Principles of Power Electronics”, Addison-Wesley, 1991.
3. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.

#### **Reference Books:**

1. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
2. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2001.

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	2	3	2	-	-	-	-	-	-	-	3
<b>CO2</b>	3	2	1	2	2	-	-	-	-	-	-	3
<b>CO3</b>	3	2	2	3	-	-	-	-	-	-	-	3

**Paper Name: Advanced Electric Drives**

**Paper Code: EE 802A**

**Contact: 3L:0T:0P**

**Credit: 3**

**Prerequisites:** Concept of Electrical Machines and Power Electronics.

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

- CO1.** Analyze the operation of power electronic converters and their control strategies.
- CO2.** construct the modelling of AC motors in different reference frames.
- CO3.** Understand the vector control strategies for ac motor drives.

### Course Content

**Module 1: Power Electronic Converters for AC Drives** **10L**

Review of Three-Phase Inverter with square-wave switching, Pulse Width Modulation Techniques – Sinusoidal PWM, Selected Harmonic Elimination, Space Vector Modulation, current control of VSI with PWM, three-level inverter and its different topologies, SVM for three-level inverter, H-bridge as a four-quadrant drive.

**Module 2: Modelling and Control of DC Machines** **5L**

Electromechanical modelling, state-space modelling, Block diagram and transfer function, Control of separately excited dc motor drives for Inner current loop and speed control design.

**Module 3: Induction Motor Drives** **7L**

Different transformations and reference frame theory, modelling of induction machines, voltage fed inverter control, open loop Volt/Hz control, vector control, direct torque and flux control, Introduction to three-phase traction drives with parallel machines.

**Module 5: Permanent Magnet Motor Drives** **4L**

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

**Module 6: Switched Reluctance Motor Drives** **4L**

Evolution of switched reluctance motors, various topologies for SRM drives, comparison, closed loop speed and torque control of SRM.

#### **Text Books:**

1. B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, Asia, 2003.
2. R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRC Press, 2009.

#### **Reference Books:**

1. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, “Analysis of Electric Machinery and Drive Systems”, John Wiley & Sons, 2013.
2. Bin-Wu, “High-power Converters and AC Drives”, IEEE Press, John Wiley & Sons, 2006.

#### **CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	3	2	-	1	-	-	-	1	-	-	1
CO3	1	3	2	-	1	-	-	-	1	-	-	1

**Paper Name: Control Systems Design**

**Paper Code: EE 802B**

**Contact: 3L:0T:0P**

**Credit: 3**

**Prerequisites:** Control System – I, Control Systems – II.

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

- CO1.** Understand various design philosophy of classical controllers.
- CO2.** Analysis of conventional and robust controllers satisfying the desired specifications.
- CO3.** Design of optimal and non-linear controllers.

### Course Content

- Module 1: Design Specifications** **6L**  
Introduction to design problem and philosophy, Introduction to time domain and frequency domain design specification and its physical relevance, Effect of gain on transient and steady state response, Effect of addition of pole on system performance, Effect of addition of zero on system response.
- Module 2: Design of Classical Control System** **5L**  
Introduction to compensator, Design of Lag, lead lag-lead compensator, Feedback and Feed forward compensator design, Feedback compensation, Realization of compensators.
- Module 3: Design of PID controllers** **6L**  
Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.
- Module 4: Introduction to Robust Control** **9L**  
Robust control system and system sensitivities to parameter, perturbations, analysis of robustness, systems with uncertain parameters, considerations in design of robust control system, robust PID controller.
- Module 5: Lyapunov's stability and optimal control** **10L**  
Positive/negative definite, positive/negative semi-definite functions, Lyapunav stability criteria, introduction to optimal control, Riccati Equation, Linear Quadratic Regulator, Design Examples.

**Text Books:**

1. N. Nise, "Control system Engineering", John Wiley, 2000.
2. I. J. Nagrath and M. Gopal, "Control system engineering", Wiley, 2000.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.

**Reference Books:**

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 2010.
2. B. C. Kuo, "Automatic Control system", Prentice Hall, 1995.
3. J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.
4. R.T. Stefani and G.H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994.
5. G. C. Goodwin, S. F. Graebe, M. E. Salgado, "Control System Design".

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	2	1	3	3	2	-	-	-	-	-	-	2
<b>CO2</b>	2	2	2	3	2	-	-	-	-	-	-	2
<b>CO3</b>	2	3	2	2	-	-	-	-	-	-	-	2

**Paper Name: Industrial Electrical System**

**Paper Code: EE 802C**

**Contact: 3L:0T:0P**

**Credit: 3**

**Prerequisites:** Concept of Electrical Machines and Power Systems.

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

- CO1.** Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- CO2.** Understand various components of industrial electrical systems.
- CO3.** Analyze and select the proper size of various electrical system components.

### Course Content

**Module 1: Electrical System Components 7L**

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

**Module 2: Residential and Commercial Electrical Systems 12L**

General rules and guidelines for installation, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

**Module 3: Industrial Electrical Systems 9L**

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

**Module 4: Industrial Electrical System Automation 8L**

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

**Text Books:**

1. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
2. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.
3. Paul Gill, “Electrical Power Equipment, Maintenance and Testing”, CRC Press.
4. R. G. Jamkar, “Industrial Automation using PLC, SCADA & DCS”, Global Education.

**Reference Books:**

1. S.L. Uppal and G.C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008
2. Web site for IS Standards.
3. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

**CO-PO Mapping:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	2	2	3	2	1	-	-	-	-	-	3
<b>CO2</b>	3	2	1	3	2	1	-	-	-	-	-	1
<b>CO3</b>	3	2	3	3	2	1	-	-	-	-	-	2



**Paper Name: Principles of Management**

**Paper Code: HU 801**

**Contact: 2L:0T:0P**

**Credit: 2**

**Prerequisites:** NIL.

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

- CO1.** Recall and identify the relevance of management concepts.
- CO2.** Apply management techniques for meeting current and future management challenges faced by the organization
- CO3.** Compare the management theories and models critically to solve real life problems in an organisation.
- CO4.** Apply principles of management in order to execute the role as a manager in an organisation.

### Course Content

- Module 1: Management Concepts** **4L**  
 Definition, roles, functions and importance of Management, Evolution of Management thought-contribution made by Taylor, Fayol, Gilbreth, Elton Mayo, McGregor, Maslow.
- Module 2: Planning and Control** **4L**  
**Planning:** Nature and importance of planning, types of planning, Levels of planning, The Planning Process - MBO, SWOT analysis, McKinsey's 7S Approach.  
**Organising for decision making:** Nature of organizing, span of control, Organisational structure – line and staff authority.  
**Control:** Basic control process: Control as a feedback system, Feed Forward Control, Requirements for effective control.
- Module 3: Group dynamics** **4L**  
 Types of groups, characteristics, objectives of Group Dynamics.  
**Leadership:** Definition, styles & functions of leadership, qualities for good leadership, Theories of leadership .
- Module 4: Work Study and Work Measurement** **4L**  
 Definition of work study, Method Study Steps, Tools and Techniques used in the Method Study and Work Measurement Time Study: Aim and Objectives,, Use of stopwatch procedure in making Time Study. Performance rating, allowances and its types. Calculation of Standard Time. Work sampling.
- Module 5: Marketing Management** **2L**  
 Functions of Marketing, Product Planning and development, Promotional Strategy .
- Module 6: Quality Management** **6L**  
 Quality definition, Statistical quality control, acceptance sampling, Control Charts –Mean chart, range chart, c chart, p chart, np chart, Zero Defects, Quality circles, Kaizen and Six Sigma, ISO - 9000 Implementation steps, Total quality management.

**Text Books:**

1. Essentials of Management, by Harold Kooritz & Heinz Wehrich Tata McGraw Hill.
2. Production and Operations Management, K.Aswathapa, K .Shridhara Bhat, Himalayan Publishing House.

**References Books:**

1. Organizational Behavior, by Stephen Robbins Pearson Education, New Delhi.
2. New era Management, Daft, 11<sup>th</sup> Edition, Cengage Learning.
3. Principles of Marketing, Kotlar Philip and Armstrong Gary, Pearson publication.

**CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	-	3	-
CO2	-	-	-	-	-	2	-	3	3	-	3	3
CO3	-	-	-	-	-	-	-	-	2	-	3	3
CO4	-	-	-	-	-	2	-	-	3	-	3	-

**Paper Name: Essence of Indian Knowledge Tradition**

**Paper Code: MC 804**

**Contact: 3L:0T:0P**

**Credit: 0**

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

- CO1.** Identify the concept of Traditional knowledge and its importance.
- CO2.** Explain the connection between Modern Science and Indian Knowledge System.
- CO3.** Understand the importance of Yoga for health care.
- CO4.** Interpret the effect of traditional knowledge on environment.

### Course Content

#### **Module 1: Basic structure of Indian Knowledge System**

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs western knowledge traditional knowledge.

#### **Module 2: Modern Science and Indian Knowledge System**

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge.

#### **Module 3: Yoga and Holistic Health care**

Yoga for positive health, prevention of stress related health problems and rehabilitation, Integral approach of Yoga Therapy to common ailments.

#### **Module 4: Traditional Knowledge and Environment**

Traditional knowledge and engineering, Traditional medicine system, Importance of conservation and sustainable development of environment, Management of biodiversity.

#### **Reference Books:**

1. V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya Bhavan, Mumbai, 5<sup>th</sup> Edition, 2014.
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan.
3. Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan.
4. Fritzo Capra, The Wave of life.
5. VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Arnakulam.
6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
7. RN Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakashan, Delhi 2016 RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakashan, Delhi 2016.

#### **CO-PO Mapping:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	-	-	2	1	2	1
CO2	-	-	-	-	-	-	-	3	2	1	2	2
CO3	-	-	-	-	-	-	-	-	2	2	-	1
CO4	-	-	-	-	-	-	-	-	1	2	-	1