DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

COURSE STRUCTURE

&

SYLLABUS-NRIA20

(Along with HONORS and MINORS)

(Applicable for batches admitted from 2020-2021)

NRI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

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Accredited by NAAC with "A" GRADE, Accredited by NBA (CSE, ECE&EEE)
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

NRIA20 Course Structure

I YEAR I SEMESTER

Sl. No	Course Code	Course Category	Title of the Course	L	T	P	Total Credits
1	20A1100101	HSC	Professional Communication	3	-	-	3
2	20A1100201	BSC	Engineering Mathematics-1	3	-	-	3
3	20A1100203	BSC	APPLIED Physics	3	-	-	3
4	20A1103301	ESC	ENGG. GRAPHICS	1	-	-	3
5	20A1105301	ESC	Programming and Problem Solving with C	3	-	-	3
6	20A1100292	BSC	APPLIED Physics Lab	-	-	3	1.5
7	20A1105391	ESC	Programming and Problem Solving with C Lab	-	-	3	1.5
						TOTAL CREDITS =	**18**

Courses offered to other departments by EEE	
Basic Electrical & Electronics Engineering	CE
Basic Civil and Electrical Engineering Workshop	CE

Category	Credits
Basic Science Course	7.5
Engineering Sciences Course	7.5
Humanities and Social Sciences Course	3
TOTAL CREDITS	**18**

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NRIA20 Course Structure

I YEAR II SEMESTER

Sl. No	Course Code	Course Category	Title of the Course	L	T	P	Total Credits
1	20A1200201	BSC	Engineering Mathematics-II	3	-	-	3
2	20A1200205	BSC	Applied Chemistry	3	-	-	3
3	20A1205302	ESC	JAVA Programming	2	-	-	3
4	20A1202401	ESC	Electrical Circuit Analysis-1	3	1	-	4
5	20A1201301	ESC	Basics of Civil & Mechanical Engineering	3	-	-	3
6	20A1200801	MC	Environmental Sciences	2	-	-	0
7	20A1200191	HSC	Communicative English	-	-	3	1.5
8	20A1200294	BSC	Applied Chemistry LAB	-	-	3	1.5
9	20A1201391	ESC	Basics of Civil & Mechanical Engineering Lab	-	-	3	1.5
10	20A1202491	ESC	Electrical Engineering Workshop	-	-	3	1.5
						TOTAL CREDITS =	**22**

Courses offered to other departments by EEE	
Basic Electrical & Electronics Engineering	MECH
Basic Electrical & Electronics Engineering lab	MECH
Basic Electrical Engineering	ECE
Basic Electrical Engineering lab	ECE

Category	Credits
Basic Science Course	7.5
Engineering Sciences Course	13
Humanities and Social Sciences Course	1.5
Mandatory Course	0
TOTAL CREDITS	**22**

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

NRIA20 Course Structure

II YEAR I SEMESTER

Sl. No	Course Code	Course Category	Title of the Course	L	T	P	Total Credits
1	20A2100201	BSC	Vector calculus, Fourier Transforms and Partial Differential Equations	3	-	-	3
2	20A2102401	PCC	Electronic Devices and Circuits	3	-	-	3
3	20A2102402	PCC	Electrical Circuit Analysis-II	3	-	-	3
4	20A2102403	PCC	DC Machines and Transformers	3	-	-	3
5	20A2102404	PCC	Electro Magnetic Fields	3	-	-	3
6	20A2102491	PCC	Electrical Circuits Lab	-	-	3	1.5
7	20A2102492	PCC	DC Machines and Transformers Lab	-	-	3	1.5
8	20A2102493	PCC	Electronic Devices and Circuits Lab	-	-	3	1.5
9	20A2102991	SC	**Skill oriented course:** Design of Electrical Circuits using Engineering Software Tools	-	-	4	2
10	20A2102802	MC	Professional Ethics & Human Values	2	-	-	0
							TOTAL CREDITS = 21.5

Category	Credits
Basic Science Course	3
Professional Core Courses	16.5
Skill advanced course/ Soft skill course	2
Mandatory Course	0
TOTAL CREDITS	**21.5**

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NRIA20 Course Structure

II YEAR II SEMESTER

Sl. No	Course Code	Course Category	Title of the Course	L	T	P	Total Credits
1	20A2205301	ESC	Python Programming	3	-	-	3
2	20A2202401	PCC	Digital Electronics	3	-	-	3
3	20A2202402	PCC	Power System-I	3	-	-	3
4	20A2202403	PCC	Induction and Synchronous Machines	3	-	-	3
5	20A2200101	HSC	Managerial Economics & Financial Analysis	3	-	-	3
6	20A2205391	ESC	Python Programming Lab	-	-	3	1.5
7	20A2202491	PCC	Induction and Synchronous Machines Lab	-	-	3	1.5
8	20A2202492	PCC	Digital Electronics Lab	-	-	3	1.5
						TOTAL CREDITS =	**19.5**

Category	Credits
Engineering Science Course	4.5
Professional Core Courses	12
Humanities and Social Sciences Course	3
TOTAL CREDITS	**19.5**

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NRIA20 Course Structure

III YEAR I SEMESTER

Sl. No	Course Code	Course Category	Title of the Course	L	T	P	Total Credits
1	20A3102401	PCC	Power Systems-II	3	-	-	3
2	20A3102402	PCC	Power Electronics	3	-	-	3
3	20A3102403	PCC	Linear Control Systems	3	-	-	3
4	20A3100601	SC	**Soft Skill Course**: **Employability Skills** Aptitude and Reasoning	3	-	-	3
5	20A3102511	PEC	**Professional Elective – I:** Utilization of Electrical Energy	3	-	-	3
6	20A3102491	PCC	Control Systems Lab	-	-	3	1.5
7	20A3102492	PCC	Power Electronics Lab	-	-	3	1.5
8	20A3102991	SC	**Skill oriented course :** IoT Lab	-	-	3	2
9	20A3102791	PROJ	Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester)	-	-	-	1.5
TOTAL CREDITS = 21.5							
			Minors Course	4	0	0	4
			Honors Course	4	0	0	4

Category	Credits
Professional Core Courses	12
Professional Elective Courses	3
Skill advanced course/ Soft skill course	5
Summer Internship	1.5
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

NRIA20 Course Structure

III YEAR II SEMESTER

Sl. No	Course Code	Course Category	Title of the Course	L	T	P	Total Credits
1	20A3202401	PCC	Microprocessors and Microcontrollers	3	-	-	3
2	20A3202402	PCC	Electrical Measurements and Instrumentation	3	-	-	3
3	20A3202403	PCC	Power System Analysis	3	-	-	3
4	20A3202511	PEC	**Professional Elective – II:** Switch Gear and Protection	3	-	-	3
5	20A3204605	OEC	**Open Elective –II/ Job Oriented Elective-II: Industrial Electronics**	3	-	-	3
6	20A3202491	PCC	Electrical Measurements and Instrumentation Lab	-	-	3	1.5
7	20A3202492	PCC	Microprocessors and Microcontrollers Lab	-	-	3	1.5
8	20A3202493	PCC	Power Systems and Simulation Lab	-	-	3	1.5
9	20A3202991	SC	**Skill Advanced Course:** Machine Learning with Python Lab	-	-	-	2
10	20A3200801	MC	Research Methodology	-	-	-	0
						TOTAL CREDITS =	**21.5**
			Minors Course	4	0	0	4
			Honors Course	4	0	0	4

Category	Credits
Professional Core Courses	13.5
Professional Elective Courses	3
Skill advanced course/ Soft skill course	2
Open Elective Courses	3
Mandatory Course	0
TOTAL CREDITS	**21.5**

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

NRIA20 Course Structure

IV YEAR I SEMESTER

Sl. No	Course Code	Course Category	Title of the Course	L	T	P	Total Credits
1	20A4102511	PEC	Professional Elective – III: ***Renewable and Distributed Energy Technologies***	3	-	-	3
2	20A4102522	PEC	Professional Elective – IV: ***High Voltage Engineering***	3	-	-	3
3	20A4102531	PEC	Professional Elective – V: ***Power System Operation and Control***	3	-	-	3
4	20A4101607	OEC	Open Elective- III /Job Oriented Elective-III: ***Highway Engineering***	3	-	-	3
5	20A4103613	OEC	Open Elective-IV /Job Oriented Elective-IV: ***Safety Engineering***	3	-	-	3
6	20A4100101	HSC	Universal Human Values-2: Understanding Harmony	3	-	-	3
7	20A4102792	MINI PROJ	Mini Project	2	-	-	2
8	20A4102791	PROJ	Industrial / Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII Semester)	-	-	-	3
9	20A4102793		Term Paper	-	-	-	1
TOTAL CREDITS = 24							
			Minors Course	4	0	0	4
			Honors Course	4	0	0	4

Category	Credits
Professional Elective Courses	9
Open Elective Courses	6
Humanities and Social Sciences Courses	3
Summer Internship	3
Mini Project	2
Term Paper	1
TOTAL CREDITS	**24**

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IV YEAR II SEMESTER

Sl. No	Course Code	Course Category	Title of the Course	L	T	P/D	Total Credits
1	20A4202791	Project	Major Project-Project Work, Seminar and Internship in Industry	-	-	16	8
2	20A4202792	CSP	Community Service Project	-	-	8	4
						TOTAL CREDITS = 12	

Category	Credits
Major Project	08
Community Service Project	04
TOTAL CREDITS	**12**

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

NRIA20 Course Structure

List of Professional Elective Subjects offered to EEE Branch Students:

Professional Elective – I:

1.	Linear IC Applications
2.	Utilization of Electrical Energy
3.	Computer Architecture and Organization
4.	Optimization Techniques
5.	Object Oriented Programming through Java

Professional Elective – II:

1.	Signal and Systems
2.	Electric Drives
3.	Advanced Control Systems
4.	Switchgear and Protection
5.	Big Data Analytics

Professional Elective –III:

1.	Digital Signal Processing
2.	Renewable and Distributed Energy Technologies
3.	Flexible AC Transmission Systems
4.	Power Systems Deregulation
5.	Data Base Management Systems

Professional Elective – IV:

1.	Hybrid Electric Vehicles
2.	High Voltage Engineering
3.	Programmable Logic Controllers and Applications
4.	Cloud Computing with AWS
5.	Deep Learning Techniques

Professional Elective – V:

1.	Power System Operation and Control
2.	Switched Mode Power Conversion
3.	AI Applications to Electrical Engineering
4.	Data Science
5.	MEAN Stack Technologies

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NRIA20 Course Structure

List of Open Electives offered by EEE Department for Other Branches:

1	Concepts of Optimization Techniques
2	Concepts of Control Systems
3	Battery Management Systems and Charging Stations
4	Fundamentals of utilization of Electrical Energy
5	Indian Electricity Act
6	Concepts of Microprocessors and Microcontrollers
7	Fundamentals of Electric Vehicles
8	Concepts of Internet of Things
9	Green Energy
10	Concepts of Power System Engineering
11	Concepts of Smart Grid Technologies

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Courses offered for HONORS Degree for EEE Department

II B.Tech II Semester:

1.	Communication Systems
2.	Electrical Wiring, Estimation & Costing
3.	Electrical Distribution Systems

II B.Tech I Semester:

1.	Advanced Computer Networks
2.	Power Quality
3.	Special Electrical Machines

III B.Tech II Semester:

1.	Digital Control Systems
2.	Analysis of Power Electronic Converters
3.	HVDC Transmission

III B.Tech I Semester:

1.	EHV AC Transmission
2.	Smart Grid Technologies
3.	Power Electronic Control of Electrical Drives

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NRIA20 Course Structure

Courses offered for MINOR Degree by EEE Department for other branches

II B.Tech II Semester:

1.	Fundamentals of Electrical Circuits
2.	Concepts of Electrical Measurements

III B.Tech I Semester:

1.	Analysis of Linear Systems
2.	Energy Auditing, Conservation and Management

III B.Tech II Semester:

1.	Evolutionary Algorithms
2.	Fundamentals of Power Electronics

IV B.Tech I Semester:

1.	Neural Networks and Fuzzy Logic
2.	Concepts of Electric Drives and Its Applications

20A1100101: PROFESSIONAL COMMUNICATION
(Common to CE,EEE,ME,ECE,CSE,IT,AIML and DS)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits	3	**External Marks:**	70

Prerequisites: None

Course Objectives

1. To strengthen the lexical ability of the students in different contexts.
2. To expose the students to various sub-skills and strategies of reading and writing – summarizing and paraphrasing.
3. To help the students develop effective writing skills through paragraph writing.
4. To train the students in fundamentals of grammar required to equip them with fluent English.
5. To enable the students to think critically by exposing them to different socio-cultural contexts through various literary texts.

Course Outcomes

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

CO1	Build the grammatical structures accurately in their real-time situations in either spoken or written form.
CO2	Extend their ability to use vocabulary from various texts along with GRE and technical vocabulary in written and spoken communication
CO3	Comprehend, analyze and evaluate texts critically. Demonstrate effective writing skills in specific forms of written communication (paragraphs, summaries, email and letters.)
CO4	Apply the strategies of reading various texts and graphs, and describe in prose.
CO5	Relate human values and professional ethics in their academic, professional and social lives.
CO6	Summarize the main events of the literary texts, from different socio-cultural contexts, and interpret them critically.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1										**1**		**2**
CO2										**1**		**2**
CO3										**2**		**2**
CO4										**1**		**2**
CO5							1	**1**				**2**
CO6												**2**

UNIT I

1. **Text: A Drawer full of happiness** from "**Infotech English**", Maruthi Publications
2. **Reading:** Skimming text to get the main idea. Scanning to look for specific pieces of information.
3. **Reading for Writing:** Paragraph Writing (specific topics) using suitable Cohesive Devices; Linkers, Sign Posts and Transition Signals; Mechanics of Writing - Punctuation, Capital Letters.
4. **Vocabulary:** Technical vocabulary from across technical branches (20) GRE Vocabulary (20) (Antonyms and Synonyms, Word applications) Verbal Reasoning and Sequencing of Words.
5. **Grammar:** Content Words and Function Words; Word Forms: Verbs, Nouns, Adjectives and Adverbs; Nouns: Countables and Uncountables; Singular and Plural, Basic Sentence Structures; Simple Question Form - WH- Questions; Word Order in Sentences. Collocations (30 Phrases)

UNIT II

1. **Text: Nehru's letter to his daughter Indira on her birthday** from "**Infotech English**", Maruthi Publications
2. **Reading**: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.
3. **Reading for Writing**: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.

4. **Vocabulary**: Technical vocabulary from across technical branches (20 words). GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications)
5. **Grammar**: Use of Articles and Zero Article; Prepositions; Connectives (25 words)

UNIT III

1. **Text: Stephen Hawking-Positivity 'Benchmark'** from "**Infotech English**", Maruthi Publications
2. **Reading**: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Critical Reading.
3. **Reading for Writing**: Summarizing - Identifying main ideas and Rephrasing what is read; avoiding Redundancies and Repetitions. Letter Writing-types, Format and Principles of Letter Writing. E-mail Etiquette, Writing CVs.
4. **Vocabulary**: Technical vocabulary from across technical branches (20 words). GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, Sequencing of Words
5. **Grammar**: Verbs, Phrasal Verbs - Tenses; Subject-Verb Agreement;

UNIT IV

1. **Text: Liking a Tree, Unbowed: Wangari Maathai-biography** from "**Infotech English**", Maruthi Publications
2. **Reading**: Studying the use of graphic elements in texts to convey information, reveal trends / patterns / relationships, communicative process or display complicated data.
3. **Reading for Writing**: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. Writing SOP, writing for media.
4. **Vocabulary**: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters.
5. **Grammar**: Quantifying Expressions - Adjectives and Adverbs; Comparing and Contrasting; Use of Antonyms; Direct and Indirect Speech, Reporting Verbs for Academic Purposes. Idiomatic Expressions (25 Idioms)

UNIT V

1. **TEXT: Stay Hungry-Stay foolish** from "**Infotech English**", Maruthi Publications
2. **Reading**: Reading for Comprehension. RAP Strategy Intensive Reading and Extensive Reading Techniques.
3. **Reading for Writing**: Report writing (Significance, Format and Style of Writing Technical Reports)
4. **Vocabulary**: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, Matching Emotions.
5. **Grammar**: Change of Voice; Editing Short Texts – Identifying and Correcting Common Errors in grammar and usage (Articles, Prepositions, Tenses, Subject-Verb Agreement)

Text Book: "Infotech English", Maruthi Publications.

REFERENCE BOOKS:

1. **English Grammar in Use**, Raymond Murphy, Cambridge University Press.
2. **Oxford Practice Grammar,** John Eastwood, Oxford University Press.
3. **The Most Common Mistakes in English Usage** – Thomas Elliott Berry
4. **Essential Communication Skills** – Shalini Agarwal, Ane Books Pvt Ltd.
5. **Dictionary of Synonyms and Antonyms**, Oxford & IBH, III Ed
6. **A Practical English Grammar**, Agnes V. Martinet and Audrey Jean Thomson, Oxford University Press.
7. **English Vocabulary in Use,** Michael McCarthy and Felicity O'Dell, Cambridge University Press

E-RESOURCES

1. https://www.grammarbank.com/
2. http://guidetogrammar.org/grammar/index.htm
3. https://writeandimprove.com/
4. https://englishforeveryone.org/
5. http://www.englishvocabularyexercises.com/
6. https://englishplusmagazine.com/

20A1100201 ENGINEERING MATHEMATICS-I
(Common to CE, EEE, ME, ECE, CSE, IT, AIML and DS)

Lecture – Tutorial:	3-1	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Fundamentals of matrices, Fundamentals of Trigonometry and Calculus.

Course Objectives:

- To instruct the concept of Matrices in solving linear algebraic equations
- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Course Outcomes:

CO1	Student will be able to develop the **use** of matrix algebra techniques that is needed by engineers for practical applications (L6) solve system of linear algebraic equations using Gauss elimination, Gauss Seidel and **write** Eigen values and eigenvectors of a matrix (L3)
CO2	Student will be able to **write** diagonal form and different factorizations of a matrix (L3), to find inverse of a matrix and integral powers of a matrix by Cayley-Hamilton Theorem **identify** the nature of a Quadratic form such as positive definite, positive semi definite etc., and use this information to facilitate the calculation of matrix characteristics (L2)
CO3	Student will be able to **evaluate** the approximate roots of polynomial and transcendental equations by different algorithms (L5)
CO4	Student will be able to **apply** Newton's forward & backward interpolation and Lagrange's formulae for unequal intervals (L3)
CO5	Student will be able to **apply** numerical integral techniques to different Engineering problems (L3)
CO6	Student will be able to **apply** different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2								
CO2	3	3	2	2								
CO3	3	3	2	2								
CO4	3	3	2	2								
CO5	3	3	2	2								
CO6	3	3	2	2								

UNIT – I: Solving systems of linear equations, Eigen values and Eigen vectors: (10hrs)

Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non- homogeneous linear equations – Gauss

Elimination method – Eigen values and Eigen vectors and properties.

Unit – II: Cayley–Hamilton theorem and Quadratic forms: (10hrs)

Cayley-Hamilton theorem (without proof) – Applications – Finding the inverse and power of a matrix by Cayley-Hamilton theorem – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation.

UNIT – III: Iterative methods: (8 hrs)

Introduction– Bisection method – Method of false position– Iteration method

Newton-Raphson method (One variable).

Gauss-Jacobi and Gauss-Seidel methods for solving system of equations numerically.

UNIT – IV: Interpolation: (10 hrs)

Introduction– Errors in polynomial interpolation – Finite differences– Forward differences– Backward differences –Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula.

UNIT –V: Numerical integration and Solution of ordinary differential equations with initialconditions (10 hrs)

Trapezoidal rule– Simpson's 1/3rd and 3/8th rule– Solution of initial value problems by Taylor's series– Picard's method of successive approximations– Euler's method –Modified Euler's method – Runge-Kutta method (second and fourth order).

TEXT BOOKS:

1. **B. S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. **B. V. Ramana,**Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
3. **David Poole,** Linear Algebra- A modern introduction, 4th Edition, Cengage.

REFERENCE BOOKS:

1. **Steven C. Chapra,** Applied Numerical Methods with MATLAB for Engineering and Science,Tata Mc. Graw Hill Education.
2. **M. K. Jain, S.R.K. Iyengar and R.K. Jain,** Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
3. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press.

E-RESOURCES:1. www.nptel **videos.com/mathematics/(Math Lectures from MIT,Stanford,IIT'S**

2. nptl.ac.in/courses/1221104017

20A1100203 : **APPLIED PHYSICS**
(Common to EEE and ECE)

Lecture – Tutorial:	3-0	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Knowledge on fundamental concepts of waves, optics, sound and magnetism

Course Objectives:

- The course aims at making students to understand the basic concepts of Principles of Physics in a broader sense with a view to lay foundation for the various engineering courses.
- To develop analytical capability and solve various engineering problems.

Course Outcomes:

CO1	Apply the interaction of light with matter through interference, diffraction, polarization and identify these phenomena in different natural optical processes and optical instruments.
CO2	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications.
CO3	Interpret the knowledge of dielectric and magnetic materials with characteristic utility in appliances.
CO4	Apply the knowledge of basic quantum mechanics, to set up one dimensional Schrodinger's wave equation and its application to a infinite potential well.
CO5	Summarize the importance of free electrons in determining the properties of metals and understand the origin & role of energy bands in classifying the solids
CO6	Understand the physics of Semiconductors and their working mechanism for their utility in sensors.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3				3					3		
CO2	3	3		2	2					3		
CO3	3	3			2							
CO4	3											
CO5	3		2		2							
CO6	3				2							

Unit-I: Wave Optics
(12hrs)

Interference: Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) - Colors in thin films- Newton's Rings- Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffraction - Fraunhofer diffraction due to single slit, double slit - N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative).

Polarization: Introduction-Types of polarization - Double refraction - Nicol's Prism - Half wave and Quarter wave plates.

Unit-II: Lasers and Fiber optics
(8hrs)

Lasers: Introduction – Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Einstein's coefficients – Population inversion – Lasing action - Pumping Schemes – Ruby laser – He-Ne laser - Applications of lasers.

Fiber optics: Introduction –Principle of optical fiber- Acceptance Angle - Numerical

Aperture -
Classification of optical fibers based on refractive index profile and modes – Propagation of electromagnetic wave through optical fibers - Applications.

Unit-III: Magnetic and Dielectric Materials

(10hrs)

Magnetic Materials: Introduction - Origin of permanent magnetic moment - Classification of
magnetic materials: Dia, para, Ferro, antiferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility and Dielectric constant - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field- Clausius- Mossotti equation.

Unit IV: Quantum Mechanics, Free Electron Theory

(8hrs)

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory– Equation for electrical conductivity based on quantum free electron theory- Fermi-Dirac distribution- Fermi energy-Density of states.

Unit – V: Band theory of Solids &Semiconductors

(10hrs)

Band theory of Solids: Bloch's Theorem (Qualitative) - Kronig - Penney model (Qualitative)- E vs K diagram - v vs K diagram - effective mass of electron – Classification of crystalline solids-Concept of hole.

Semiconductors: Introduction- Intrinsic semiconductors – Density of charge carriers – Electrical conductivity – Fermi level – extrinsic semiconductors – density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation- Hall effect – Hall coefficient –Applications of Hall effect.

TEXT BOOKS:

1. **M. N. Avadhanulu, P.G.Kshirsagar & TVS Arun Murthy**" A Text book of Engineering Physics"- S.Chand Publications, 11th Edition 2019.
2. Engineering Physics by **P.K.Palanisamy** SciTech publications

REFERENCE BOOKS:

1. Engineering Physics by **M.R.Srinivasan**, New Age international publishers (2009).
2. Engineering Physics - **Sanjay D. Jain, D. Sahasrabudhe and Girish**, University Press
3. **B.K. Pandey and S. Chaturvedi**, Engineering Physics, Cengage Learning

E-RESOURCES: www.doitpoms.ac.uk,
http://www.itp.uni-hannover.de/~zawischa/ITP/diffraction.html,
http://www.coherent.com/products/?834/Lasers,
http://plato.stanford.edu/entries/qm/

20A1103301: ENGINEERING GRAPHICS

(Common to EEE and ECE)

Lecture – Practical:	**2 - 2 Hours**	**Internal Marks:**	**30**
Credits:	**3**	**External Marks:**	**70**

Prerequisites:

1. Knowledge of basic Mathematics
2. Drawing skills

Course Objectives:

1. To introduce the students the usage of drawing instruments and to draw polygons, Engg. Curves and scales.
2. To introduce the students to use orthographic projections, projection of points & simple lines.
3. To make the students draw the projections of the lines inclined to both the planes.
4. To make the students draw the projections of the plane inclined to both the planes.
5. To make the students draw the projections of the various types of solids in different positions inclined to one of the planes.
6. To represent the object in 3D view through isometric views and to convert the isometric view to orthographic view and vice versa.

Course Outcomes:

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

CO1	Understand the simple geometric constructions like polygons, engineering curves.
CO2	Understand the orthographic projections of points and lines
CO3	Understand the orthographic projections of straight lines- inclined to one plane and inclined to both the planes.
CO4	Understand the orthographic projections of planes and Planes inclined to both the planes.
CO5	Understand and draw the projections of the various types of solids in different positions inclined to one of the planes
CO6	Understand the transformation of orthographic views into isometric views and vice versa.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	3	-	1
CO2	3	2	-	-	-	-	-	-	-	3	-	1
CO3	3	2	-	-	-	-	-	-	-	3	-	1
CO4	3	2	-	-	2	-	-	-	-	3	-	1
CO5	3	2	-	-	2	-	-	-	-	3	-	1
CO6	3	2	-	-	2	-	-	-	-	3	-	1

UNIT I

Polygons: Constructing regular polygons by general methods, inscribing and describing polygons on circles.

Curves: Parabola, Ellipse and Hyperbola by general and special methods, tangents

& normals for the curves.
Scales: Plain scales, diagonal scales and vernier scales

UNIT II

Orthographic Projections: Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to other plane.
Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination.

UNIT III

Projections of planes: regular planes perpendicular/parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT IV

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to both the planes.

UNIT V

Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.
Computer Aided Design, Drawing practice using Auto CAD, Creating 2D&3D drawings of objects using Auto CAD

Note: In the End Examination there will be no question from CAD.

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

REFERENCE BOOKS:

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGrawHill Publishers
4. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

20A1105301:-Programming and Problem solving with C
(Common to EEE,ME,ECE,CSE,IT,AIML and DS)

Lecture – Tutorial-Practical::	3-0-0	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Basic knowledge on computers, Mathematics

Course Objectives: The objectives of Programming for Problem Solving Using C are

- To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
- To gain knowledge of the operators, selection, control statements and repetition in C
- To learn about the design concepts of arrays, strings, enumerated structure and union types and their usage.
- To assimilate about pointers, dynamic memory allocation and know the significance of Preprocessor.
- To assimilate about File I/O and significance of functions

Course Outcomes:

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

CO1	Understand the programming terminology and implement various c-tokens & input-output statements to solve simple problems
CO2	Able to compare and differentiate various looping & branching constructs and apply the best looping structure for a given problem
CO3	Identify the necessity of modularity in programming and design various function types
CO4	Understand pointers and implement the programs to directly access memory locations
CO5	Interpret and implement the need of arrays and structure/union to store homogeneous and heterogeneous groups of data
CO6	Contrast the need of using files in programming and implement file operations

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2- Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		1									
CO2		1	3									
CO3		1	3									
CO4	3		1									
CO5			3									
CO6			3									

UNIT I : Objective: Notion of Computer Languages, algorithm, computational procedure, editing and executing programs and C Declarations

BASICS AND INTRODUCTION TO C: Basics of Computer, Introduction to C, Machine, Assembly and High level Language, Assembler, Compiler and Interpreter, Structure of a C program, Programming Rules, Executing the C Program, Advantages of C, Header Files, Flow Chart, Algorithm.

THE C DECLARATIONS: The C-Character set, Delimiters, Types of Tokens, The C keywords, Identifiers, Constants, Variables, C Data types, initialization, type modifiers, type conversions, constant and volatile variables. Properties of Operators, Operator Priority ,comma and conditional operators, arithmetic, relational, assignment operators and expressions, logical , bitwise operators. Input and output in c: Formatted and Unformatted functions

UNIT II: Objective: Understanding branching, iteration, data representation using arrays and strings

DECISION STATEMENTS: The if statement, if-else, nested if else, if-else-if ladder, break, continue goto, Switch statement, nested switch case, Switch case and nested ifs.
LOOP CONTROL: for loop, nested for loop, while, do-while, do-while statement with while loop.
ARRAYS: Array initialization, array terminology, characteristics of an array, 1-D array and its operations, 2-D arrays and operations, Multi -dimensional arrays.
STRINGS: Declaration and initialization of string, string standard functions, string conversion functions, memory functions, application of strings.

UNIT III: Objective: Modular programming and recursive solution formulation and storage classes

FUNCTIONS: Basics, function definition, return statement, types of functions, call by value ,call by reference, function as an argument, Functions with operators, Function and Decision Statements, Functions and loop Statements, Functions with arrays and Pointers, Recursion-Types of Recursion, Rules for Recursive Function, Recursion versus Iterations, Advantages and Disadvantages of Recursion, Efficiency of Recursion, Library Functions.
STORAGE CLASS: Variable Lifetime, Automatic Variables, External Variables, Static Variables, Register Variables.

UNIT IV: Objective: Understanding pointers, dynamic memory allocation and Preprocessor Directives.

POINTERS: Features of pointers, pointers and address, pointer declaration, void pointers, arithmetic operations with pointers, pointers and arrays, array of pointers, pointers to pointers, pointers and strings. Dynamic memory allocation
PREPROCESSOR DIRECTIVES: The #define Directive, Defining and Undefining a Macros, The #include Directive

UNIT V: Objective: Understanding derived data types of C and basic of file operations.

STRUCTURE AND UNION: Features of Structures, Declaration and initialization of Structures, Structure within Structure, Arrays of Structure, Pointer to Structure, Structure and functions, typedef, Bit fields, Enumerated Data Type, Unions and Unions Vs Structures.
FILES: Streams and File Types, Steps for File Operations, FILE I/O, Structures Read and Write, Other file function, Command line Arguments.

TEXT BOOKS:

[1] Behrouz A. Forouzan & Richard F. Gilberg , —"Computer Science A Structured Programming Approach using C" , CENGAGE Learning, Third Edition.

REFERENCE BOOKS:

[1]Kernighan and Ritchie , —"The C programming language" , The (Ansi C Version), PHI second edition.
[2]Yashwant Kanetkar , —"Let us C" , BPB Publications, 2nd Edition 2001.
[3]Paul J. Dietel and Dr. Harvey M. Deitel, —"C: How to Program", Prentice Hall, 7 th edition (March 4,2012).
[4]Herbert Schildt, —"C:The Complete reference", McGraw Hill, 4th Edition, 2002.
[5]K.R.Venugopal, Sundeep R Prasad, —"Mastering C", McGraw Hill, 2nd Edition, 2015

E-RESOURCES:

1.http://cslibrary.stanford.edu/101/EssentialC.pdf
2. http://nptel.ac.in/courses/106104128/
3.http://www.vssut.ac.in/lecture_notes

20A1100292 : **APPLIED PHYSICS LAB**
(Common to EEE AND ME)

Labs / Instructions Hours/Week	3	**Internal Marks:**	30
Credits:	2	**External Marks:**	70

Prerequisites: Knowledge on vernier callipers, Screw guage, common balance

Course Objectives:

- The Objective of this course is to make the students gain practical knowledge to co-relate with the theoretical studies.
- To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipments.
- Training field oriented Engineering graduates to handle instruments and their design methods to improve the accuracy of measurements.

Course Outcomes:

CO1	Understand principle, concept, working of an instrument and can compare results with theoretical calculations.
CO2	Analyze the physical principle involved in the various instruments; also relate the principle to new application.
CO3	Understand design of an instrument with targeted accuracy for physical measurements.
CO4	Develop skills to impart practical knowledge in real time solution.
CO5	The various experiments in the areas of optics, mechanics and thermal physics will nurture the students in all branches of Engineering..
CO6	Think innovatively and also improve the creative skills that are essential for engineering.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3											
CO2	3	3		3					3			
CO3	3	3	1	3					3			
CO4	3	3		3								
CO5	3											
CO6	3	3	2	3								

List of Experiments

1. Study of variation of magnetic field along the axis of a current carrying circular coil by Stewart & Gee's method.
2. Determination of numerical aperture and acceptance angle of an optical fiber.
3. Determination of thickness of thin object by wedge method.
4. Determination of radius of curvature of given plano convex lens by Newton's rings.
5. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
6. Determination of dispersive power of the prism.
7. Sonometer: Verification of laws of string.
8. Study of I/V Characteristics of Semiconductor diode.
9. I/V characteristics of Zener diode.
10. Melde's experiment-Longitudinal and Transverse mode.
11. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).

12. Estimation of Planck's constant using photoelectric effect.
13. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect
14. Determination of wavelength of Laser light using diffraction grating.
15. Rigidity modulus of material of a wire-dynamic method (Torsional pendulum).

Note: Any 8 experiments out of 15 should be done in the laboratory and 2 experiments in virtual lab.

TEXT BOOKS:

S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.

REFERENCE BOOKS:

Engineering Physics / Applied Physics Lab Manual – **Spectrum Publications**

E-RESOURCES: www.vlab.co.in

20A1105391-Programming and Problem Solving with C Lab
(Common to EEE,ME,ECE,CSE,IT,AIML and DS)

Lecture – Tutorial-Practical::	0-0-4	**Internal Marks:**	30
Credits:	2	**External Marks:**	70

Prerequisites:

Course Objectives:

1. To make the student learn a programming language.
2. To learn problem solving techniques.
3. To teach the student to write programs in C and to solve the problems

Course Outcomes:

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

CO1	Understand basic Structure of the C-PROGRAMMING, declaration and usage of variables
CO2	Exercise conditional and iterative statements to inscribe C programs
CO3	Exercise user defined functions to solve real time problems
CO4	Inscribe C programs using Pointers to access arrays, strings and functions
CO5	Inscribe C programs using pointers and allocate memory using dynamic memory management functions
CO6	Exercise user defined data types including structures and unions to solve problems
CO7	Exercise files concept to show input and output of files in C

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1		3									
CO2			2									
CO3			3									
CO4			2									
CO5			3									
CO6		2	3									
CO7		1	3									

Exercise 1:

1. Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five and four characters.
2. Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches.
3. Write a C program to display multiple variables.

Exercise 2:

1. Write a C program to calculate the distance between the two points.
2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

Exercise 3:

1. Write a C program to convert a string to a long integer.
2. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
3. Write a C program to calculate the factorial of a given number

Exercise 4:

1. Write a program in C to display the n terms of even natural number and their sum.
2. Write a program in C to display the n terms of harmonic series and their sum. 1 +

1/2 + 1/3 + 1/4 + 1/5 ... 1/n terms.
3. Write a C program to check whether a given number is an Armstrong number or not.

Exercise 5:

1. Write a program in C to print all unique elements in an array.
2. Write a program in C to separate odd and even integers in separate arrays.
3. Write a program in C to sort elements of array in ascending order.

Exercise 6:

1. Write a program in C for multiplication of two square Matrices.
2. Write a program in C to find transpose of a given matrix.

Exercise 7:

1. Write a program in C to search an element in a row wise and column wise sorted matrix.
2. Write a program in C to print individual characters of string in reverse order.

Exercise 8:

1. Write a program in C to compare two strings without using string library functions.
2. Write a program in C to copy one string to another string.

Exercise 9:

1. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation
2. Write a program in C to demonstrate how to handle the pointers in the program.

Exercise 10:

1. Write a program in C to demonstrate the use of & (address of) and *(value at address) operator.
2. Write a program in C to add two numbers using pointers.

Exercise 11:

1. Write a program in C to add numbers using call by reference.
2. Write a program in C to find the largest element using Dynamic Memory Allocation.

Exercise 12:

1. Write a program in C to swap elements using call by reference.
2. Write a program in C to count the number of vowels and consonants in a string using a pointer.

Exercise 13:

1. Write a program in C to show how a function returning pointer.
2. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc( ) function.

Exercise 14:

1. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc( ) function. Understand the difference between the above two programs
2. Write a program in C to convert decimal number to binary number using the function.

Exercise 15:

1. Write a program in C to check whether a number is a prime number or not using the function.
2. Write a program in C to get the largest element of an array using the function.

Exercise 16:

1. Write a program in C to append multiple lines at the end of a text file.
2. Write a program in C to copy a file in another name.
3. Write a program in C to remove a file from the disk.

TEXT BOOKS:

[1] Behrouz A. Forouzan & Richard F. Gilberg , —"Computer Science A Structured Programming Approach using C" , CENGAGE Learning, Third Edition.

REFERENCE BOOKS:

[1]Kernighan and Ritchie , —"The C programming language" , The (Ansi C Version),

PHI, second edition.
[2]Yashwant Kanetkar , —"Let us C" , BPB Publications, 2nd Edition 2001.
[3]Paul J. Dietel and Dr. Harvey M. Deitel, —"C: How to Program", Prentice Hall, 7 th edition (March 4,2012).
[4]Herbert Schildt, —"C:The Complete reference", McGraw Hill, 4th Edition, 2002.
[5]K.R.Venugopal, Sundeep R Prasad, —"Mastering C", McGraw Hill, 2nd Edition, 2015

E-RESOURCES:

1.http://cslibrary.stanford.edu/101/EssentialC.pdf
2. http://nptel.ac.in/courses/106104128/
3.http://www.vssut.ac.in/lecture_notes

20A1200201 : **ENGINEERING MATHEMATICS-II**
(Common to All Branches)

Lecture – Tutorial:	3-1	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Fundamentals of matrices, Fundamentals of Trigonometry and Calculus.

Course Objectives:

- To familiarize a variety of well-known sequences and series, with a developing intuition about the behaviour of new ones.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Course Outcomes:

CO1	Student will be able to **find** the General/Particular solutions of first order and first degree ordinary differential equations by **apply** different methods **(L3),** know the applications of Newton's law of cooling, natural growth and decay problems and **find** orthogonal trajectories of the given family of curves. **(L3)**
CO2	Student will be able to **identify** the essential characteristics of linear differential equations with constant coefficients. **(L2)solve** the linear differential equations with constant coefficients by appropriate method **(L3)**
CO3	Student will be able to find convergence (or) divergence of a series **(L3)**
CO4	Student will be able to utilize mean value theorems to real life problems**(L3)**
CO5	Student will be able to find partial derivatives numerically and symbolically and use them to **analyze** and interpret the way a function varies. **(L4)acquire** the Knowledge maxima and minima of functions of several variable **(L1)Utilize** Jacobian of a coordinate transformation to deal with the problems in change of variables **(L3)**
CO6	Student will be able to **find** length of the arc, volume of solid of revolution and surface area of solid of revolution**(L3)**

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2								
CO2	3	3	2	2								
CO3	3	3	2	2								
CO4	3	3	2	2								
CO5	3	3	2	2								
CO6	3	3	2	2								

UNIT – I: Differential equations of first order and first degree: (10hrs)

Linear differential equations– Bernoulli's equations –Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling– Law of natural growth and decay– Orthogonal trajectories.

UNIT-II: Linear Differential equations of higher order: (10hrs)

Homogeneous and Non-homogeneous differential equations of higher order with constant coefficients – with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, $e^{ax}V(x)$ and $x^nV(x)$ – Method of Variation of parameters, Cauchy and Legendre's linear equations.

UNIT – III: Sequences, Series and Mean value theorems: (10hrs)

Sequences and Series: Convergences and divergence – Ratio test – Comparison tests – Integral test – Cauchy's root test – Alternate series– Leibnitz's rule.
Mean Value Theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with remainders, Problems and applications on the above theorem.

UNIT – IV: Partial differentiation: (10hrs)

Introduction – Homogeneous function – Euler's theorem– Total derivative– Chain rule– Jacobian – Functional dependence –Taylor's and MacLaurin's series expansion of functions of two variables.Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's multiplied method.

UNIT – V: Multiple integrals: (8hrs) (8 hrs)

Double and Triple integrals – Change of order of integration in double integrals – Change of variables to polar, cylindrical and spherical coordinates.
Applications: Finding Areas and Volumes

TEXT BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. B. V. Ramana,Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

REFERENCE BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. Joel Hass, Christopher Heil and Maurice D. Weir, Thomas calculus, 14thEdition, Pearson.
3. Lawrence Turyn, Advanced Engineering Mathematics, CRC Press, 2013.
4. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.

E-RESOURCES:

1. www.nptel **videos.com/mathematics/(Math Lectures from MIT,Stanford,IIT'S**

2. nptl.ac.in/courses/1221104017

20A1200205: APPLIED CHEMISTRY
(Common to EEE and ECE)

Lecture – Tutorial:	3-1	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites:

Course Objectives:

- Importance of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
- Outline the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
- Explain the preparation of semiconductors and nanomaterials, engineering applications of nanomaterials, superconductors and liquid crystals.
- Recall the increase in demand for power and hence alternative sources of power are studied due to depleting sources of fossil fuels. Advanced instrumental techniques are introduced.
- Outline the basics of computational chemistry and molecular switches

Course Outcomes:

CO1	**Analyze** the different types of composite plastic materials and **interpret** the mechanism of conduction in conducting polymers.
CO2	Predict potential complications from combining various Chemicals, metals in engineering setting and categorize materials science relevant to corrosion phenomena.
CO3	Apply new materials with excellent engineering properties to take care of society needs and environment.
CO4	Analyze the principles of different analytical instrumentation and applications
CO5	Design models for energy by different natural sources
CO6	Understand the knowledge of computational chemistry and molecular machines

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	3	3	2	-	-	2	-	-	-	-	-
CO2	3	3	2	1	-	-	2	-	-	-	-	-
CO3	3	2	2	-	-	-	2	-	-	-	-	-
CO4	3	3	2	2	-	-	2	-	-	-	-	-
CO5	3	2	2	2	-	-	2	-	-	-	-	-
CO6	3	3	3	3	-	-	3	-	-	-	-	-

UNIT – I: POLYMER TECHNOLOGY

Polymerisation:- Introduction, methods of polymerization (emulsion and suspension), mechanical properties.

Plastics:Thermoplastic-Thermosetting, Compounding, fabrication (compression, injection, Transfer and extrusion), preparation, properties and applications (PVC, polycarbonates and Bakelite), mention some examples of plastic materials used in electronic gadgets.

Elastomers:- Introduction, preparation, properties and applications (Buna S, thiokol and polyurethanes).

Composite materials: Fibre reinforced plastics, conducting polymers, biodegradable polymers..

Unit – II: ELECTROCHEMICAL CELLS AND CORROSION

Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, batteries (Dry cell, liquid Li ion battery), fuel cells (H2-O2).

*Corrosion:-*Definition, theories of corrosion (chemical and electrochemical), galvanic corrosion, differential aeration corrosion, factors influencing rate of corrosion, corrosion control method- Protective coatings (Galvanizing, tinning, electroplating and electroless plating [nickel])

UNIT – III: MATERIAL CHEMISTRY

Semiconductors: Preparation of semi conductors by zone refining, Czochralski crystal pulling – applications

Super conductors:-Type –I, Type II and applications

Nano materials:- Introduction, sol-gel method & Chemical reduction method of preparation , transmission electron microscopy [TEM], applications of fullerenes, carbon nanotubes (types, preparation and applications)

Liquid crystals:- Introduction-types-applications.

UNIT – IV :SPECTROSCOPIC TECHNIQUES & NON-CONVENTIONAL ENERGY SOURCES

SPECTROSCOPIC TECHNIQUES: Electromagnetic spectrum-UV laws of ab:sorption, instrumentation, theory of electronic spectroscopy, Frank-condon principle, chromophores and auxochromes, applications, FT-IR Basic principle, instrumentation and IR stretching of functional groups (alcohols, carbonyls, amines) applications,

NON-CONVENTIONAL ENERGY SOURCES Design, working, schematic diagram, advantages and disadvantages of photovoltaic cell, hydropower, geothermal power, tidal and wave power, ocean thermal energy conversion.

UNIT –V: **ADVANCED CONCEPTS/TOPICS IN CHEMISTRY**

Computational chemistry: Introduction to computational chemistry, molecular modelling and docking studies.

Molecular switches: characteristics of molecular motors and machines, Rotaxanes and Catenanes as artificial molecular machines, prototypes – linear motions in rotaxanes, an acid-base controlled molecular shuttle, a molecular elevator, an autonomous light-powered molecular motor

TEXT BOOKS:

1. P.C. Jain and M. Jain "**Engineering Chemistry**", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, "**Engineering Chemistry**", Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, "**A Textbook of Engineering Chemistry**", S.Chand & Co, (2010).
4. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publicating Co. (Latest edition).

REFERENCE BOOKS:

1. K. Sesha Maheshwaramma and Mridula Chugh, "**Engineering Chemistry**", Pearson India Edn.
2. (a) O.G. Palana, "**Engineering Chemistry**", Tata McGraw Hill Education Private Limited, (2009).
   (b) CNR Rao and JM Honig (Eds) "**Preparation and characterization of materials**" Academic press, New York (latest edition)
3. B. S. Murthy, P. Shankar and others, "**Textbook of Nanoscience and Nanotechnology**", University press (latest edition)

E-RESOURCES:

1. https://en.wikipedia.org >wiki> Conductive polymers
2. www.sae.org/fuel cells/fuelcells-types.htm
3. https://en.wikipedia.org >wiki> Nanomaterials
4. https://en.wikipedia.org >wiki> Electrochemical cell
5. https://en.wikipedia.org >wiki> Spectroscopy

20A1205302: JAVA PROGRAMMING

(Common to ECE&EEE)

Lecture – Tutorial-Practical::	2-0-2	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites:

C Programming

Course Objectives:

To **introduce** the object oriented programming concepts.
To **understand** object oriented programming concepts, and apply them in solving Problems.
To **introduce** the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes
To **introduce** the implementation of packages and interfaces
To **introduce** the concepts of exception handling and multithreading.
To **introduce** the design of Graphical User Interface using applets.

Course Outcomes:

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

CO1	Able to **solve** real world problems using OOP techniques.
CO2	Able to **understand** the use of abstract classes and Packages in java.
CO3	Able to **develop** and **understand** exception handling and Interfaces in java
CO4	Able to understand multithreaded applications with synchronization and **design** GUI based applications and **develop** applets for web applications

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	-	-	-	-	-	-	-	-	-	3
CO2	3	3	3	-	-	-	-	-	-	-	-	3
CO3	3	3	3	2	-	-	-	-	2	-	-	3
CO4	3	3	3	2	-	-	-	-	2	-	-	3

UNIT I

The History and Evolution of Java: Java's Lineage, Java's Magic: The Byte code, The Java Buzzwords. An overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements. Data Types, Variables, and Arrays: Java Is a Strongly Typed Language, Integers, Floating-Point Types, Characters, The Primitive Types, Booleans, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays.

UNIT II

Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, A Stack Class. A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Introducing Access Control, Understanding static, Introducing final, Using Command-Line Arguments.

UNIT III

INHERITANCE: Inheritance basics, Using super keyword, method overriding, Dynamic method dispatch using final with inheritance, abstract classes
Packages: Defining a package, Finding packages and class path, Example, Access protection, importing packages.
Interfaces: Defining Interface, Implementing Interface, Nested Interfaces, Applying interfaces, Variables in interface, Interfaces can be extended.

UNIT IV

Exception handling: Fundamentals, Exception types, uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws, finally, Java's built-in exceptions, Creating your own exception subclasses.
Multithreaded Programming: The Java thread model, The Main thread, Creating a thread, creating multiple threads, Using isalive() and Join( ), thread priorities, Synchronization, Inter thread communication.

UNIT V

APPLETS: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating applets.

Lab Programs:

1. Create a java application that implements the concept of classes and objects.
2. Develop Java Application using inheritance.
3. Use interfaces and develop a java application.
4. Create a package and access members from a package.
5. Develop Java Application using Method overloading and method overriding.
6. Create a java application to copy content from one file to another using IO streams.
7. Develop Java Application to use String and String Buffer classes
8. Implement Exception handling in a given application.
9. Develop java application using Multithreading
10. GUI Application using applets

TEXT BOOKS:

1. The Complete Reference Java, 8th edition, Herbert Schildt, TMH.
2. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.

REFERENCE BOOKS:

1. An Introduction to programming and OO design using Java, J. Nino and F.A. Hosch, John Wiley & sons.
2. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
3. Object Oriented Programming through Java, P. Radha Krishna, Universities Press.
4. Programming in Java, S. Malhotra, S. Chudhary, 2nd edition, Oxford Univ. Press.
5. Java Programming and Object oriented Application Development, R. A. Johnson, Cengage Learning.

E-RESOURCES:

http://www.javatpoint.com/
java.sun.com/docs/books/tutorial/java/TOC.html
http://www.learnjavaonline.org/
http://www.tutorialspoint.com/java/
www.java.com/en/download/faq/develop.xml
www.oracle.com › Java › Java SE
www.w3schools.com

20A1202401: ELECTRICAL CIRCUIT ANALYSIS-1
(Electrical and Electronics Engineering)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits	4	**External Marks:**	70

Prerequisites: This course introduces the basic concepts of circuit analysis which is the foundation for all subjects of the Electrical Engineering discipline. The emphasis of this course is laid on the basic analysis of circuits which includes single phase circuits, magnetic circuits, network theorems, transient analysis and network topology.

Course Objectives

- To study the concepts of passive elements, types of sources and variousnetwork reduction techniques.
- To understand the applications of network topology to electrical circuits.
- To study the concept of magnetic coupled circuit.
- To understand the behavior of RLC networks for sinusoidal excitations.
- To study the performance of R-L, R-C and R-L-C circuits with variation of one of the parameters and to understand the concept of resonance.
- To understand the applications of network theorems for analysis of electrical networks.

Course Outcomes

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

CO1	Various electrical networks in presence of active and passive elements.
CO2	Electrical networks with network topology concepts.
CO3	Any magnetic circuit with various dot conventions.
CO4	Any R, L, C network with sinusoidal excitation.
CO5	Any R, L, network with variation of any one of the parameters i.e R, L, C and f.
CO6	Electrical networks by using principles of network theorems.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**										
CO2	**3**	**3**	**2**									
CO3	**3**	**3**										
CO4	**3**	**2**	**2**									
CO5	**3**	**2**										
CO6	**3**	**2**	**2**									

UNIT I

Introduction to Electrical Circuits

Basic Concepts of passive elements of R, L, C and their V-I relations, Sources (dependent and independent), Kirchhoff's laws, Network reduction techniques (series, parallel, series - parallel, star-to-delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis to DC networks with dependent and independent voltage and current sources, node and mesh analysis.

UNIT II

Magnetic Circuits

Basic definition of MMF, flux and reluctance, analogy between electrical and magnetic

circuits, Faraday's laws of electromagnetic induction – concept of self and mutual inductance, Dot convention – coefficient of coupling and composite magnetic circuit, analysis of series and parallel magnetic circuits.

UNIT III

Single Phase A.C Systems

Periodic waveforms (determination of rms, average value and form factor), concept of phasor, phase angle and phase difference – waveforms and phasor diagrams for lagging, leading networks, complex and polar forms of representations. node and mesh analysis. Steady state analysis of R, L and C circuits, power factor and its significance, real, reactive and apparent power, waveform of instantaneous power and complex power .

UNIT IV

Resonance - Locus Diagrams

Series and parallel resonance, selectively band width and Quality factor, locus diagram- RL, RC, RLC with R, L and C variables.

UNIT V

Network theorems (DC & AC Excitations)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem and compensation theorem.

Text Book:

1. Engineering Circuit Analysis by William Hayt and Jack E. Kemmerley, 6th edition McGraw Hill Company, 2012.
2. Network Analysis: Van Valkenburg; Prentice-3rd edition, Hall of India Private Ltd, 2015.

REFERENCE BOOKS:

1. Fundamentals of Electrical Circuits by Charles K. Alexander and Mathew N.O.Sadiku, 5th edition, McGraw Hill Education (India), 2013.
2. Linear Circuit Analysis by De Carlo, Lin, 2nd edition, Oxford publications, 2001.
3. Electric Circuits – (Schaum's outlines) by Mahmood Nahvi & Joseph Edminister, Adapted by KumaRao, 5th Edition – McGraw Hill, 2017.
4. Electric Circuits by David A. Bell, 7th edition, Oxford publications, 2009.
5. Introductory Circuit Analysis by Robert L Boylestad, 13th edition, Pearson, 2015
6. Circuit Theory (Analysis and Synthesis) by A. Chakrabarthi, 7th edition, DhanpatRai&Co., 2018.

E-RESOURCES

1. http://nptel.ac.in/courses.php
2. http://jntuk-coeerd.in/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/

20A1201301: Basic Civil and Mechanical Engineering

(Electrical and Electronics Engineering)

Lecture – Tutorial-Practical:	3-0-0	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites:

1. Mathematics
2. Physics

Course Objectives:

1. To make the students exposed to the concepts of force and friction, direction and its application & able to demonstrate the basic surveying skills
2. The students are exposed to the concepts of classification of bricks, manufacture of bricks and various aspects of bricks.
3. To introduce the concepts of Soil Types and various aspects of Foundations.
4. To make the students exposed to the Fundamental principles of Thermodynamics.
5. To introduce the concepts of Engineering Materials and Basic manufacturing processes used in manufacturing of products.
6. The students are exposed to the concepts of Engineering Mechanics like analysis of coplanar concurrent systems.

Course Outcomes:

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

CO1	Understand the concepts of force and friction, direction and its application & able to demonstrate the basic surveying skills
CO2	Identify different building materials and their importance in building construction.
CO3	Differentiate brick masonry, stone masonry and types of flooring & roofing and to know about types of soil and foundations.
CO4	Understand the basic concepts of thermodynamics.
CO5	Familiarize with the basic manufacturing processes used in manufacturing of products. F Familiarize with the Engineering materials, their types, properties and applications.
CO6	Analyze coplanar concurrent systems and Familiarize with fundamental principles of thermodynamics.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-

UNIT – I

SIMPLE STRESS AND STRAINS:

Definition of Mechanics- External and Internal forces-Stress and Strain-Elasticity and Hooke's Law- Relations between elastic constants.

SURVEYING:

Objectives, Types, Principles of Surveying; Measurement of distances and angles

UNIT II:

CIVIL ENGINEERING MATERIALS:
Classification of bricks, Manufacture of bricks, Laboratory and field tests on bricks, stones; Grades of Steel and Cement Concrete.

MASONRY:
Bonds in Brick Masonry, Stone Masonry; Types of Flooring and Roofing.

UNIT III:

SUB-STRUCTURE: Soil –Types; Introduction to Foundations – Classifications; Bearing capacity of Soil - Improvement

Fundamentals of Thermodynamics: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics.

UNIT-IV

Introduction to Engineering materials: Engineering materials, classification - Properties and applications of Metals: Ferrous and Non-ferrous; Non-metals: Glasses- Ceramics; Polymers: PVC &HDPE.

Basic Manufacturing Processes: Casting: Classification, Steps involved in making a casting - Advantage of casting and its applications. Welding: Classification of welding processes, Fundamental treatment of various welding processes.

UNIT-V

System of forces: Types of Force systems - Coplanar Concurrent Forces - Resultant - Moment of a Force -Resultant of a Force System -Conditions of Equilibrium - Equilibrium analysis of Coplanar Force Systems -Free body diagrams.

TEXTBOOKS:

1. Strength of Materials by R K Bansal, Laxmi publications.
2. Building Materials, S. S. Bhavikatti, Vices publications House private ltd.
3. Surveying and levelling, R. Subramanian, Oxford University press
4. Basic Civil Engineering, Palanichamy, M. S, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002.
5. Thermal Engineering, R.K.Rajput, Laxmi publications.
6. A text book of Material science and metallurgy – O.P. Khanna/ Dhanpat rai publications.
7. Elements of Manufacturing Processes - PARASHAR, B.S. NAGENDRA, MITTAL,
8. Engineering Mechanics – Statics and Dynamics - A. K. Tayal, Umesh Publications.

REFERENCE BOOKS:

1. Building Materials, S. K. Duggal, New Age International Publications
2. Fundamentals of surveying, S.K. Roy – PHI learning (P) ltd.
3. Thermodynamics – An Engineering Approach – YunusCengel& Boles /TMH
4. Engineering Mechanics, SS Bhavikatti& KG Rajasekharappa, New Age International
5. Materials Science and Metallurgy – C. Daniel Yesudian, D. G. Harris Samuel.
6. Production Technology, K.L.Narayana, S.V.Ramana& P. Vamsi Krishna, first edition, I.K. Books
7. Engineering Thermodynamics / PK Nag /TMH International, 2006.
8. Production Technology Vol I, O.P. Khanna & M. Lal, Dhanpat Rai Publicati

20A1200801:ENVIRONMENTAL Sciences
(Common to CE,EEE,ME and ECE

Lecture – Tutorial:	2-0	**Internal Marks:**	30+70
Credits:	--	**External Marks:**	

Prerequisites:

Course Objectives:

The objectives of the course are to impart:

- Overall understanding of the natural resources.
- Basic understanding of the ecosystem and its diversity.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

Course Outcomes:

CO1	➢ Illustrate the importance of sustainability in the progress of a nation. (L2)
CO2	➢ Infer the existence of ecosystems in maintaining ecological balance. (L2)
CO3	➢ Recall the importance of biodiversity and its conservation. (L1)
CO4	➢ Summarize the role of natural resources for the sustenance of life on earth and recognize the need to conserve them. (L2)
CO5	➢ Identify the environmental pollutants and the abatement devices to be used. (L3)
CO6	➢ Interpret environmental related acts and social issues. (L2)

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	2	2	-	-	2	3	2	-	-	2	2
CO2	3	2	2	-	-	2	3	2	-	-	2	2
CO3	3	2	2	-	-	2	3	2	-	-	2	2
CO4	3	2	2	-	-	2	3	2	-	-	2	2
CO5	3	2	2	-	-	2	3	2	-	-	2	2
CO6	3	2	2	-	-	2	3	2	-	-	2	2

UNIT I (6hrs)

Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information technology in environment and human health.

Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem; Producers, consumers and decomposers. - Energy flow in the ecosystem - Food chains, food webs and ecological pyramids- Ecological succession.

UNIT II (4hrs)

Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity- classification - Value of biodiversity: consumptive use, productive use, social value. India as a mega diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. Endangered and endemic species of India – Conservation of biodiversity.

UNIT III (7hrs)

Natural Resources: Natural resources and associated problems.
Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people.
Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems.
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.
Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy
sources.
Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT IV (5hrs)

Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well being.
Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

UNIT V (6hrs)

Social Issues and the Environment: Urban problems related to energy, rain water harvesting. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act - Wildlife Protection Act -Forest Conservation Act. Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS. Ecotourism, Green Campus – Green business and Green politics.

TEXT BOOKS:

1) Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014
2)Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
3) Environmental Studies, R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
4) Environmental Studies, P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

REFERENCE BOOKS:

1) Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2) A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3) Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi

E-RESOURCES: 1. http://nptel.ac.in/courses.php.
2. http://jntuk-coeerd.in/

20A1200191: Communicative English LAB
(Common to All Branches (CE, EEE, MECH, ECE, CSE, IT, AIML, DS)

Labs / Instructions Hours/Week	3 Hours	**Internal Marks:**	30
Credits	1.5	**External Marks:**	70

PREREQUISITES: None

COURSE OBJECTIVES

1. To learn the sound systems of English and understand word stress of English.
2. To train the students in the art of conversation and discussion
3. To equip the students with good communication skills.
4. To emphasize the need of English in the technical world.
5. To improve their presentation and participation skills
6. To prepare them for interviews and future job environments.

COURSE OUTCOMES

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

CO 1	Demonstrate better understanding of the nuances of spoken English to put into use in various situation and events.
CO 2	Apply the rules of phonetics–pronunciation, accent and intonation– in their everyday communication
CO 3	Relate their understanding of the importance of spoken skills and the need for life-long learning in day-to-day communication.
CO 4	Construct strategies like critical and analytical skills to participate effectively in group discussions and debates.
CO 5	Demonstrate their ideas accurately and effectively in presentations.
CO 6	Build responses to the questions by listening to short audio texts and identify the context and specific pieces of information.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1										**1**		**2**
CO 2										**1**		**2**
CO 3												**2**
CO 4									**1**	**1**		**2**
CO 5										**2**		**2**
CO 6										**1**		**2**

UNIT I

- Making Inquiries on the phone, Thanking and Responding to Thanks, Responding to Requests and Asking for Directions
- Vowels, Consonants, Pronunciation, Phonetic Transcription, Common Errors in Pronunciation

UNIT II

- Asking for Clarifications, Inviting, Expressing Sympathy, Congratulating, Apologising, Advising, Suggesting, Agreeing and Disagreeing

- Word stress – Di-Syllabic Words, Poly-Syllabic Words, Weak and Strong Forms, Contrastive Stress (Homographs)

UNIT III

- Debating
- Stress in Compound Words, Rhythm, Intonation, Accent Neutralization.

UNIT IV

- Group Discussions
- Listening to Short Audio Texts, and Identifying the context and specific pieces of information to answer a series of questions in speaking.

UNIT V

- Presentation Skills and Interview Skills
- Newspapers reading; Understanding and identifying key terms and structures useful for writing reports.

Lab Manual: "Infotech English", Maruthi Publications.

Software: k-van solutions Multimedia language lab

REFERENCE BOOKS:

1. **Exercises in Spoken English Part 1,2,3,4,** OUP and CIEFL.
2. **English Pronunciation in use** - Mark Hancock, Cambridge University Press.
3. **English Phonetics and Phonology**-Peter Roach, Cambridge University Press.
4. **English Pronunciation in use**- Mark Hewings, Cambridge University Press.
5. **English Pronunciation Dictionary**- Daniel Jones, Cambridge University Press.
6. **English Phonetics for Indian Students**- P. Bala Subramanian, Mac Millan Publications

E-RESOURCES

1. https://learnenglish.britishcouncil.org/
2. https://rachelsenglish.com/
3. https://www.bbc.co.uk/learningenglish/
4. https://www.engvid.com/
5. https://bbclearningenglish.com

20A1200294 : AppliedChemistry Lab

Labs / Instructions Hours/Week	3	**Internal Marks:**	30
Credits:	1.5	**External Marks:**	70

Prerequisites: Knowledge on Volumetric analysis.

Course Objectives:

- To provide knowledge of chemistry practicals.
- It enables the students to analyze the different parameters of water sample like hardness and alkalinity and different volumetric titrations.
- It makes the students to obtain basic knowledge of instrumentation based on different Engineering applications.

Course Outcomes:

CO1	Students of Engineering should understand and apply polymers and plastic technologies along with their utilization to solve the problems of the society.
CO2	Knowledge of cells and sensors utilized in many instruments is necessary to engineering students in solving and applying to batteries and fuel cells.
CO3	Knowledge of electrochemical cells is essential in understanding corrosion along with the methods of controlling to budding engineers.
CO4	Students should have the knowledge of water and its hardness, boiler troubles and problems associated with the environment and its sustainability.
CO5	Knowledge of fuels and energy, their advantages & disadvantages should be known by the students to solve and understand engineering problems.
CO6	Knowledge, design and analysis of materials should be understood by the Engineering students in solving the complex problems of the society.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	1	1								
CO2	3	3	1	-								
CO3	3	2	2	-								
CO4	3	1	-	1								
CO5	3	2	2	1								
CO6	3	1	1	1								

List of Experiments

1.Introduction to Chemistry laboratory – Molarity, Normality, Primary, secondary standard solutions, Volumetric titrations, Quantitative analysis, Qualitative analysis, etc.

2. Determination of HCl using standard Na_2CO_3 solution.
3. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
4. Determination of $KMnO_4$ using standard Oxalic acid solution.
5. Determination of total hardness of water using standard EDTA solution.
6. Determination of Iron using standard $K_2Cr_2O_7$ solution
7. Estimation of vitamin C
8. Determination of Iron by a Colorimetric method using thiocyanates as reagent.
9. Conductometric titration between strong acid and strong base.
10. Potentiometric titration between strong acid and strong base.
11. Preparation of Bakelite.
12. Determination of pH of water sample

EQUIPMENT REQUIRED:

PH meters, Potentiometers, Conductometers, colorimeters.

APPARATUS

Burettes, Pipettes, Conical flask, Beakers, Volumetric flask.

REFERENCE BOOKS:

1 . A Textbook of Quantitative Analysis, Arthur J. Vogel.
2. Dr.JyotsnaCherukuri (2012) *Laboratory Manual of engineering chemistry-II,* VGSTechno Series
3. Chemistry Practical Manual, Lorven Publications
4. K. Mukkanti (2009) *Practical Engineering Chemistry,* B.S. Publication

20A1201391: Basic Civil and Mechanical Engineering Lab
(Electrical and Electronics Engineering)

practical	3Hours	**Internal Marks:**	30
Credits:	1.5	**External Marks:**	70

Prerequisites:

Course Objectives:

1) To make the students outline the process of identification of various building components
2) To make the students exposed to the operation of the various survey instruments used for linear measurements.
3) To make the students exposed to the operation of the various survey instruments used for angular measurements.
4)To introduce the concepts of ferrous and Non Ferrous materials
5) To introduce the concepts of primary manufacturing processes.

Course Outcomes:

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

CO1	Understand various survey equipment's like chain, tape, cross-staff and compass
CO2	De Determine distances and irregular areas using conventional survey instruments
CO3	Demonstrate various building materials
CO4	Observe the micro structure of different materials.
CO5	Understand mold preparation
CO6	Design the different types of weld joints and operate the weld machines

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	2	1	3	-	-	-	-	-	-	-	-
CO2	3	2	-	2	-	-	-	-	-	-	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-
CO4	3	2	-	2	-	-	-	-	-	-	-	-
CO5	3	**2**	1	3	-	-	-	-	-	-	-	-
CO6	3	2	1	3	-	-	-	-	-	-	-	-

List of Experiments

Civil part:

1. Demonstration on usage of chain
2. Ranging – offsets – chain-age
3. To find the area of an irregular polygon using chain by using horizontal measurements
4. Determination of bearings with prismatic compass.
5.Determination of included angles with prismatic compass
6. Demonstration on various Building materials used in construction

Mechanical part:

1. Study of the micro structure of steels.
2. Study of the micro structure of Cast Irons.
3. Mould preparation, Melting and Casting
4. Gas cutting
5. Manual metal arc welding - Lap & Butt Joints
6. Resistance Spot Welding

REFERENCE BOOKS:

1.U.C Jindal and Atish Mozumber, Material science and metallurgy, Pearson education-2012

2.Elements of Manufacturing Processes -, B.S. NAGENDRA PARASHAR, MITTAL

3 .Production Technology Vol I, O.P. Khanna & M. Lal, Dhanpat Rai Publicati

4. A text book of Material science and metallurgy – O.P. Khanna/ Dhanpat rai publications.

5. Laboratory Manual for Basic Civil and Mechanical Engineering workshops

20A1202491: ELECTRICAL ENGINEERING WORKSHOP
(Electrical and Electronics Engineering)

Practical:	3 Hours	**Internal Marks:**	30
Credits	1.5	**External Marks:**	70

Prerequisites: This laboratory introduces the basic concepts of electrical engineering equipment, wiring and safety measures which is the foundation for all labs of Electrical Engineering discipline.

Course Objectives

- To demonstrate the usage of measuring equipment
- To train the students in setting up simple wiring circuits
- To impart methods in electrical machine wiring

Course Outcomes

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

CO1	Explain the limitations of electrical systems and wiring.
CO2	Explain the tolerances of electrical systems and wiring.
CO3	Explain the safety aspects of electrical systems and wiring.
CO4	. Select wires/cables and other accessories used in different types of wiring.
CO5	Make simple lighting and power circuits.
CO6	Measure current, voltage and power in a circuit

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2						1			
CO2	3	3	2						1			
CO3	3	3	2						1			
CO4	3	3	2						1			
CO5	3	3	2						1			
CO6	3	3	2						1			

List of Experiments

Any 10 of the following experiments are to be conducted:

1 . Study of various electrical tools and symbols.

2. Study various types of electrical cables/wires, switches, fuses, fuse carriers, MCB, ELCB, RCCB and MCCB with their specifications and usage.

3. Soldering and de-soldering practice.

4. Identification of various types of resistors and capacitors and understand the usage digital multi-meter.

5. Identification of various semiconductor devices.

6. Study of Moving Iron, Moving Coil, Electrodynamic and Induction type meters.
7. Fluorescent lamp wiring.
8. Wiring of lighting circuit using two way control.(stair case wiring)
9. Godown wiring/ Tunnel wiring
10. Hospital wiring.
11. Measurement of voltage, current, power in DC circuit.
12. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and energy meter for calculating Power and Power Factor.
13. Measurement of earth resistance.
14. Wiring of backup power supply for domestic Installations including inverter, battery and load.
15. Troubleshooting of domestic electrical equipment's (tube light and fan).
16. Understand the usage of CRO, function generator. & Regulated power supply and Measurement of ac signal parameters using CRO.
17. Assembling electronic components on bread board.
18. Obtain V-I characteristics of Light Emitting Diode

REFERENCE BOOKS:

1.U.C Jindal and Atish Mozumber, Material science and metallurgy, Pearson education-2012

2.Elements of Manufacturing Processes -, B.S. NAGENDRA PARASHAR, MITTAL

3 .Production Technology Vol I, O.P. Khanna & M. Lal, Dhanpat Rai Publicati

4. A text book of Material science and metallurgy – O.P. Khanna/ Dhanpat rai publications.

VECTOR CALCULUS, FOURIER TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To familiarize the complex variables.
- To familiarize the students with the foundations of probability and statistical methods
- To equip the students to solve application problems in their disciplines.

Course Outcomes

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

CO1	To familiarize the complex variables
CO2	To familiarize the residue theorem
CO3	To familiarize the students with the foundations of probability methods
CO4	To familiarize the students with the foundations of statistical methods
CO5	To equip the students to solve application problems in their disciplines
CO6	To Perform various tests

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**										**1**	
CO2	**3**										**1**	
CO3	**3**										**1**	
CO4	**3**										**1**	
CO5	**3**										**1**	
CO6	**3**										**1**	

UNIT I

Functions of a complex variable and Complex integration:

Introduction – Continuity – Differentiability – Analyticity –Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method. Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula (all without proofs) and problems on above theorems.

UNIT II

Series expansions and Residue Theorem:

Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series. Types of Singularities: Isolated – Essential –Pole of order m– Residues – Residue theorem (without proof) – Evaluation of real integral of the types $\int_{-\infty}^{\infty} f(x)\,dx$ and

UNIT III

Probability and Distributions:

Review of probability and Baye's theorem – Random variables – Discrete and

Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT IV

Sampling Theory:

Introduction – Population and Samples – Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Representation of the normal theory distributions – Introduction to t, 2 χ and F-distributions – Point and Interval estimations – Maximum error of estimate.

UNIT V

Tests of Hypothesis:

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions.

TEXT BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
2. Miller and Freund's, Probability and Statistics for Engineers,Pearson,7th edition, 2008.

REFERENCE BOOKS:

1.J. W. Brown and R. V. Churchill, Complex Variables and Applications, 9th edition, Mc-Graw Hill, 2013.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand & Sons Publications, 2012.
3. Jay l. Devore, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
4. Shron L.Myers, Keying Ye, Ronald E Walpole, Probability and Statistics Engineers and the Scientists,8th Edition, Pearson 2007.
5. Sheldon, M. Ross, Introduction to probability and statistics Engineers and the Scientists, 4thEdition, Academic Foundation,2011

ELECTRONIC DEVICES AND CIRCUITS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- The basic concepts of semiconductor physics are to be reviewed.
- Study the physical phenomena such as conduction, transport mechanism and electrical characteristics of different diodes.
- The application of diodes as rectifiers with their operation and characteristics with and without filters are discussed.
- The principle of working and operation of Bipolar Junction Transistor and Field Effect Transistor and their characteristics are explained.
- The need of transistor biasing and its significance is explained. The quiescent point or operating point is explained.
- Small signal equivalent circuit analysis of BJT and FET transistor amplifiers in different configuration is explained.

Course Outcomes

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

CO1	Study the basic concepts of semiconductor physics are to be reviewed
CO2	Study the physical phenomena such as conduction, transport mechanism and electrical characteristics of different diodes
CO3	Study the application of diodes as rectifiers with their operation and characteristics with and without filters
CO4	Study the principle of working and operation of Bipolar Junction Transistor and Field Effect Transistor and their characteristics
CO5	Study the need of transistor biasing and its significance is explained. The quiescent point or operating point
CO6	Explain Small signal equivalent circuit analysis of BJT and FET transistor amplifiers in different configuration

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**											
CO2	**3**	**2**										
CO3	**3**	**2**										
CO4	**3**	**2**										
CO5	**3**	**2**										
CO6	**3**											

UNIT I

Semi-Conductor Physics: Insulators, Semiconductors, and Metals, classification using energy band diagrams, mobility and conductivity, electrons and holes in intrinsic semiconductors, extrinsic semiconductors, drift and diffusion, charge densities in semiconductors, Hall effect, continuity equation, law of junction, Fermi Dirac function, Fermi level in intrinsic and extrinsic Semiconductors **Junction Diode Characteristics:** Open circuited p-n junction, Biased p-n junction, p-n junction diode, current components in PN junction Diode, diode equation, V-I

Characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance, energy band diagram of PN junction Diode.

UNIT II

Special Semiconductor Devices: Zener Diode, Breakdown mechanisms, Zener diode applications, LED, Photodiode, Tunnel Diode, SCR, UJT. Construction, operation and characteristics of all the diodes are required to be considered.

Rectifiers and Filters: Basic Rectifier setup, half wave rectifier, full wave rectifier, bridge rectifier, derivations of characteristics of rectifiers, rectifier circuits-operation, input and output waveforms, Filters, Inductor filter, Capacitor filter, comparison of various filter circuits in terms of ripple factors.

UNIT III

BJT: Junction transistor, transistor current components, transistor equation, transistor configurations, transistor as an amplifier, characteristics of transistor in Common Base, Common Emitter and Common Collector configurations, Ebers-Moll model of a transistor, punch through/ reach through, Photo transistor, typical transistor junction voltage values.

FET: FET types, construction, operation, characteristics, parameters, MOSFET-types, construction, operation, characteristics, comparison between JFET and MOSFET.

UNIT IV

Transistor Biasing and Thermal Stabilization: Need for biasing, operating point, load line analysis, BJT biasing- methods, basic stability, fixed bias, collector to base bias, self-bias, Stabilization against variations in VBE, Ic, and β, Stability factors, (S, S' , S''), Bias compensation, Thermal runaway, Thermal stability. FET Biasing-methods and stabilization.

UNIT V

Small Signal Low Frequency Transistor Amplifier Models: BJT: Two port network, Transistor hybrid model, determination of h-parameters, conversion of h-parameters, generalized analysis of transistor amplifier model using h-parameters, Analysis of CB, CE and CC amplifiers using exact and approximate analysis, Comparison of transistor amplifiers. FET: Generalized analysis of small signal model, Analysis of CG, CS and CD amplifiers, comparison of FET amplifiers.

TEXT BOOKS:

1. Electronic Devices and Circuits- J. Millman, C.Halkias, Tata Mc-Graw Hill, 2nd Edition, 2010.

2.Electronics devices & circuit theory- Robert L.Boylestad and LouiNashelsky, Pearson/Prentice hall, 10thedition, 1999.

REFERENCE BOOKS:

1. Electronic Devices and Circuits-K. Satya Prasad, VGS Book Links, 2nd Edition, 2006.

2. Electronic Devices and Circuits-Salivahanan, Kumar, Vallavaraj, Tata Mc-Graw Hill, 2nd Edition, 2018.

3. Electronic Devices and Circuits – David Bell, Oxford, 5th Edition, 2008.

ELECTRICAL CIRCUIT ANALYSIS-II

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To study the concepts of passive elements, types of sources and various network reduction techniques.
- To understand the applications of network topology to electrical circuits.
- To study the concept of magnetic coupled circuit.
- To understand the behavior of RLC networks for sinusoidal excitations.
- To study the performance of R-L, R-C and R-L-C circuits with variation of one of the parameters and to understand the concept of resonance.
- To understand the applications of network theorems for analysis of electrical networks.

Course Outcomes

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

CO1	Study the concepts of passive elements, types of sources and various network reduction techniques
CO2	Understand the applications of network topology to electrical circuits
CO3	Study the concept of magnetic coupled circuit
CO4	Understand the behavior of RLC networks for sinusoidal excitations
CO5	Study the performance of R-L, R-C and R-L-C circuits with variation of one of the parameters and to understand the concept of resonance.
CO6	Understand the applications of network theorems for analysis of electrical networks

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3										
CO2	3	3										
CO3	3	2										
CO4	3	3										
CO5	3	3										
CO6	3											

UNIT I

Balanced and Unbalanced Three phase circuits

Analysis of three phase balanced circuits: Phase sequence, star and delta connection of sources and loads, relation between line and phase voltages and currents, analysis of balanced three phase circuits, measurement of active and reactive power.

Analysis of three phase unbalanced circuits: Loop method, Star-Delta transformation technique, two-wattmeter method for measurement of three phase power.

UNIT II

Transient Analysis in DC Circuits Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using differential equations.

Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using Laplace transforms.

UNIT III

Transient Analysis in AC circuits

Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using differential equations.

Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using Laplace transforms.

UNIT IV

Two Port Networks

Two port network parameters – Z, Y, ABCD and Hybrid parameters and their relations, cascaded networks.

UNIT V

Filters

Need of Filters – Classification -Characteristic impedance- Low Pass Filter, High Pass Filter, Band Pass Filter, Band Stop or Band Elimination Filter, m-Derived Filter, Composite filters– Design of Filters.

TEXT BOOKS:

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley, McGraw Hill Company,9thedition, 2018.

2. Network analysis: Van Valkenburg: Prentice-Hall of India Private Ltd, 3rd edition, 2019.

REFERENCE BOOKS:

1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, McGraw Hill Education (India), 6th edition, 2019.

2. Introduction to circuit analysis and design by Tildon H Glisson. Jr, Springer Publications, 1st edition, 2011.

3. Circuits by A.Bruce Carlson, Cengage Learning Publications, 1st edition, 2008.

4. Network Theory Analysis and Synthesis by SmarajitGhosh, PHI publications, ninth print, 2015.

5. Networks and Systems by D. Roy Choudhury, New Age International publishers, 2nd edition, 2013. 6. Electric circuit by Joseph Edminister, Schaum's outlines series, seventh edition, 2017.

7. Electric Circuits by David A. Bell, Oxford publications, 7th edition, 2009.

8. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi, DhanpatRai&Co, 7th - Revised edition, 2018)

DC MACHINES AND TRANSFORMERS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To Understand the construction, principle of operation and performance of DC machines.
- To Learn the characteristics, performance, methods of speed control and testing methods of DC motors.
- To predetermine the performance of single phase transformers with equivalent circuit models.
- To Understand the methods of testing of single-phase transformer.
- To Analyze the three phase transformers and achieve three phase to two phase conversion.

Course Outcomes

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

CO1	Understand the construction, principle of operation and performance of DC machines
CO2	Learn the characteristics, performance, methods of speed control and testing methods of DC motors
CO3	Predetermine the performance of single phase transformers with equivalent circuit models
CO4	Understand the methods of testing of single-phase transformer
CO5	Analyze the three phase transformers
CO6	Achieve three phase to two phase conversion

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**2**										
CO2	**3**	**2**										
CO3	**3**	**2**										
CO4	**3**											
CO5	**3**	**2**										
CO6	**3**	**2**										

UNIT I

Electromechanical Energy Conversion and introduction to DC machines

Principles of electromechanical energy conversion - singly excited and multi excited systems- calculation of force and torque using the concept of co-energy. Construction and principle of operation of DC machines – EMF equation for generator – Excitation techniques– characteristics of DC shunt generator – applications of DC Generators

UNIT II

Operation of DC motors

Back-emf and torque equations of dc motors – Armature reaction and commutation – characteristics of separately-excited, shunt, series and compound motors – losses and efficiency – applications of dc motors. Necessity of a starter – starting by 3 point and 4-point starters.

UNIT III

Speed Control of motors and Testing of DC Machines

Speed control by armature voltage and field control – testing of DC machines – brake test, Swinburne's method – principle of regenerative or Hopkinson's method – retardation test – field's test- separation of losses.

Single-phase Transformers

Types and constructional details – principle of operation –emf equation – operation on no load and on load – lagging, leading and unity power factors loads –phasor diagrams of transformers – equivalent circuit.

UNIT IV

Performance and testing of transformers and auto transformers: Regulation – losses and efficiency – effect of variation of frequency and supply voltage on losses – all day efficiency. Tests on single phase transformers – open circuit and short circuit tests – Sumpner's test – separation of losses – parallel operation with equal voltage ratios – auto transformer – equivalent circuit – comparison with two winding transformers.

UNIT V

3-Phase Transformer: Polyphase connections- Y/Y, Y/ Δ, Δ/Y, Δ/ Δ and open Δ- third harmonics in phase voltages – three winding transformers- transients in switching –off load and on load tap changers- Scott connection.

TEXT BOOKS:

1. Electrical Machines by P.S. Bhimbra, Khanna Publishers,7th edition, 2011.
2. Electric Machinery by A.E.Fitzgerald, Charleskingsley, Stephen D.Umans, TMH, 6 th edition, 2003.

REFERENCE BOOKS:

1. Electrical Machines by D. P.Kothari, I. J. Nagarth, McGraw Hill Publications, 4th edition, 2010.
2. Electrical Machines by R.K.Rajput, Lakshmi publications, 5th edition.
3. Electrical Machinery by Abijith Chakrabarthi and Sudhipta Debnath, McGraw Hill, 1st edition.
4. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education, 4 th edition, 2010.
5. Electric Machines by MulukutlaS.Sarma & Mukeshk Pathak, CENGAGE Learning, 1 st edition, 2008.
6. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria& Sons, 1st edition, 2009.

ELECTRO MAGNETIC FIELDS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To study the production of electric field and potentials due to different configurations of static charges.
- To study the properties of conductors and dielectrics, calculate the capacitance of different configurations. Understand the concept of conduction and convection current densities.
- To study the magnetic fields produced by currents in different configurations, application of Ampere's law and the Maxwell's second and third equations.
- To study the magnetic force and torque through Lorentz force equation in magnetic field environment like conductors and other current loops.
- To develop the concept of self and mutual inductances and the energy stored.
- To study time varying and Maxwell's equations in different forms and Maxwell's fourth equation for the induced EMF

Course Outcomes

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

CO1	student will be able to Compute electric fields and potentials using Gauss law or solve Laplace's or Poisson's equations for various electric charge distributions.
CO2	student will be able to Calculate the capacitance and energy stored in dielectrics
CO3	student will be able to Calculate the magnetic field intensity due to current carrying conductor and understanding the application of Ampere's law, Maxwell's second and third law.
CO4	student will be able to Estimate self and mutual inductances and the energy stored in the magnetic field.
CO5	student will be able to Understand the concepts of displacement current
CO6	student will be able to Poynting theorem and Poynting vector

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**										
CO2	**3**											
CO3	**3**	**2**										
CO4	**3**	**3**										
CO5	**3**	**3**										
CO6	**3**	**3**										

UNIT I

Electrostatics:

Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge, work done in moving a point charge in an electrostatic field, electric potential – potential gradient, Gauss's law – Maxwell's first law (div(D)=ρv), Laplace's and Poison's equations and solution of Laplace's equation in one variable.

UNIT II

Conductors – Dielectrics and Capacitance:

Electric dipole – dipole moment – potential and EFI due to an electric dipole, Torque on an Electric dipole in an electric field, conductors and Insulators – their behavior in electric field. Polarization, boundary conditions between conductor to dielectric, dielectric to dielectric and conductor to free space. Capacitance of parallel plates, spherical dielectrics, energy stored and energy density in a static electric field, current density, conduction and convection current densities, Ohm's law in point form – equation of continuity.

UNIT III

Magneto statics, Ampere's Law and Force in magnetic fields:

Biot-Savart's law and its applications viz. Straight current carrying filament, circular, square, rectangle and solenoid current carrying wire – Maxwell's second Equation (div(B)=0), Ampere's circuital law and its applications viz. MFI due to an infinite sheet, long filament, solenoid, toroidal current carrying conductor, point form of Ampere's circuital law, Maxwell's third equation (Curl (H)=J) Magnetic force, moving charges in a magnetic field – Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors.

UNIT IV

Self and mutual inductance:

Self and mutual inductance – determination of self-inductance of a solenoid and toroid and mutual inductance between a straight long wire and a square loop wire in the same plane – energy stored and density in a magnetic field.

UNIT V

Time Varying Fields:

Faraday's laws of electromagnetic induction – integral and point forms, Maxwell's fourth equation (Curl(E)=-∂B/∂t), statically and dynamically induced EMF – modification of Maxwell's equations for time varying fields, displacement current, Poynting theorem and Poynting vector.

TEXT BOOKS:

1. "Engineering Electromagnetics" by William H. Hayt & John. A. Buck Mc. Graw-Hill, 7 th Editon.2006.

2. "Principles of Electro Magnetics" by Sadiku, Oxford Publications, 6th edition, 2015.

REFERENCE BOOKS:

1. Introduction to Electro Dynamics by D J Griffiths, Prentice-Hall of India Pvt. Ltd, 2 nd edition

2. Electromagnetic Field Theory by Yaduvir Singh, Pearson India, 1st edition, 2011.

3. Fundamentals of Engineering Electromagnetics by Sunil Bhooshan, Oxford University Press,2012. 4. Electromagnetics by Joseph A. Edminister, Schaum's Outline,4th Edition,2014.

ELECTRICAL CIRCUITS LAB

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	35
Credits:	1.5	**External Marks:**	50

Course Objectives:

- To verify and demonstrate various theorems and resonance.
- To draw the locus diagram of series circuits
- To determine the various parameters of a two port networks
- To determine self and mutual inductance of a magnetic circuit, parameters of a given coil.
- To measure the power of three phase unbalanced circuit.

List of Experiments

(Any 10 of the following experiments are to be conducted)

1. Verification of Kirchhoff's circuit laws.

2. Verification of Superposition theorem

3. Verification of Thevenin's and Norton's Theorems

4. Verification of Maximum power transfer theorem

5. Verification of Compensation theorem

6. Verification of Reciprocity and Millman's Theorems

7. Locus diagrams of R-L(L Variable) and R-C (C Variable) series circuits

8. Series and parallel resonance

9. Determination of self, mutual inductances and coefficient of coupling

10. Determination of Impedance (Z) and Admittance (Y) Parameters for a two port network

11. Determination of Transmission and Hybrid parameters

12. Determination of Parameters of a choke coil.

13. Determination of cold and hot resistance of an electric lamp.

14. Measurement of 3-phase power by two wattmeter method for unbalanced loads

DC MACHINES AND TRANSFORMERS LAB

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	35
Credits:	1.5	**External Marks:**	50

Course Objectives:

- To plot the magnetizing characteristics of DC shunt generator and understand the mechanism of self-excitation.
- To control the speed of DC motors.
- To determine and predetermine the performance of DC machines.
- To predetermine the efficiency and regulation of transformers and assess their performance.

List of Experiments

(Any 10 of the following experiments are to be conducted)

1. Determination of critical field resistance and critical speed of DC shunt generator by using Magnetization characteristics
2. Predetermination of efficiency of DC Machine by conducting Swinburne's test
3. Performance characteristics of a DC shunt motor by conducting Brake test.
4. Predetermination of efficiency of two DC shunt machines by conducting Hopkinson's test
5. Speed control of DC shunt motor by Field and armature Control methods
6. Determination of constant losses of DC shunt motor by conducting Retardation test
7. Separation of losses (Eddy current and Hysteresis) in a DC shunt motor.
8. Predetermination of efficiency, regulation and to obtain the parameters of the equivalent circuit of a single phase transformer by conducting OC & SC tests.
9. Predetermination of efficiency, regulation and to obtain the parameters of the equivalent circuit of a single phase transformer by conducting Sumpner's test.
10. Conversion of three phase to two phase supply by using Scott connection of transformers
11. Parallel operation of two Single phase Transformers under no-load and load conditions
12. Separation of core losses of a single phase transformer
13. Heat run test on a bank of three single phase Delta connected transformers

ELECTRONIC DEVICES AND CIRCUITS LAB

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	35
Credits:	1.5	**External Marks:**	50

Course Objectives:

- To study the characteristics of electronic components and measuring instruments.
- To understand the characteristics of PN, Zener diode, design rectifiers with and without filters
- To understand the characteristics of BJT, FET, MOSFET, SCR, UJT
- To understand the biasing of transistors
- To understand the frequency response of amplifiers, measure frequency, phase of signals.

Electronic Workshop Practice:

1. Identification, Specifications, Color Codes for resistor, R, L, C Components, Potentiometers, Coils, Gang condensers, Relays, Bread Boards.
2. Identification, Specifications and Testing of active devices, Diodes, BJTs, JFETs, LEDs, LCDs, SCR, UJT. 3. Soldering Practice- Simple circuits using active and passive components.
4. Study and operation of Ammeters, Voltmeters, Transformers, Analog and Digital
5. Multimeter, Function Generator, Regulated Power Supply and CRO.

List of Experiments

(Any 10 of the following experiments are to be conducted)

1. P.N Junction Diode Characteristics

Part A: Germanium Diode (Forward bias& Reverse bias)

Part B: Silicon Diode (Forward Bias only)

.Zener Diode Characteristics

Part A: V-I Characteristic

Part B: Zener Diode as Voltage Regulator

3.Rectifiers (without and with c-filter)

Part A: Half-wave Rectifier

Part B : Full-wave Rectifier

4.BJT Characteristics (CE Configuration)

Part A: Input Characteristics

Part B: output Characteristics

5.FET Characteristics

Part A: Drain Characteristics

Part B: Transfer Characteristics

6.SCR Characteristics

7.UJT Characteristics

8.MOSFET Characteristics

9.Transistor Biasing

10. Measurement of electrical quantities using CRO

11. BJT-CE Amplifier

12.Emitter Follower –CC Amplifier

13.FET-CS Amplifier

Equipment required:

1.Regulated Power supplies

2.Analog/Digital Storage Oscilloscopes

3.Analog/Digital Function Generators

4.Digital Multi-meters 5.Decade Résistance Boxes/Rheostats

6.Decade Capacitance Boxes

7.Ammeters (Analog or Digital)

8.Voltmeters (Analog or Digital)

9.Active & Passive Electronic Components

SKILL ORIENTED COURSE

DESIGN OF ELECTRICAL CIRCUITS USING ENGINEERING SOFTWARE TOOLS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	-
Credits:	2	**External Marks:**	50

Course Objectives:

- To Learn the fundamentals of MATLAB Tools
- To generate various waveform signals and sequences
- To verify and simulate various electrical circuits using Mesh and Nodal Analysis
- To verify and simulate various theorems
- To verify and simulate RLC series and parallel resonance.
- To determine self and mutual inductance of a magnetic circuit, parameters of a given coil.

List of Experiments

(Any 10 of the following experiments are to be conducted)

Note: MATLAB/SMULINK fundamentals shall be explained during the first week before starting of the Lab course

1. Generation of various signals and sequences (Periodic and Aperiodic), such as unit Impulse, Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp.

2. Operations on signals and sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy, and Average Power.

3. Verification of Kirchhoff's current law and voltage law using simulation tools.

4. Verification of mesh analysis using simulation tools.

5. Verification of nodal analysis using simulation tools.

6. Determination of average value, rms value, form factor, peak factor of sinusoidal wave, square wave using simulation tools.

7. Verification of super position theorem using simulation tools.

8. Verification of reciprocity theorem using simulation tools.

9. Verification of maximum power transfer theorem using simulation tools.

10. Verification of Thevenin's theorem using simulation tools.

11. Verification of Norton's theorem using simulation tools.

12. Verification of compensation theorem using simulation tools.

13. Verification of Milliman's theorem using simulation tools.

14. Verification of series resonance using simulation tools.

15. Verification of parallel resonance using simulation tools.

16. Verification of self inductance and mutual inductance by using simulation tools.

PROFESSIONAL ETHICS & HUMAN VALUES

Lecture – Tutorial:	2-0 Hours	**Internal Marks:**	30
Credits:	0	**External Marks:**	70

Course Objectives:

- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty
- To appreciate the rights of others
- To create awareness on assessment of safety and risk

Course Outcomes

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

CO1	Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field
CO2	Identify the multiple ethical interests at stake in a real-world situation or practice
CO3	Articulate what makes a particular course of action ethically defensible
CO4	Assess their own ethical values and the social context of problems
CO5	Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
CO6	Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**1**										
CO2	**3**	**1**										
CO3	**3**	**1**										
CO4	**3**	**1**										
CO5	**3**	**1**										
CO6	**3**	**1**										

UNIT I

Human Values:

Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others –Living Peacefully –Caring –Sharing –Honesty -Courage-Cooperation– Commitment – Empathy –Self Confidence Character –Spirituality. Learning outcomes:

1. Learn about morals, values & work ethics.
2. Learn to respect others and develop civic virtue.
3. Develop commitment
4. Learn how to live peacefully

UNIT II

Engineering Ethics:

Senses of 'Engineering Ethics-Variety of moral issued –Types of inquiry –Moral

dilemmas – Moral autonomy –Kohlberg's theory-Gilligan's Theory-Consensus and controversy –Models of professional roles-Theories about right action-Self-interest - Customs and religion –Uses of Ethical theories –Valuing time –Cooperation – Commitment. Learning outcomes:

1. Learn about the ethical responsibilities of the engineers.
2. Create awareness about the customs and religions.
3. Learn time management
4. Learn about the different professional roles.

UNIT III

Engineering as Social Experimentation:

Engineering As Social Experimentation –Framing the problem –Determining the facts – Codes of Ethics –Clarifying Concepts –Application issues –Common Ground - General Principles –Utilitarian thinking respect for persons. Learning outcomes: 1. Demonstrate knowledge to become a social experimenter. 2. Provide depth knowledge on framing of the problem and determining the facts. 3. Provide depth knowledge on codes of ethics. 4. Develop utilitarian thinking

UNIT IV

Engineers Responsibility for Safety and Risk:

Safety and risk –Assessment of safety and risk –Risk benefit analysis and reducing risk- Safety and the Engineer-Designing for the safety-Intellectual Property rights (IPR).

Learning outcomes:

1. Create awareness about safety, risk & risk benefit analysis. 2. Engineer's design practices for providing safety.
3. Provide knowledge on intellectual property rights.

UNIT V

Global Issues:

Globalization –Cross-culture issues-Environmental Ethics –Computer Ethics – Computers as the instrument of Unethical behavior –Computers as the object of Unethical acts – Autonomous Computers-Computer codes of Ethics –Weapons Development -Ethics and Research –Analyzing Ethical Problems in research. Learning outcomes:

1. Develop knowledge about global issues.
2. Create awareness on computer and environmental ethics
3. Analyze ethical problems in research.
4. Give a picture on weapons development.

TEXT BOOKS:

1) "Engineering Ethics includes Human Values" by M.Govindarajan, S.Natarajan and, V.S.Senthil Kumar-PHI Learning Pvt. Ltd-2009

2) "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

3) "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger –Tata McGraw- Hill–2003.

4) "Professional Ethics and Morals" by Prof.A.R.Aryasri, DharanikotaSuyodhana-

Maruthi Publications.
5) “Professional Ethics and Human Values” by A.Alavudeen, R.KalilRahman and M. Jayakumaran, Laxmi Publications.
6) “Professional Ethics and Human Values” by Prof.D.R.Kiran-“Indian Culture, Values and Professional Ethics” by PSR Murthy-BS Publication

PYTHON PROGRAMMING

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To learn about Python programming language syntax, semantics, and the runtime environment
- To be familiarized with universal computer programming concepts like data types, containers
- To be familiarized with general computer programming concepts like conditional execution, loops & functions
- To be familiarized with general coding techniques and object-oriented programming

Course Outcomes

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

CO1	Develop essential programming skills in computer programming concepts like data types
CO2	Develop essential programming skills in computer programming concepts like containers
CO3	Apply the basics of programming in the Python language
CO4	Solve coding tasks related conditional execution
CO5	Solve coding tasks related loops
CO6	Solve coding tasks related to the fundamental notions and techniques used in object- oriented programming

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**3**										
CO2	**3**	**3**										
CO3	**3**	**3**										
CO4	**3**	**3**										
CO5	**3**	**3**										
CO6	**3**	**3**										

UNIT I

Introduction:

Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, Operators. Type conversions, Expressions, More about Data Output.

Data Types, and Expression: Strings Assignment, and Comment, Numeric Data Types and Character Sets, Using functions and Modules. Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables. Repetition Structures:

Introduction, while loop, for loop, Calculating a Running Total, Input Validation Loops, Nested Loops.

UNIT II

Control Statement: Definite iteration for Loop Formatting Text for output, Selection if and if else Statement Conditional Iteration The While Loop Strings and Text Files: Accessing Character and Substring in Strings, Data Encryption, Strings and Number Systems, String Methods Text Files.

UNIT III

List and Dictionaries:

Lists, Defining Simple Functions, Dictionaries Design with Function: Functions as Abstraction Mechanisms, Problem Solving with Top Down Design, Design with Recursive Functions, Case Study Gathering Information from a File System, Managing a Program's Namespace, Higher Order Function. Modules: Modules, Standard Modules, Packages.

UNIT IV

File Operations:

Reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek, Programming using file operations

Object Oriented Programming: Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance , overlapping and overloading operators, Adding and retrieving dynamic attributes of classes, Programming using OOPs support Design with Classes: Objects and Classes, Data modeling Examples, Case Study An ATM, Structuring Classes with Inheritance and Polymorphism

UNIT V

Errors and Exceptions:

Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up Actions, Redefined Clean-up Actions. Graphical User Interfaces: The Behavior of Terminal Based Programs and GUI -Based, Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources. Programming: Introduction to Programming Concepts with Scratch.

TEXT BOOKS:

1) Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage, 2/e, 2011.

REFERENCE BOOKS:

1) Introduction to Python Programming, Gowrishankar S., VeenaA, CRC Press, 2nd Edition, 2019.

2) Introduction to Programming Using Python, Y. Daniel Liang, Pearson, 1st Edition, 2012.

E-RESOURCES:

1) https://www.tutorialspoint.com/python3/python_tutorial.pdf

DIGITAL ELECTRONICS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To solve a typical number base conversion and analyze new error coding techniques.
- Theorems and functions of Boolean algebra and behavior of logic gates.
- To optimize logic gates for digital circuits using various techniques.
- To understand concepts of combinational circuits.
- To develop advanced sequential circuits.

Course Outcomes

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

CO1	Classify different number systems and apply to generate various codes.
CO2	Use the concept of Boolean algebra in minimization ofswitching functions
CO3	Design different types of combinational logic circuits.
CO4	Apply knowledge of flip-flops in designing of Registers
CO5	Apply knowledge of flip-flops in designing of counters
CO6	The operation and design methodology for synchronous sequential circuits and algorithmic state machines.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**1**										
CO2	**3**											
CO3	**3**											
CO4	**3**											
CO5	**3**	**1**										
CO6	**3**	**1**										

UNIT I

Review of Number Systems & Codes:

Representation of numbers of different radix, conversion from one radix to another radix, r- 1's complements and r's complements of signed members. Gray code,4 bit codes; BCD, Excess-3, 2421, 84-2-1 code etc., Error detection & correction codes: parity checking, even parity, odd parity, Hamming code.

Boolean theorems and logic operations

Boolean theorems, principle of complementation & duality, De-Morgan theorems. Logic operations; Basic logic operations -NOT, OR, AND, Universal Logic operations, EX-OR, EX-NOR operations. Standard SOP and POS Forms, NAND-NAND and NOR-NOR realizations.

UNIT II

Minimization Techniques:

Minimization and realization of switching functions using Boolean theorems, K-Map

(up to 6 variables) and tabular method.

Combinational Logic Circuits Design:

Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders; 4- bit adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit and carry look-a-head adder circuit

UNIT III

Combinational Logic Circuits

Design Using MSI &LSI: Design of encoder, decoder, multiplexer and demultiplexers, Implementation of higher order circuits using lower order circuits. Realization of Boolean functions using decoders and multiplexers. Design of Priority encoder, 4-bit digital comparator and seven segment decoder

Introduction of PLD's:

PLDs: PROM, PAL, PLA -Basics structures, realization of Boolean functions.

UNIT IV

Sequential Circuits-I:

Classification of sequential circuits (synchronous and asynchronous) , operation of NAND & NOR Latches and flip-flops; truth tables and excitation tables of RS flip-flop, JK flip- flop, T flip-flop, D flip-flop with reset and clear terminals. Conversion from one flip-flop to another flip-flop. Design of ripple counters, design of synchronous counters, Johnson counter, ring counter. Design of registers - Buffer register, control buffer register, shift register, bi-directional shift register, universal shift register.

UNIT V

Sequential Circuits -II:

Finite state machine; state diagrams, state tables, reduction of state tables. Analysis of clocked sequential circuits Mealy to Moore conversion and vice-versa. Realization of sequence generator and sequence detector circuits, Races and Hazards.

TEXT BOOKS:

1. Switching and finite automata theory:ZviKohavi, Niraj K. Jha,Cambridge University Press, 3rd Edition, 2009.

2. Digital Design by Morris Mano, Prentice Hall India, 5th Edition.

REFERENCE BOOKS:

1. Digital Principles and Applications by Leach , Malvino , Saha, Mc-Graw Hill, 8th Edition, 2014.

2. Switching Theory and Logic Design by A. Anand Kumar, PHI learning, 3rd edition.

3. Introduction to Switching Theory and Logic Design – Fredriac J Hill, Gerald R Peterson, 3rdEdition, John Willey and Sons Inc,

4. Fundamentals of Logic Design by Charles H. RothJr., Cengage Learning, 7th edition,2013.

POWER SYSTEMS-I

Lecture – Tutorial:	3-1 Hours	Internal Marks:	30
Credits:	3	External Marks:	70

Course Objectives:

- To study the principle of operation of different components of a thermal power stations.
- To study the principle of operation of different components of a Nuclear power stations.
- To study the constructional and operation of different components of an Air and Gas Insulated substations.
- To study the constructional details of different types of cables.
- To study different types of load curves and tariffs applicable to consumers.

Course Outcomes

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

CO1	Identify the different components of thermal power plants.
CO2	Identify the different components of nuclear Power plants.
CO3	Identify the different components of air insulated substations.
CO4	Identify the different components of gas insulated substations.
CO5	Identify single core and three core cables with different insulating materials.
CO6	Analyse the different economic factors of power generation and tariffs.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3											
CO2	3	2										
CO3	3											
CO4	3											
CO5	3	2										
CO6	3	2										

UNIT I

Hydroelectric Power Stations: Selection of site, general layout of a hydroelectric power plant with brief description of major components and principle of operation

Thermal Power Stations Selection of site, general layout of a thermal power plant. Brief description of components: boilers, super heaters, economizers and electrostatic precipitators, steam turbines: impulse and reaction turbines, condensers, feed water circuit, cooling towers and chimney.

UNIT II

Nuclear Power Stations

Location of nuclear power plant, working principle, nuclear fission, nuclear fuels, nuclear chain reaction, nuclear reactor components: moderators, control rods, reflectors and coolants, types of nuclear reactors and brief description of PWR, BWR

and FBR. Radiation: radiation hazards and shielding, nuclear waste disposal.

UNIT III

Classification of Air and Gas Insulated substations

Air Insulated Substations – indoor & outdoor substations, substations layouts of 33/11 kV showing the location of all the substation equipment. Bus bar arrangements in the sub-stations: simple arrangements like single bus bar, sectionalized single bus bar, double bus bar with one and two circuit breakers, main and transfer bus bar system with relevant diagrams.

Gas Insulated Substations (GIS) – advantages of gas insulated substations, constructional aspects of GIS, installation and maintenance of GIS, comparison of air insulated substations and gas insulated substations.

UNIT IV

Underground Cables

Types of cables, construction, types of insulating materials, calculation of insulation resistance, stress in insulation and power factor of cable. Capacitance of single and 3-Core belted Cables. Grading of cables: capacitance grading and intersheath grading.

UNIT V

Economic Aspects of Power Generation & Tariff

Economic Aspects – load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity factor and plant use factor, base and peak load plants.

Tariff Methods– costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a tariff method, tariff methods: simple rate, flat rate, block- rate, two-part, three–part, and power factor tariff methods.

TEXT BOOKS:

1. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagarand A. Chakrabarti, DhanpatRai& Co. Pvt. Ltd, 2016.

2. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa, New age International (P) Limited, Publishers, 3rd edition.

REFERENCE BOOKS:

1. Elements of Electrical Power Station Design by M V Deshpande, PHI, New Delhi, 2009.

INDUCTION AND SYNCHRONOUS MACHINES

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- Understand the principle of operation and performance of 3-phase induction motor.
- Quantify the performance of induction motor and induction generator in terms of torque and slip.
- To understand the torque producing mechanism of a single phase induction motor.
- To understand the principle of emf generation, the effect of armature reaction and predetermination of voltage regulation in synchronous generators.
- To study parallel operation and control of real and reactive powers for synchronous generators.
- To understand the operation, performance and starting methods of synchronous motors.

Course Outcomes

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

CO1	Explain the operation and performance of three phase induction motor
CO2	Analyze the torque-speed relation, performance of induction motor and induction generator
CO3	Implement the starting ofsingle phase induction motors.
CO4	Develop winding design and predetermine the regulation ofsynchronous generators.
CO5	Explain hunting phenomenon of staring and correction of power factor with synchronous motor.
CO6	Explain implement methods of staring and correction of power factor with synchronous motor.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**2**										
CO2	**2**	**3**										
CO3	**3**	**3**										
CO4	**2**	**3**										
CO5	**3**	**3**										
CO6	**3**	**3**										

UNIT I

3-phase induction motors

Construction details of squirrel cage and slip ring induction motors – production of rotating magnetic field – principle of operation – Equivalent circuit –phasor diagram- slip speed-rotor emf and rotor frequency – rotor current and pf at

standstill and during running conditions – rotor power input, rotor copper loss and mechanical power developed and their interrelationship.

UNIT II

Characteristics and testing methods of induction motors

Torque equation – expressions for maximum torque and starting torque – torque slip characteristic – double cage and deep bar rotors – crawling and cogging – speed control of induction motor with V/f control method – no load and blocked rotor tests – circle diagram for predetermination of performance – induction generator operation (Qualitative treatment only)

UNIT III

Starting methods of 3-phase induction motors

Methods of starting of three phase Induction motors: DOL, Auto transformer, Star-Delta and rotor resistance methods.

Single phase induction motors: Constructional features- equivalent circuit-problem of starting-double revolving field theory- Methods of starting. AC series motors.

UNIT IV

Construction, operation, voltage regulation and parallel operation of synchronous generator:

Constructional features of non-salient and salient pole machines –types of armature windings – distribution, pitch and winding factors – E.M.F equation – improvements of waveform and armature reaction –phasor diagrams- voltage regulation by synchronous impedance method – MMF method and Potier triangle method– two reaction analysis of salient pole machines and phasor diagram. Parallel operation with infinite bus and other alternators – synchronizing power – load sharing – control of real and reactive power – numerical problems.

UNIT V

Synchronous motor – operation, starting and performance

Synchronous motor principle and theory of operation – phasor diagram – starting torque – variation of current and power factor with excitation – capability curves - synchronous condenser – mathematical analysis for power developed – hunting and its suppression – methods of starting – applications.

TEXT BOOKS:

1. Electrical Machines by P.S. Bhimbra, Khanna Publishers
2. Electric Machinery by A.E.Fitzgerald, Charles Kingsley, Stephen D.Umans, TMH

REFERENCE BOOKS:

1. 1.Performance and design of AC machines – M.G. Say
2. Alternating Current Machines by A.F.Puchstein, T.C. Lloyd, A.G. Conrad, ASIA Publishing House 3. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education, 2010.
4. Electrical Machines by R.K.Rajput, Lakshmi publications, 5th edition

MANAGERIAL ECONOMICS & FINANCIAL ANALYSIS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- The Learning objectives of this paper are to understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting.
- To familiarize about the Production function, Input Output relationship, Cost-Output relationship and Cost-Volume-Profit Analysis.
- To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles.
- To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation.
- Finally, it is also to understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

Course Outcomes

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

CO1	Equipped with the knowledge of estimating the Demand and demand elasticities for a product.
CO2	Understand the Input-Output-Cost relationships
CO3	Estimation of the least cost combination of inputs
CO4	Ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.
CO5	Prepare Financial Statements and the usage of various Accounting tools for Analysis
CO6	Evaluate various investment project proposals with the help of capital budgeting techniques for decision making.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1											
CO2		1										
CO3	2	2	1									
CO4			1				1					
CO5	1		1			2						
CO6	1				1						1	

UNIT I

Introduction to Managerial Economics and demand Analysis:

Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

UNIT II

Theories of Production and Cost Analyses:

Theories of Production function- Law of Variable Proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale- Different cost concepts: opportunity costs, explicit and implicit costs-Fixed costs, Variable Costs and Total costs –Cost –Volume-Profit Analysis-Determination of Breakeven point(problems)-Managerial significance and limitations of Breakeven point.

UNIT III

Introduction to Markets, Theories of the Firm & Pricing Policies:

Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing, Business Cycles: Meaning and Features – Phases of a Business Cycle. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms.

UNIT IV

Introduction to Accounting & Financing Analysis:

Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow analysis (Problems)

UNIT V

Capital and Capital Budgeting:

Capital Budgeting: Meaning of Capital-Capitalization- Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods (payback period, accounting rate of return) and modern methods (Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

TEXT BOOKS:

1. Managerial Economics and Financial Analysis by A R Aryasri, McGraw – Hill, 3rd edition.

REFERENCE BOOKS:

1. Managerial Economics by Varshney R.L, K.L Maheswari, S. Chand & Company Ltd,

2. Managerial Economics, JL Pappas and EF Brigham, Holt, R & W; New edition.

3. Accounting for Management, N.P Srinivasn and M. Sakthivel Murugan, S. Chand & Company Ltd, 1 st edition, 2011.

4. An Introduction to Accountancy by Maheswari S.N, Vikas Publishing House Pvt Ltd, 12th edition, 2018.

5. Financial Management by I.M Pandey, Vikas Publishing House Pvt Ltd, 9th edition, 2009.

6. Managerial Economics by V. Maheswari, S. Chand & Company Ltd, 2002.

PYTHON PROGRAMMING LAB

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	35
Credits:	1.5	**External Marks:**	50
Course Objectives:			

- To acquire programming skills in core Python.
- To acquire Object Oriented Skills in Python
- To develop the skill of designing Graphical user Interfaces in Python
- To develop the ability to write database applications in Python

List of Experiments

1) Write a program that asks the user for a weight in kilograms and converts it to pounds. There are 2.2 pounds in a kilogram.

2) Write a program that asks the user to enter three numbers (use three separate input statements). Create variables called total and average that hold the sum and average of the three numbers and print out the values of total and average.

3) Write a program that uses a for loop to print the numbers 8, 11, 14, 17, 20, . . . , 83, 86,89.

4) Writeaprogramthatastheuserfortheirnameandhowmanytimestoprintit.The program should print out the user's name the specified number of times.

5) Use a for loop to print a triangle like the one below. Allow the user to specify how high the triangle should be.

```
*
**
***
****
```

6) Generate a random number between 1 and 10. Ask the user to guess the number and print a message based on whether they get it right or not.

7) Write a program that asks the user for two numbers and prints Close if the numbers are within .001 of each other and Not close otherwise.

8) Write a program that asks the user to enter a word and prints out whether that word contains any vowels.

9) Write a program that asks the user to enter two strings of the same length. The program should then check to see if the strings are of the same length. If they are not, the program should print an appropriate message and exit. If they are of the same length, the program should alternate the characters of the two strings. For example, if the user enters abcde and ABCDE the program should print outAaBbCcDdEe.

10) Write a program that asks the user for a large integer and inserts commas into it according to the standard American convention for commas in large

numbers. For instance, if the user enters 1000000, the output should be1,000,000.

11) In algebraic expressions, the symbol for multiplication is often left out, as in 3x+4y or 3(x+5). Computers prefer those expressions to include the multiplication symbol, like 3*x+4*y or 3*(x+5). Write a program that asks the user for an algebraic expression and then inserts multiplication symbols where appropriate.

12) Write a program that generates a list of 20 random numbers between 1 and100. (a) Print the list. (b) Print the average of the elements in the list. (c) Print the largest and smallest values in the list. (d) Print the second largest and second smallest entries in the list (e) Print how many even numbers are in the list.

13) Write a program that asks the user for an integer and creates a list that consists of the factors of that integer.

14) Write a program that generates 100 random integers that are either 0 or 1. Then find the longest run of zeros, the largest number of zeros in a row. For instance, the longest run of zeros in [1,0,1,1,0,0,0,0,1,0,0] is4.

15) Write a program that removes any repeated items from a list so that each item appears at most once. For instance, the list [1,1,2,3,4,3,0,0] would become[1,2,3,4,0].

16) Write a program that asks the user to enter a length in feet. The program should then give the user the option to convert from feet into inches, yards, miles, millimeters, centimeters, meters, or kilometers. Say if the user enters a 1, then the program converts to inches, if they enter a 2, then the program converts to yards, etc. While this can be done with if statements, itis much shorter with lists and it is also easier to add new conversions if you use lists.

17) Write a function called sum_digits that is given an integer num and returns the sum of the digits of num.

18) Write a function called first_diff that is given two strings and returns the first location in which the strings differ. If the strings are identical, it should return-1.

19) Write a function called number_of_factors that takes an integer and returns how many factors the number has.

20) Write a function called is_sorted that is given a list and returns True if the list is sorted and False otherwise.

21) Write a function called root that is given a number x and an integer n and returns x1/n. In the function definition, set the default value of n to2.

22) Write a function called primes that is given a number n and returns a list of the first n primes. Let the default value of n be100.

23) Write a function called merge that takes two already sorted lists of possibly different lengths, and merges them into a single sorted list. (a) Do this using the sort method. (b) Do this without using the sort method.

24)Write a program that asks the user for a word and finds all the smaller words that can be made from the letters of that word. The number of occurrences of a letter in a smaller word can't exceed the number of occurrences of the letter in the user's word.

25) Write a program that reads a file consisting of email addresses, each on its own line. Your program should print out a string consisting of those email addresses separated by semicolons.
26) Write a program that reads a list of temperatures from a file called temps.txt, converts those temperatures to Fahrenheit, and writes the results to a file called ftemps.txt.
27) Write a class called Product. The class should have fields called name, amount, and holding the product's name, the number of items of that product in stock, and the regular price of the product. There should be a method get_price that receives the number of items to be bought and returns a the cost of buying that many items, where the regular price is charged for orders of less than 10 items, a 10% discount is applied for orders of between 10 and 99 items, and a 20% discount is applied for orders of 100 or more items. There should also be a method called make_purchase that receives the number of items to be bought and decreases amount by that much.
28) Write a class called Time whose only field is a time in seconds. It should have a method called convert_to_minutes that returns a string of minutes and seconds formatted as in the following example: if seconds is 230, the method should return '5:50'. It should also have a method called convert_to_hours that returns a string of hours, minutes, and seconds formatted analogously to the previous method.
29) Write a class called Converter. The user will pass a length and a unit when declaring an object from the class for example, c = Converter(9,'inches'). The possible units are inches, feet, yards, miles, kilometers, meters, centimeters, and millimeters. For each of these units there should be a method that returns the length converted into those units. For example, using the Converter object created above, the user could call c. feet() and should get 0.75 as the result.
30) Write a Python class to implement pow(x,n).
31) Write a Python class to reverse a string word byword.
32) Write a program that opens a file dialog that allows you to select a text file. The program then displays the contents of the file in a textbox.
33) Write a program to demonstrate Try/except/else.
34) Write a program to demonstrate try/finally and with/as

INDUCTION AND SYNCHRONOUS MACHINES LAB

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	35
Credits:	1.5	**External Marks:**	50

Course Objectives:

- Speed control methods of three-phase induction motors.
- Performance characteristics of three-phase and single-phase induction motors.
- Principles of power factor improvement of single-phase induction motor.
- Voltage regulation calculations of three–phase alternator by various methods,
- Performance curves of three-phase synchronous motor.

List of Experiments

(Any 10 of the following experiments are to be conducted)

1. Performance characteristics of a three- phase Induction Motor by conducting Brake test

2. Determination of equivalent circuit parameters, efficiency and regulation of a three phase Induction motor by conducting No–load & Blocked rotor tests

3. Determination of Regulation of a three–phase alternator by using synchronous impedance & m.m.f. methods

4. Determination of Regulation of a three–phase alternator by using Potier triangle method

5. Determination of V and Inverted V curves of a three phase synchronous motor.

6. Determination of Xd and Xq of a salient pole synchronous machine

7. Speed control of three phase induction motor by V/f method.

8. Determination of equivalent circuit parameters of single phase induction motor

9. Determination of efficiency of three-phase alternator by loading with three phase induction motor.

10. Power factor improvement of single-phase induction motor by using capacitors.

11. Parallel operation of three-phase alternator under no-load and load conditions

12. Determination of efficiency of a single-phase AC series Motor by conducting Brake test.

13. Starting of single-phase Induction motor by using capacitor start and capacitor start run methods.

14. Determination of efficiency of a single-phase Induction Motor by conducting Brake test.

DIGITAL ELECTRONICS LAB

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	35
Credits:	1.5	**External Marks:**	50

Course Objectives:

- To know the concept of Boolean laws for simplifying the digital circuits.
- To understand the concepts of flipflops.
- To understand the concepts of counters.
- To analyze and design various circuits.

List of Experiments

(Any 10 of the following experiments are to be conducted)

1. Verification of truth tables of Logic gates: Two input (i) OR (ii) AND (iii) NOR (iv) NAND (v) Exclusive OR (vi) Exclusive NOR

2. Design a simple combinational circuit and obtain minimal SOP expression and verify the truth table using Digital Trainer Kit

3. Verification of functional table of 3 to 8 line Decoder / De-multiplexer

4. 4 variable logic function verification using 8 to 1 multiplexer.

5. Design full adder circuit and verify its functional table.

6. Design full Subtractor circuit and verify its functional table.

7. Verification of functional tables of Flip-Flops

8. Design a four bit ring counter using D Flip – Flops / JK Flip Flop and verify output

9. Design a four bit Johnson's counter using D Flip-Flops / JK Flip Flops and verify output

10. Draw the circuit diagram of MOD-8 ripple counter and construct a circuit using T- Flip-Flops and Test it with a low frequency clock and Sketch the output waveforms.

11. Design MOD – 10 ripple counter using T- Flip-Flop and verify the result and Sketch the output waveforms

12. Design MOD – 8 synchronous counter using D Flip-Flop and verify the result and Sketch the output waveforms.

POWER SYSTEMS-II

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To understand the concepts of GMD/GMR and to compute inductance/capacitance of transmission lines.
- To distinguish the short and medium length transmission lines, their models and performance.
- To understand the performance and modeling of long transmission lines.
- To learn the effect of travelling waves on transmission lines.
- To learn the concepts of corona and the factors effecting corona.
- To understand sag and tension computation of transmission lines as well as to learn the performance of overhead insulators.

Course Outcomes

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

CO1	Calculate parameters of transmission lines for different circuit configurations
CO2	Determine the performance of short, medium and long transmission lines.
CO3	Analyse the effect of travelling waves on transmission lines.
CO4	Analyse the various voltage control methods and effect of corona.
CO5	Calculate sag of transmission lines and performance of line insulators.
CO6	Calculate tension of transmission lines and performance of line insulators.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	2	2	2					2	2			
CO2	2	1	2					2	1			
CO3	1	2	2					2	3			
CO4	2	1	2					2	2			
CO5	3	2	1					1	2			
CO6	2	2	2					2	1			

UNIT I

Transmission Line Parameters Conductor materials – Types of conductors – Calculation of resistance for solid conductors – Skin and Proximity effects – Calculation of inductance for Single-phase and Three-phase– Single and double circuit lines– Concept of GMR and GMD–Symmetrical and asymmetrical conductor

configuration with and without transposition–Bundled conductors – Calculation of capacitance for 2 wire and 3 wire systems – Effect of ground on capacitance – Capacitance calculations for symmetrical and asymmetrical single and Three-phase–Single and double circuit lines without and with Bundled conductors.

UNIT II

Performance Analysis of Transmission Lines Classification of Transmission Lines – Short, medium, long lines and their model representation – Nominal-T, Nominal-Pie and A, B, C, D Constants for symmetrical and Asymmetrical Networks. Rigorous Solution for long line equations –Representation of Long lines – Equivalent T and Equivalent Pie network models - Surge Impedance and Surge Impedance Loading (SIL) of Long Lines - Regulation and efficiency for all types of lines – Ferranti effect.

UNIT III

Power System Transients Types of System Transients – Propagation of Surges – Attenuation–Distortion– Reflection and Refraction Coefficients.
Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – TJunction – Lumped Reactive Junctions.

UNIT IV

Corona Description of the phenomenon – Types of Corona - critical voltages and power loss – Advantages and Disadvantages of Corona - Factors affecting corona - Radio Interference.

UNIT V

Sag and Tension Calculations and Overhead Line Insulators: Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor – Stringing chart and sag template and its applications Types of Insulators – String efficiency and Methods for improvement - Voltage distribution–Calculation of string efficiency – Capacitance grading and Static Shielding.

TEXT BOOKS:

1. Electrical Power Systems – by C.L.Wadhwa, New Age International (P) Limited, 1998.
2. Power System Engineering by I.J.Nagarath and D.P.Kothari, Tata McGraw Hill, 3 rd Edition.

REFERENCE BOOKS:

1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4th edition
2. Power System Analysis and Design by B.R.Gupta, Wheeler Publishing.
3. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar A.Chakrabarthy, DhanpatRai Co Pvt. Ltd.2016
4. Electrical Power Systems by P.S.R. Murthy, B.S. Publications, 2017.

POWER ELECTRONICS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To know the characteristics of various power semiconductor devices.
- To learn the operation of single phase full–wave converters and perform harmonic analysis of input current.
- To learn the operation of three phase full–wave converters and AC/AC converters.
- To learn the operation of different types of DC-DC converters.
- To learn the operation of PWM inverters for voltage control and harmonic mitigation.

Course Outcomes

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

CO1	Illustrate the static and dynamic characteristics of SCR, Power-MOSFET and Power-IGBT.
CO2	Analyse the operation of phase-controlled rectifiers
CO3	Analyse the operation of three-phase full–wave converters, AC Voltage Controllers
CO4	Analyse the operation of Cycloconverters
CO5	Examine the operation and design of different types of DC-DC converters.
CO6	Analyse the operation of PWM inverters for voltage control and harmonic mitigation.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I

Power Semi-Conductor Devices Silicon controlled rectifier (SCR) – Two transistor analogy - Static and Dynamic characteristics – Turn on and Turn off Methods - Triggering Methods (R, RC and UJT) – Snubber circuit design. Static and Dynamic Characteristics of Power MOSFET and Power IGBT– Gate Driver Circuits for Power MOSFET and IGBT - Numerical problems

UNIT II

Single-phase AC-DC Converters Single-phase half-wave controlled rectifiers - R and RL loads with and without freewheeling diode - Single-phase fully controlled mid-point and bridge converter with R load, RL load and RLE load - Continuous and Discontinuous conduction - Effect of source inductance in Single-phase fully controlled bridge rectifier – Expression for output voltages – Single-phase Semi-Converter with R load-RL load and RLE

load – Continuous and Discontinuous conduction - Harmonic Analysis – Dual converter and its mode of operation - Numerical Problems.

UNIT III

Three-phase AC-DC Converters & AC – AC Converters Three-phase half-wave Rectifier with R and RL load - Three-phase fully controlled rectifier with R and RL load - Three-phase semi converter with R and RL load - Expression for Output Voltage - Harmonic Analysis - Three-phase Dual Converters - Numerical Problems. Single-phase AC-AC power control by phase control with R and RL loads - Expression for rms output voltage – Single-phase step down and step up Cycloconverter - Numerical Problems.

UNIT IV

DC–DC Converters Operation of Basic Chopper – Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressions for output voltage ripple and inductor current ripple – control techniques – Introduction to PWM control -Numerical Problems.

UNIT V

DC–AC Converters Introduction - Single-phase half-bridge and full-bridge inverters with R and RL loads – Phase Displacement Control – PWM with bipolar voltage switching, PWM with unipolar voltage switching - Three-phase square wave inverters - 1200 conduction and 1800 conduction modes of operation - Sinusoidal Pulse Width Modulation - Current Source Inverter (CSI) - Numerical Problems.

TEXT BOOKS:

1. Power Electronics: Converters, Applications and Design by Ned Mohan, Tore M Undeland, William P Robbins, John Wiley & Sons.
2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998
3. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.

REFERENCE BOOKS:

1. Elements of Power Electronics–Philip T.Krein. Oxford University Press; Second edition
2. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.
4. Power Electronics: by Daniel W.Hart, Mc Graw Hill.

CONTROL SYSTEMS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
- To analyze the time response of first and second order systems and improvement of performance using PI, PD, PID controllers.
- To investigate the stability of closed loop systems using Routh's stability criterion and root locus method.
- To understand basic aspects of design and compensation of LTI systems using Bode diagrams.
- To learn Frequency Response approaches for the analysis of LTI systems using Bode plots, polar plots and Nyquist stability criterion.
- To learn state space approach for analysis of LTI systems and understand the concepts of controllability and observability.

Course Outcomes

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

CO1	Derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
CO2	Determine time response specifications of second order systems and absolute and relative stability of LTI systems using Routh's stability criterion and root locus method.
CO3	Analyze the stability of LTI systems using frequency response methods.
CO4	Design Lag, Lead, Lag-Lead compensators to improve system performance using Bode diagrams.
CO5	Represent physical systems as state models and determine the response.
CO6	Understand the concepts of controllability and observability.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I

Mathematical Modelling of Control Systems Classification of control systems - open loop and closed loop control systems and their differences - Feedback characteristics - transfer function of linear system, differential equations of electrical networkstranslational and rotational mechanical systems - transfer function of Armature voltage controlled DC servo motor - block diagram algebra -

signal flow graph – reduction using Mason's gain formula.

UNIT II

Time Response Analysis and Controllers Standard test signals – time response of first and second order systems – time domain specifications - steady state errors and error constants - effects of proportional (P) - proportional integral (PI) - proportional derivative (PD) - proportional integral derivative (PID) systems.

Stability Assessment Techniques The concept of stability – Routh's stability criterion – limitations of Routh's stability, root locus concept – construction of root loci (simple problems) - Effect of addition of Poles and Zeros to the transfer function.

UNIT III

Frequency Response Analysis Introduction to frequency domain specifications – Bode diagrams – transfer function from the Bode diagram –Polar plots, Nyquist stability criterion-stability analysis using Bode plots (phase margin and gain margin).

UNIT IV

Classical Control Design Techniques Lag, lead, lag-lead compensators - physical realisation - design of compensators using Bode plots.

UNIT V

State Space Analysis of Linear Time Invariant (LTI) Systems Concepts of state - state variables and state model - state space representation of transfer function - diagonalization using linear transformation - solving the time invariant state equations - State Transition Matrix and its properties- concepts of controllability and observability.

TEXT BOOKS:

1. Modern Control Engineering by Kotsuhiko Ogata, Prentice Hall of India
2. Automatic control systems by Benjamin C.Kuo, Prentice Hall of India, 2nd Edition.

REFERENCE BOOKS:

1. Control Systems principles and design by M.Gopal, Tata Mc Graw Hill education Pvt Ltd., 4thEdition.
2. Control Systems Engineering by Norman S. Nise, Wiley Publications, 7th edition
3. Control Systems by Manik Dhanesh N, Cengage publications.
4. Control Systems Engineering by I.J.Nagarath and M.Gopal, Newage International Publications, 5 th Edition.

RENEWABLE ENERGY SOURCES
(Open Elective-I)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To study the solar radiation data, equivalent circuit of PV cell and its I-V & P-V characteristics.
- To understand the concept of Wind Energy Conversion & its applications.
- To study the principles of biomass and geothermal energy.
- To understand the principles of Ocean Thermal Energy Conversion (OTEC), motion of waves and power associated with it.
- To study the various chemical energy sources such as fuell cell and hydrogen energy along with their operation and equivalent circuit.

Course Outcomes

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

CO1	Analyze solar radiation data, extra-terrestrial radiation, radiation on earth's surface and solar Energy Storage.
CO2	Illustrate the components of wind energy systems
CO3	Illustrate the working of biomass, digesters and Geothermal plants
CO4	Demonstrate the principle of Energy production from OTEC, Tidal and Waves.
CO5	Evaluate the concept and working of Fuel cells power generation
CO6	Evaluate the concept and working of MHD power generation

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I

Solar Energy: Introduction - Renewable Sources - prospects, Solar radiation at the Earth Surface - Equivalent circuit of a Photovoltaic (PV) Cell - I-V & P-V Characteristics - Solar Energy Collectors: Flat plate Collectors, concentrating collectors - Solar Energy storage systems and Applications: Solar Pond - Solar water heating - Solar Green house.

UNIT II

Wind Energy: Introduction - basic Principles of Wind Energy Conversion, the nature of Wind - the power in the wind - Wind Energy Conversion - Site selection considerations -

basic components of Wind Energy Conversion Systems (WECS) - Classification - Applications.

UNIT III

Biomass and Geothermal Energy: Biomass: Introduction - Biomass conversion technologies - Photosynthesis, factors affecting Bio digestion - classification of biogas plants - Types of biogas plants - selection of site for a biogas plant Geothermal Energy: Introduction, Geothermal Sources – Applications - operational and Environmental problems.

UNIT IV

Energy From oceans, Waves & Tides: Oceans: Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC in India. Waves: Introduction - Energy and Power from the waves - Wave Energy conversion devices. Tides: Basic principle of Tide Energy -Components of Tidal Energy.

UNIT V

Chemical Energy Sources: Fuel Cells: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells - Applications.

Hydrogen Energy: Introduction - Methods of Hydrogen production - Storage and Applications

Magneto Hydro Dynamic (MHD) Power generation: Principle of Operation - Types.

TEXT BOOKS:

1. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011.
2. John Twidell & Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013.

REFERENCE BOOKS:

1. S.P.Sukhatme & J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011.
2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013.
3. Shoba Nath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015.

CONCEPTS OF OPTIMIZATION TECHNIQUES
(Open Elective-I)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To know the importance of adopting optimization techniques in day to day life.
- To analyse the importance of various types of constraints at various stages.
- To learn more on linear & nonlinear programming concepts.
- To analyse the significance of transportation problem.
- To learn the concepts of dynamic programming.

Course Outcomes

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

CO1	State and formulate the optimization problem without and with constraints, also apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints and arrive at an optimal solution.
CO2	Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
CO3	Formulate a mathematical model and apply non-linear programming techniques for unconstrained and constrained case studies.
CO4	Solve transportation and assignment problem by using Linear programming Simplex method.
CO5	Formulate Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.
CO6	Apply Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Introduction to Optimization Techniques Statement of an Optimization problem – design vector – design constraints – objective function – classification of Optimization problems.

Classical Optimization Techniques Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers.

UNIT II

Linear Programming Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

UNIT III

Nonlinear Programming

Unconstrained cases - One – dimensional minimization methods: Classification - Fibonacci method and Quadratic interpolation method - Univariate method - Powell's method.

Constrained cases - Characteristics of a constrained problem - Classification - Basic approach of Penalty Function method.

UNIT IV

Transportation Problem Finding initial basic feasible solution by north – west corner rule - least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems – Special cases in transportation problem

UNIT V

Dynamic Programming Dynamic programming - Multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution

TEXT BOOKS:

Text Books: 1. "Engineering optimization: Theory and practice"-by S. S.Rao- New Age International (P) Limited - 3rd edition - 1998.

2. "Introductory Operations Research" by H.S. Kasene& K.D. Kumar - Springer (India) 2013.

REFERENCE BOOKS:

1. "Optimization Methods in Operations Research and systems Analysis" – by K.V. Mital and C. Mohan - New Age International (P) Limited - Publishers - 3 rd edition - 1996.

2. Operations Research – by Dr. S.D.Sharma- Kedarnath - Ramnath& Co - 2012.

3. "Operations Research: An Introduction" – by H.A.Taha - PHI pvt. Ltd. - 6th edition

4. Linear Programming–by G.Hadley.

CONCEPTS OF CONTROL SYSTEMS
(Open Elective-I)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
- To analyze the time response of first and second order systems and improvement of performance using PI, PD, PID controllers.
- To investigate the stability of closed loop systems using Routh's stability criterion and root locus method.
- To learn Frequency Response approaches for the analysis of LTI systems using Bode plots, polar plots and Nyquist stability criterion.
- To learn state space approach for analysis of LTI systems and understand the concepts of controllability and observability.

Course Outcomes

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

CO1	Derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
CO2	Determine time response specifications of second order systems and to determine error constants
CO3	Analyze absolute and relative stability of LTI systems using Routh's stability criterion and the root locus method.
CO4	Analyze the stability of LTI systems using frequency response methods.
CO5	Represent physical systems as state models and determine the response.
CO6	Understanding the concepts of controllability and observability.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Mathematical Modelling of Control Systems Classification of control systems - open loop and closed loop control systems and their differences - transfer function of linear system - differential equations of electrical networks - translational and

rotational mechanical systems – block diagram algebra – Feedback characteristics.

UNIT II

Time Response Analysis Standard test signals – time response of first and second order systems – time domain specifications - steady state errors and error constants - P - PI & PID Controllers.

UNIT III

Stability and Root Locus Technique The concept of stability – Routh-Hurwitz Criteria – limitations of Routh-Hurwitz criterion-.Root locus concept – construction of root loci (simple problems).

UNIT IV

Frequency Response Analysis Introduction to frequency domain specifications – Bode diagrams – Transfer function from the Bode diagram – phase margin and gain margin.

UNIT V

State Space Analysis of Linear Time Invariant (LTI) Systems Concepts of state - state variables and state model - state space representation of transfer function - State Transition Matrix and it's properties - concepts of controllability and observability.

TEXT BOOKS:

1. Modern Control Engineering by Kotsuhiko Ogata - Prentice Hall of India.
2. Automatic control systems by Benjamin C.Kuo - Prentice Hall of India - 2 nd Edition.

REFERENCE BOOKS:

1. Control Systems principles and design by M.Gopal - Tata Mc Graw Hill education Pvt Ltd. - 4 thEdition.
2. Control Systems by Manik Dhanesh N - Cengage publications.
3. Control Systems Engineering by I.J.Nagarath and M.Gopal - Newage International Publications - 5 th Edition.
4. Control Systems Engineering by S.Palani - Tata Mc Graw Hill Publications.

LINEAR IC APPLICATIONS
(Professional Elective-I)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- Describe the Op-Amp and internal Circuitry: 555 Timer, PLL
- Discuss the Applications of Operational amplifier: 555 Timer, PLL
- Design the Active filters using Operational Amplifier
- Use the Op-Amp in A to D & D to A Converters

Course Outcomes

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

CO1	Describe the Op-Amp and internal Circuitry: 555 Timer, PLL
CO2	Discuss the Applications of Operational amplifier: 555 Timer
CO3	Discuss the Applications of Operational amplifier: PLL
CO4	Design the Active filters using Operational Amplifier
CO5	Use the Op-Amp in D to A Converters
CO6	Use the Op-Amp in A to D Converters

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

OP-Amp Block Diagram (Symbolic Representation), Characteristics of Op-Amp, Ideal and Practical OpAmp specifications, DC and AC Characteristics, Definitions of Input and Output Off-set voltage and currents slow rate, CMRR, PSRR. Measurements of Op-Amp Parameters, Three-Terminal Voltage Regulators 78xx& 79xx Series, current Booster, adjustable voltage, DualPowerSupplywith78xx&79xx

UNIT II

OP-AMPS Applications: Introduction, Basic Op-Amp Applications, Instrumentation Amplifier, AC Amplifier, V to I and I to V Converter, Sample and Hold Circuit, Log and Antilog Amplifier, Multiplier and Divider, Differentiator, integrator.

Comparators and Waveform Generators: Introduction, Comparator, Square Wave Generator, Monostable Multivibrator, Triangular Wave Generator, Sine Wave Generators.

UNIT III

Active Filters: Design & Analysis of Butterworth active filters – 1st order, 2nd order LPF, HPF filters. Band pass, Band reject and all pass filters.

UNIT IV

Timers: Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger.

Phase Locked Loops: Introduction, block schematic, principles and description of individual blocks, 565 PLL, Applications of PLL – frequency multiplication, frequency translation, AM, FM & FSK demodulators. Applications of VCO (566)

UNIT V

Digital To Analog And Analog To Digital Converters: Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A-D Converters – parallel Comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC.DAC and ADC Specifications.

TEXT BOOKS:

1. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition 2003.

2. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma; SK Kataria & Sons; 2 nd Edition, 2010

REFERENCE BOOKS:

1. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI, 1993.

2. Operational Amplifiers & Linear ICs – David A Bell, Oxford Uni. Press, 3rd Edition.

UTILIZATION OF ELECTRIC ENERGY
(Professional Elective-I)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To study the basic principles of illumination and its measurements and to design the different types lighting systems.
- To acquaint with the different types of heating and welding techniques.
- To understand the operating principles and characteristics of various motors with respect to speed, temperature and loading conditions.
- To understand the basic principles of electric traction including speed–time curves of different traction services and calculation of braking, acceleration and other related parameters.
- To Introduce the concepts of various types of energy storage systems.

Course Outcomes

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

CO1	Identify various illumination methods produced by different illuminating sources.
CO2	Identify a suitable motor for electric drives and industrial applications
CO3	Identify most appropriate heating and welding techniques for suitable applications.
CO4	Distinguish various traction system
CO5	Determine the tractive effort and specific energy consumption.
CO6	Validate the necessity and usage of different energy storage schemes for different applications and comparisons.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2									1	
CO2	3	3	1	1							1	
CO3	3	3	1	1							1	
CO4	3	3	1	1							1	
CO5	3	3	1								1	
CO6	3	3	1								1	

UNIT I

Illumination fundamentals Introduction - terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Sources of light.

Various Illumination Methods Discharge lamps - MV and SV lamps – Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and design of lighting and flood lighting–LED lighting - Energy conservation.

UNIT II

Selection of Motors Choice of Motor - Type of Electric Drives - Starting And Running Characteristics – Speed Control– Temperature Rise – Applications of Electric Drives–Types of Industrial Loads–Continuous–Intermittent And Variable Loads–Load Equalization - Introduction To Energy Efficient Motors.

UNIT III

Electric Heating Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating

Electric Welding Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding.

UNIT IV

Electric Traction System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves. Calculations of tractive effort– power – Specific energy consumption for given run–Effect of varying acceleration and braking retardation– Adhesive weight and braking retardation adhesive weight and coefficient of adhesion-Numerical problems.

UNIT V

Introduction to Energy Storage Systems Need For Energy Storage - Types of Energy Storage-Thermal - Electrical - Magnetic And Chemical Storage Systems - Comparison of Energy Storage Technologies-Applications.

TEXT BOOKS:

1. Utilization of Electric Energy – by E. Openshaw Taylor - Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab - Dhanpat Rai& Sons.
3. "Thermal energy storage systems and applications"-by Ibrahim Dincer and Mark A.Rosen. John Wiley and Sons 2002.

REFERENCE BOOKS:

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana - New Age International (P) Limited - Publishers - 1996.
2. Generation - Distribution and Utilization of electrical Energy – by C.L. Wadhwa - New Age International (P) Limited - Publishers - 1997.

COMPUTER ARCHITECTURE AND ORGANIZATION
(Professional Elective-I)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To explain the basic working of a digital computer.
- To understand the register transfer language and micro operators.
- To learn various addressing modes supported by the processors.
- To be familiar with peripheral interfacing with processors.
- To understand memory hierarchy in computers.

Course Outcomes

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

CO1	Explain the instruction cycle of a computer
CO2	Understand various micro operations
CO3	Understand various register transfer language.
CO4	Describe parallel processing and pipelining.
CO5	Interface different peripherals with processors.
CO6	Know the advantages of cache and virtual memory.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input- Output and Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator Logic

UNIT II

Register Transfer and Micro operations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations, Arithmetic Logic Shift Unit. Micro programmed Control: Control Memory, Address Sequencing, Micro program Example, Design of Control Unit.

UNIT III

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer(RISC) Pipeline and Vector Processing: Parallel

Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISK Pipeline, Vector Processing, Array Processors.

UNIT IV

Input/output Organization: Peripheral Devices, I/O interface, Asynchronous data transfer, Modes of transfer, priority Interrupt, Direct memory access, Input-Output Processor (IOP), Serial Communication.

UNIT V

Memory Organization: Memory Hierarchy, Main memory, Auxiliary memory, Associate Memory, Cache Memory, and Virtual memory, Memory Management Hardware.

TEXT BOOKS:

1. Computer System Architecture, M. Morris Mano, Prentice Hall of India Pvt. Ltd., 3 rd Edition, Sept. 2008.

REFERENCE BOOKS:

1. Computer Architecture and Organization, William Stallings, PHI Pvt. Ltd., Eastern Economy Edition, Sixth Edition, 2003.

2. Computer Organization and Architecture, Linda Null, Julia Lobur, Narosa Publications ISBN 81- 7319-609-5

3. Computer System Organization by John. P. Hayes.

OPTIMIZATION TECHNIQUES
(Professional Elective-I)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To know the importance of adopting optimization techniques in day to day life.
- To analyse the importance of various types of constraints at various stages.
- To learn more on linear & nonlinear programming concepts.
- To analyse the significance of transportation problem.
- To learn the concepts of dynamic programming.

Course Outcomes

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

CO1	State and formulate the optimization problem without and with constraints, also apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints and arrive at an optimal solution.
CO2	Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
CO3	Formulate a mathematical model and apply non-linear programming techniques for unconstrained and constrained case studies.
CO4	Solve transportation and assignment problem by using Linear programming Simplex method.
CO5	Formulate Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.
CO6	Apply Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Introduction to Optimization Techniques Statement of an Optimization problem – design vector – design constraints – objective function – classification of Optimization problems.

Classical Optimization Techniques Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers.

UNIT II

Linear Programming Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

UNIT III

Nonlinear Programming

Unconstrained cases - One – dimensional minimization methods: Classification - Fibonacci method and Quadratic interpolation method - Univariate method - Powell's method.

Constrained cases - Characteristics of a constrained problem - Classification - Basic approach of Penalty Function method.

UNIT IV

Transportation Problem Finding initial basic feasible solution by north – west corner rule - least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems – Special cases in transportation problem

UNIT V

Dynamic Programming Dynamic programming - Multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution

TEXT BOOKS:

Text Books: 1. "Engineering optimization: Theory and practice"-by S. S.Rao- New Age International (P) Limited - 3rd edition - 1998.

2. "Introductory Operations Research" by H.S. Kasene& K.D. Kumar - Springer (India) 2013.

REFERENCE BOOKS:

1. "Optimization Methods in Operations Research and systems Analysis" – by K.V. Mital and C. Mohan - New Age International (P) Limited - Publishers - 3 rd edition - 1996.

2. Operations Research – by Dr. S.D.Sharma- Kedarnath - Ramnath& Co - 2012.

3. "Operations Research: An Introduction" – by H.A.Taha - PHI pvt. Ltd. - 6th edition

4. Linear Programming–by G.Hadley.

OBJECT ORIENTED PROGRAMMING THROUGH JAVA
(Professional Elective-I)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- Implementing programs for user interface and application development using core java principles

Course Outcomes

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

CO1	Discuss and understand java programming constructs.
CO2	Discuss and understand Control structures
CO3	Illustrate and experiment Object Oriented Concepts like classes, objects
CO4	Apply Object Oriented Constructs such as Inheritance, interfaces, and exception handling
CO5	Construct applications using multithreading and I/O
CO6	Develop Dynamic User Interfaces using applets and Event Handling in java

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Focus on object oriented concepts and java program structure and its installation, Introduction to OOP Introduction, Need of Object Oriented Programming, Principles of Object Oriented Languages, Procedural languages Vs OOP, Applications of OOP, History of JAVA, Java Virtual Machine, Java Features.

UNIT II

Comprehension of java programming constructs, control structures in Java Programming Constructs Variables , Primitive Datatypes, Identifiers- Naming Conventions, Keywords, Literals, Operators-Binary, Unary and ternary, Expressions, Precedence rules and Associativity, Primitive Type Conversion and Casting, Flow of control Branching, Conditional, loops.,

UNIT III
Classes and Objects- classes, Objects, Creating Objects, Methods, constructors, Constructor overloading, cleaning up unused objects-Garbage collector, Class variable and Methods-Static keyword, this keyword, Arrays, Command line arguments Interfaces and exception handling Inheritance: Types of Inheritance, Deriving classes using extends keyword, Method overloading, super keyword, final keyword, Abstract class Interfaces,
UNIT IV
Understanding of Thread concepts and I/O in Java MultiThreading: java.lang.Thread, The main Thread, Creation of new threads, Thread priority, Multithreading- Using isAlive() and join(), Syncronization, suspending and Resuming threads, Communication between Threads.
UNIT V
Being able to build dynamic user interfaces using applets and Event handling in java Swing: Introduction, javax.swing package , JFrame, JApplet, JPanel, Components in swings, Layout Managers, JList and JScroll Pane, Split Pane, JTabbedPane, Dialog Box.
TEXT BOOKS:
1. The Complete Refernce Java, 8ed, Herbert Schildt, TMH 2. Programming in JAVA, Sachin Malhotra, Saurabh choudhary, Oxford.
REFERENCE BOOKS:
1. JAVA Programming, K.Rajkumar.Pearson 2. Core JAVA, Black Book, Nageswara Rao, Wiley, Dream Tech 3. JAVA for Beginners, 4e, Joyce Farrell, Ankit R. Bhavsar, Cengage Learning. . Object oriented programming with JAVA, Essentials and Applications, Raj Kumar Bhuyya, Selvi, Chu TMH 5. Introduction to Java programming, 7th ed, Y Daniel Liang, Pearson Core JAVA for Beginners, Rashmi Kanta Das, Vikas. 6. Object Oriented Programming through JAVA , P Radha Krishna , University Press

CONTROL SYSTEMS LAB

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Course Objectives:

- To impart hands on experience to understand the performance of basic control system components such as magnetic amplifiers
- To understand time and frequency responses of control system with and without controllers and compensators.

List of Experiments

(Any 10 of the following experiments are to be conducted)

1. Time response of Second order system
2. Characteristics of Synchros
3. Effect of P, PD, PI, PID Controller on a second order systems
4. Design of Lag and lead compensation – Magnitude and phase plot
5. Transfer function of DC motor
6. Bode Plot, Root locus, Nyquist Plots for the transfer functions of systems up to 5th order using MATLAB.
7. Controllability and Observability Test using MAT LAB.
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor
11. Characteristics of DC servo motor
12. To study and verify the truth table of logic gates and simple Boolean expressions using PLC.

POWER ELECTRONICS LAB

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Course Objectives:

- To learn the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
- To analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
- To understand the operation of AC voltage regulator with resistive and inductive loads.
- To understand the working of Buck converter and Boost converter.
- To understand the working of single-phase & three-phase inverters.

List of Experiments

(Any 10 of the following experiments are to be conducted)

1. Characteristics of SCR - Power MOSFET & Power IGBT.
2. R - RC & UJT firing circuits for SCR.
3. Single -Phase semi-converter with R & RL loads.
4. Single -Phase full-converter with R & RL loads.
5. Three- Phase full-converter with R & RL loads.
6. Single-phase dual converter in circulating current & non circulating current mode of operation.
7. Single-Phase AC Voltage Regulator with R & RL Loads.
8. Single-phase step down Cycloconverter with R & RL Loads.
9. Boost converter in Continuous Conduction Mode operation.
10. Buck converter in Continuous Conduction Mode operation.
11. Single -Phase square wave bridge inverter with R & RL Loads.
12. Single - Phase PWM inverter.
13. Three-phase bridge inverter with 1200 and 1800 conduction mode
14. SPWM control of Three-phase bridge inverter

ANALYSIS OF LINEAR SYSTEMS

(Minors Engineering Course)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To formulate state equation for electrical networks and analysis simple networks with statevariable approach
- To analyze the signals applied to electrical networks and theorems.
- To examine the applications of Fourier series, Fourier transform to simple circuits.
- To know the distinction between Laplace, Fourier and Z-Transforms.
- To evaluate testing of polynomials and network synthesis of LC, RC and RL networks.

Course Outcomes

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

CO1	Solve problems involving continuous time signals and linear systems
CO2	Use the Laplace transform to analyse signals, linear circuits and systems.
CO3	Use the Fourier series and transform to analyse signals.
CO4	Solve problems involving discrete time signals and linear systems.
CO5	illustrate testing of polynomials
CO6	illustrate network synthesis of LC, RC and RL networks.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I

State Variable Analysis

Choice of state variables in Electrical networks-Formulation of state equations for Electrical networks-Equivalent source method. Network topological method - Solution of state equations-Analysis of simple networks with state variable approach

UNIT II

Laplace Transform Applications

Application of Laplace transform methods of analysis:
Response of RL, RC and RLC networks to step, ramp, pulse and impulse functions, shifting and scaling theorems-Laplace transform of periodic functions-Convolution theorem-Convolution integral- Applications.

UNIT III

Application of Fourier Series and Fourier Transform

Fourier Series: RMS, average value of a non-sinusoidal periodic wave form-Expression for power with non sinusoidal voltage and current-Power factor-Effect of harmonics-Analysis of simple circuits with non-sinusoidal inputs.
Fourier Transform: Representation of non-periodic functions-Fourier integral-Fourier transform- Graphical Representation-Properties of Fourier transforms-Parseval's theorem-Fourier transform of constant, unit step, unit impulse, unit ramp signals and exponential functions-relationship with Laplace transform

UNIT IV

Z-Transforms

Fundamental difference between continuous and discrete time signals, discrete time complex, exponential and sinusoidal signals, periodicity of discrete time complex exponential, concept of Z-Transform of a discrete sequence. Distinction between Laplace, Fourier and Z-Transforms. Region of convergence in Z- Transforms, constraints on ROC for various classes of signals, Inverse Z-Transform properties of Z- Transforms.

UNIT V

Testing of Polynomials and Network synthesis:

Elements of reliability-Hurwitz polynomials-positive real functions-Properties-Testing-Sturm's Test,examples.

Network synthesis:

Synthesis of one port LC networks-Foster and Cauer methods-Synthesis of RL and RC one port networks-Foster and Cauer methods.

TEXT BOOKS:

1.Signals, Systems and Communications by B.P. Lathi, BS Publications 2003.
2.Network Analysis and Synthesis – B C Kuo
3.Network Analysis and Synthesis – Umesh Sinha- Satya Prakashan Publicatio

REFERENCE BOOKS:

1.Linear System Analysis – A N Sripathi, New Age International
2.Network and Systems – D Roy Chowdhary, New Age International
3.Engineering Network Analysis and Filter Desgin- Gopal G Bhise & Um

ENERGY AUDITING, CONSERVATION AND MANAGEMENT

(Minors Engineering Course)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To understand basic concepts of Energy Audit & various Energy conservation schemes..
- To design energy an energy management program.
- To understand concept of Energy Efficient Motors and lighting control efficiencies.
- To estimate/calculate power factor of systems and propose suitable compensation techniques.
- To calculate life cycle costing analysis and return on investment on energy efficient technologies.

Course Outcomes

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

CO1	Understand the principles of energy audit along with various Energy related terminologies.
CO2	Asses the role of Energy Manager and Energy Management program.
CO3	Design a energy efficient motors and good lighting system.
CO4	Analyse the methods to improve the power factor
CO5	Evaluate the computational techniques with regard to economic aspects
CO6	identify the energy instruments for variousreal time applications.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I

Basic Principles of Energy Audit

Energy audit- definitions - concept - types of audit - energy index - cost index - pie charts - Sankey diagrams and load profiles - Energy conservation schemes- Energy audit of industries- energy saving potential - energy audit of process industry - thermal power station - building energy audit - Conservation of Energy Building Codes (ECBC-2017) -

UNIT II

Energy Management

Principles of energy management - organizing energy management program - initiating - planning - controlling - promoting - monitoring - reporting. Energy manager - qualities and functions - language- Questionnaire – check list for top management

UNIT III

Energy Efficient Motors and Lighting

Energy efficient motors - factors affecting efficiency - loss distribution - constructional details - characteristics – variable speed - RMS - voltage variation-voltage unbalance-over motoring-motorenergy audit. lighting system design and practice - lighting control - lighting energy audit

UNIT IV

Power Factor Improvement And Energy Instruments

Power factor – methods of improvement - location of capacitors - Power factor with non-linear loads -effect of harmonics on p.f - p.f motor controllers – Energy Instruments- watt meter - data loggers - thermocouples - pyrometers - lux meters - tongue test

UNIT V

Economic Aspects and Their Computation

Economics Analysis depreciation Methods - time value of money - rate of return - present worth method - replacement analysis - lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method - net present value method- Power factor correction - lighting – Applications of life cycle costing analysis - return on investment

TEXT BOOKS:

1.Energy management by W.R.Murphy&G.Mckay Butter worth - Heinemann publications - 1982.
2.Energy management hand book by W.CTurner - John wiley and sons - 1982.

REFERENCE BOOKS:

1.Energy efficient electric motors by John.C.Andreas - Marcel Dekker Inc Ltd-2nd edition - 1995
2.Energy management by Paul o' Callaghan - Mc-graw Hill Book company-1st edition – 1998
3.Energy management and good lighting practice : fuel efficiency- booklet12-EEO

SUMMER INTERNSHIP

Lecture – Tutorial:	-	**Internal Marks:**	30
Credits:	1.5	**External Marks:**	70
Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester			

MICROPROCESSORS AND MICROCONTROLLERS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To understand the organization and architecture of Microprocessor
- To understand addressing modes to access memory
- To understand 8051 micro controller architecture
- To understand the programming principles for 8086 and 8051
- To understand the interfacing of Microprocessor with I/O as well as other devices
- To understand how to develop cyber physical systems

Course Outcomes

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

CO1	Know the concepts of the Microprocessor capability in general and explore the evaluation of microprocessors.
CO2	Analyse the instruction sets - addressing modes - minimum and maximum modes operations of 8086 Microprocessors
CO3	Analyse the Microcontroller and interfacing capability
CO4	Describe the architecture and interfacing of 8051 controller
CO5	Know the concepts of PIC micro controller
CO6	Know the concepts of PIC micro controller programming.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Introduction to Microprocessor Architecture Introduction and evolution of Microprocessors – Architecture of 8086 – Memory Organization of 8086 – Register Organization of 8086– Introduction to 80286

UNIT II

Minimum and Maximum Mode Operations Instruction sets of 8086 - Addressing modes – Assembler directives - General bus operation of 8086 – Minimum and Maximum mode operations of 8086 – 8086 Control signal interfacing – Read and write cycle timing diagrams.

UNIT III
Microprocessors I/O interfacing 8255 PPI– Architecture of 8255–Modes of operation– Interfacing I/O devices to 8086 using 8255– Interfacing A to D converters– Interfacing D to A converters– Stepper motor interfacing– Static memory interfacing with 8086. Architecture and interfacing of 8251 USART – Architecture and interfacing of DMA controller (8257).
UNIT IV
8051 Microcontroller Overview of 8051 Microcontroller – Architecture– Memory Organization – Register set – I/O ports and Interrupts – Timers and Counters – Serial Communication – Interfacing of peripherals
UNIT V
PIC Architecture Block diagram of basic PIC 18 micro controller – registers I/O ports – Programming in C for PIC: Data types - I/O programming - logical operations - data conversion.
TEXT BOOKS:
1. Ray and Burchandi - "Advanced Microprocessors and Interfacing" - Tata McGraw–Hill - 3 rd edition - 2006. 2. Kenneth J Ayala - "The 8051 Microcontroller Architecture - Programming and Applications" - Thomson Publishers - 2nd Edition. 3. PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18 - - Muhammad Ali Mazidi - RolindD.Mckinay - Danny causey -Pearson Publisher 21st Impression.
REFERENCE BOOKS:
1. Microprocessors and Interfacing - Douglas V Hall - Mc–Graw Hill - 2 nd Edition. 2. R.S. Kaler - "A Text book of Microprocessors and Micro Controllers" - I.K. International Publishing House Pvt. Ltd. 3. Ajay V. Deshmukh - "Microcontrollers – Theory and Applications" - Tata McGraw–Hill Companies –2005. 4. Ajit Pal - "Microcontrollers – Principles and Applications" - PHI Learning Pvt Ltd - 2011.

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To understand and analyze the factors that effect the various measuring units.
- To choose the appropriate meters for measuring of voltage, current, power, power factor and energy qualities & understand the concept of standardization.
- Describe the operating principle of AC & DC bridges for measurement of resistance, inductance and capacitance.
- To understand the concept of the transducer and their effectiveness in converting from one form to the other form for the ease of calculating and measuring purposes.
- To understand the operating principles of basic building blocks of digital systems, record and display units.

Course Outcomes

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

CO1	Know the construction and working of various types of analog instruments.
CO2	Describe the construction and working of wattmeter and power factor meters
CO3	Know the construction and working various bridges for the measurement resistance - inductance and capacitance
CO4	Know the operational concepts of various transducers
CO5	Know the construction of digital meters
CO6	Know the operation of digital meters

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Analog Ammeter and Voltmeters Classification – deflecting - control and damping torques - – PMMC - moving iron type and electrostatic instruments - Construction - Torque equation - Range extension - Errors and compensations - advantages and disadvantages. Instrument transformers: Current Transformer and Potential Transformer-construction - theory - errors-Numerical Problems.

UNIT II

Analog Wattmeters and Power Factor Meters Electrodynamometer type wattmeter (LPF

and UPF) - Power factor meters: Dynamometer and M.I type (Single phase and Three phase) - Construction - theory - torque equation - advantages and disadvantages.

Potentiometers: Introduction to DC and AC Potentiometers – Construction-working – Applications - Numerical Problems.

UNIT III

Measurements of Electrical parameters

DC Bridges: Method of measuring low - medium and high resistance - sensitivity of Wheat stone's bridge - Kelvin's double bridge for measuring low resistance - Loss of charge method for measurement of high resistance - Megger – measurement of earth resistance - Numerical Problems.

AC Bridges: Measurement of inductance and quality factor - - Maxwell's bridge - - Hay's bridge - - Anderson's bridge. Measurement of capacitance and loss angle - - Desauty's bridge - Schering Bridge - Wien's bridge - Wagner's earthing device - - Numerical Problems.

UNIT IV

Transducers Definition - Classification - Resistive - Inductive and Capacitive Transducer - LVDT - Strain Gauge - Thermistors - Thermocouples - Piezo electric and Photo Diode Transducers - Hall effect sensorsNumerical Problems.

UNIT V

Digital meters Digital Voltmeters – Successive approximation DVM - Ramp type DVM and Integrating type DVM – Digital frequency meter - Digital multimeter - Digital tachometer - Digital Energy Meter - Q meter - Power Analyzer. CRO- measurement of phase difference & Frequency using lissajious patterns - Numerical Problems.

TEXT BOOKS:

1. Electrical Measurements and measuring Instruments by E.W. Golding and F.C.Widdis - 5 th Edition - Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques by A.D. Helfrick and W.D. Cooper - PHI - 5 th Edition - 2002.

REFERENCE BOOKS:

1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co. Publications - 19th revised edition - 2011.
2. Electrical and Electronic Measurements and instrumentation by R.K.Rajput - S.Chand - 3 rd edition.
3. Electrical Measurements by Buckingham and Price - Prentice – Hall 4. Electrical Measurements by Forest K. Harris. John Wiley and Sons

POWER SYSTEM ANALYSIS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To develop the impedance diagram (p.u) and formation of Ybus
- To learn the different load flow methods.
- To learn the Zbus building algorithm.
- To learn short circuit calculation for symmetrical faults
- To learn the effect of unsymmetrical faults and their effects.
- To learn the stability of power systems and method to improve stability

Course Outcomes

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

CO1	Draw impedance diagram for a power system network and calculate per unit quantities.
CO2	Apply the load flow solution to a power system using different methods.
CO3	Form Zbus for a power system networks and analyse the effect of symmetrical faults.
CO4	Find the sequence components for power system Components
CO5	Analyse the effects of unsymmetrical faults.
CO6	Analyse the stability concepts of a power system.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Circuit Topology & Per Unit Representation Graph theory definition – Formation of element node incidence and bus incidence matrices – Primitive network representation – Formation of Ybus matrix by singular transformation and direct inspection methods – Per Unit Quantities–Single line diagram – Impedance diagram of a power system – Numerical Problems.

UNIT II

Power Flow Studies Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form) – Decoupled and Fast Decoupled methods – Algorithmic approach – Numerical Problems on 3–bus system only.

UNIT III

Z-Bus Algorithm & Symmetrical Fault Analysis Formation of Zbus: Algorithm for the Modification of Zbus Matrix (without mutual impedance) – Numerical Problems.

Symmetrical Fault Analysis: Reactance's of Synchronous Machine – Three Phase Short Circuit Currents - Short circuit MVA calculations for Power Systems – Numerical Problems.

UNIT IV

Symmetrical Components Definition of symmetrical components – symmetrical components of unbalanced three phase systems – Power in symmetrical components – Sequence impedances and Sequence networks: Synchronous generator – Transmission line and transformers – Numerical Problems.

Unsymmetrical Fault analysis Various types of faults: LG– LL– LLG and LLL on unloaded alternator-Numerical problems.

UNIT V

Power System Stability Analysis Elementary concepts of Steady state – Dynamic and Transient Stabilities – Swing equation – Steady state stability – Equal area criterion of stability – Applications of Equal area criterion – Factors affecting transient stability – Methods to improve steady state and transient stability – Numerical problems.

TEXT BOOKS:

1. Power System Analysis by Grainger and Stevenson - Tata McGraw Hill.2003
2. Modern Power system Analysis – by I.J.Nagrath & D .P.Kothari: Tata McGraw–Hill Publishing Company - 3 rd edition - 2007.

REFERENCE BOOKS:

1. Power System Analysis – by A.R.Bergen - Prentice Hall - 2 nd edition - 2009.
2. Power System Analysis by HadiSaadat – Tata McGraw–Hill 3rd edition - 2010.
3. Power System Analysis by B.R.Gupta - A H Wheeler Publishing Company Limited - 1998.
4. Power System Analysis and Design by J.Duncan Glover - M.S.Sarma - T.J.Overbye – Cengage Learning publications - 5 th edition - 2011.

SIGNALS AND SYSTEMS
(Professional Elective-II)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- This gives the basics of signals and systems required for all electrical engineering related courses.
- To understand the behavior of signal in time and frequency domain.
- To understand the characteristics of Linear Time Invariant (LTI) systems.
- Concepts of the correlation and sampling process.
- This give concepts of signals and Systems along with its analysis using different transform• techniques.

Course Outcomes

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

CO1	Apply the knowledge of various signals and operations.
CO2	Analyze the spectral characteristics of periodic signals using Fourier Analysis.
CO3	Classify the systems based on their properties and determine the response of LSI system using convolution.
CO4	Understand the process of sampling and the effects of under sampling.
CO5	Apply Laplace and z-transforms to analyze signals and Systems (continuous).
CO6	Apply Laplace and z-transforms to analyze signals and Systems (discrete).

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Introduction Definition of Signals and Systems - Classification of Signals - Classification of Systems - Operations on signals: time-shifting - time-scaling - amplitude-shifting - amplitude-scaling. Problems on classification and characteristics of Signals and Systems. Complex exponential and sinusoidal signals - Singularity functions and related functions: impulse function - step function signum function and ramp function. Analogy between vectors and signals - orthogonal signal space - Signal approximation using orthogonal functions - Mean square error - closed or complete set of orthogonal functions - Orthogonally in complex functions. Related Problems.

UNIT II

Fourier Series And Fourier Transform Fourier series representation of continuous time periodic signals - properties of Fourier series - Dirichlet's conditions - Trigonometric Fourier series and Exponential Fourier series - Relation between Trigonometric and Exponential Fourier series - Complex Fourier spectrum. Deriving Fourier transform from Fourier series - Fourier transform of arbitrary signal - Fourier transform of standard signals - Fourier transform of periodic signals - properties of Fourier transforms - Fourier transforms involving impulse function and Signum function. Introduction to Hilbert Transform. Related Problems

UNIT III

Analysis of Linear Systems Introduction - Linear system - impulse response - Response of a linear system - Linear time invariant (LTI) system - Linear time variant (LTV) system - Concept of convolution in time domain and frequency domain - Graphical representation of convolution - Transfer function of a LTI system - Related problems. Filter characteristics of linear systems. Distortion less transmission through a system - Signal bandwidth - system bandwidth - Ideal LPF - HPF and BPF characteristics - Causality and PolyWiener criterion for physical realization - relationship between bandwidth and rise time.

UNIT IV

Correlation Auto-correlation and cross-correlation of functions - properties of correlation function - Energy density spectrum - Parseval's theorem - Power density spectrum - Relation between Convolution and correlation - Detection of periodic signals in the presence of noise by correlation - Extraction of signal from noise by filtering.

Sampling Theorem Graphical and analytical proof for Band Limited Signals - impulse sampling - Natural and Flat top Sampling - Reconstruction of signal from its samples - effect of under sampling – Aliasing - Introduction to Band Pass sampling - Related problems.

UNIT V

Laplace Transforms Introduction - Concept of region of convergence (ROC) for Laplace transforms - constraints on ROC for various classes of signals - Properties of L.T's - Inverse Laplace transform - Relation between L.T's - and F.T. of a signal. Laplace transform of certain signals using waveform synthesis.

Z–Transforms Concept of Z- Transform of a discrete sequence. Region of convergence in Z-Transform - constraints on ROC for various classes of signals - Inverse Z-transform - properties of Z-transforms. Distinction between Laplace - Fourier and Z transforms.

TEXT BOOKS:

1. Signals - Systems & Communications - B.P. Lathi - BS Publications - 2003.
2. Signals and Systems - A.V. Oppenheim - A.S. Willsky and S.H. Nawab - PHI - 2nd Edition1997 3. Signals & Systems - Simon Haykin and Van Veen - Wiley - 2nd Edition – 2007

REFERENCE BOOKS:

1. Principles of Linear Systems and Signals – BP Lathi - Oxford University Press – 2015
2. Signals and Systems – T K Rawat - Oxford University press - 2011.

ELECTRIC DRIVES
(Professional Elective-II)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To learn the fundamentals of electric drive and different electric braking methods.
- To analyze the operation of three phase converter controlled dc motors and four quadrant operation of dc motors using dual converters.
- To discuss the DC-DCconverter control of dc motors.
- To understand the concept of speed control of induction motor by using AC voltage controllers, voltage source inverters and slip power recovery scheme.
- To learn the speed control mechanism of synchronous motors

Course Outcomes

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

CO1	Explain the fundamentals of electric drive and different electric braking methods.
CO2	Analyze the operation of three-phase converter fed dc motors of dc motors using dual converters.
CO3	Analyze the operation four quadrant operations of dc motors using dual converters.
CO4	Describe the DC-DC converter fed control of dc motors in various quadrants of operation
CO5	Know the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters and differentiate the stator side control and rotor side control
CO6	Learn the concepts of speed control of synchronous motor with different methods.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2									1	
CO2	3	3	1	1							1	
CO3	3	3	1	1							1	
CO4	3	3	1	1							1	
CO5	3	3	1								1	
CO6	3	3	1								1	

UNIT I

Fundamentals of Electric Drives Electric drive and its components– Fundamental torque equation – Load torque components – Nature and classification of load torques – Steady state stability – Load equalization– Four quadrant operation of drive (hoist control) – Braking methods: Dynamic – Plugging – Regenerative methods.

UNIT II

Controlled Converter Fed DC Motor Drives 3-phase half and fully-controlled converter fed separately and self-excited DC motor drive – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics – Dual converter fed DC motor drives -Numerical problems.

UNIT III

DC–DC Converters Fed DC Motor Drives Single quadrant, two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous current mode of operation - Output voltage and current waveforms – Speed– torque expressions and characteristics – Closed loop operation (qualitative treatment only).

UNIT IV

Stator and Rotor side control of 3-phase Induction motor Drive Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop V/f control of induction motor drives (qualitative treatment only). Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics.

UNIT V

Control of Synchronous Motor Drives Separate control of synchronous motor – self-control of synchronous motor employing load commutated thyristor inverter - closed loop control of synchronous motor drive (qualitative treatment only)– PMSM (Basic operation only).

TEXT BOOKS:

1. Fundamentals of Electric Drives – by G K Dubey - Narosa Publications - 2 nd edition – 2002.

2. Power Semiconductor Drives - by S.B.Dewan - G.R.Slemon - A.Straughen - Wiley India - 1984.

REFERENCE BOOKS:

1. Electric Motors and Drives Fundamentals - Types and Apllications - by Austin Hughes and Bill Drury - Newnes.4th edition - 2013.

2. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publications - 1987. 3. Power Electronic Circuits - Devices and applications by M.H.Rashid - PHI - 3 rd edition - 2009.

ADVANCED CONTROL SYSTEMS
(Professional Elective-II)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To familiarize the state space representation in controllable, observable, diagonal and Jordan canonical forms.
- Introduce the concept of controllability and observability tests through canonical forms and design of state feedback controller by pole placement technique and State Observer design.
- Analysis of a nonlinear system using describing function approach.
- Illustrate the Lypanov's method of stability analysis for linear and non-linear continuous time autonomous systems.
- Formulation of Euler Laugrange equation for the optimization of typical functional and solutions.

Course Outcomes

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

CO1	Analyse different canonical forms - solution of State equation.
CO2	Design of control system using the pole placement technique is given after introducing the concept of controllability and observability.
CO3	Analyze nonlinear system using describing function technique and phase plane analysis.
CO4	Examine the stability analysis using Lyapunov method
CO5	Illustrate the Minimization of functional using calculus of variation - state problems.
CO6	Illustrate the Minimization of functional using quadratic regulator problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

State Space Analysis State Space Representation – Canonical forms – Controllable canonical form – Observable canonical form - Jordan Canonical Form - Solution of state equation – State transition matrix.

UNIT II

Controllability - Observability and Design of Pole Placement Tests for controllability and observability for continuous time systems – Time varying case – Minimum energy control – Time invariant case – Principle of duality – Controllability and observability form Jordan canonical form and other canonical forms – Effect of state feedback on controllability and observability – Design of state feedback control through pole placement.

UNIT III

Nonlinear Systems Introduction to nonlinear systems - Types of nonlinearities. Introduction to phase–plane analysis - Singular points; Describing function - basic concepts - Describing functions of non- linearities.

UNIT IV

Stability analysis by Lyapunov Method Stability in the sense of Lyapunov – Lyapunov's stability and Lyapunov's instability theorems – Direct method of Lyapunov for the linear and nonlinear continuous time autonomous systems.

UNIT V

Calculus of Variations Minimization of functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints –Euler lagrangine equation.

TEXT BOOKS:

1. Modern Control Engineering – by K. Ogata - Prentice Hall of India - 3rd edition - 1998.
2. Automatic Control Systems by B.C. Kuo - Prentice Hall Publication.

REFERENCE BOOKS:

1. Modern Control System Theory – by M. Gopal - New Age International Publishers - 2nd edition - 1996
2. Control Systems Engineering by I.J. Nagarath and M.Gopal - New Age International (P) Ltd. 3. Digital Control and State Variable Methods – by M. Gopal - Tata Mc Graw–Hill Companies - 1997. 4. Systems and Control by Stainslaw H. Zak - Oxford Press - 2003. 5. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.

SWITCH GEAR AND PROTECTION
(Professional Elective-II)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To provide the basic principles and operation of various types of circuit breakers.
- To know the classification, operation and application of different types of electromagnetic protective relays. To explain protective schemes for generator and transformers.
- To gain the knowledge of various protective schemes used for feeders and bus bars.
- To explain the principle and operation of different types of static relays.
- To understand different types of over voltages in a power system and principles of different neutral grounding methods.

Course Outcomes

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

CO1	Illustrate the principles of arc interruption for application to high voltage circuit breakers of air - oil - vacuum - SF6 gas type.
CO2	Analyse the working principle and operation of different types of electromagnetic protective relays.
CO3	Acquire knowledge of protective schemes for generator and transformers for different fault conditions.
CO4	Classify various types of protective schemes used for feeders
CO5	Classify various types of protective schemes used for bus bar protection and Types of static relays.
CO6	Analyse the operation of different types of over voltages protective schemes required for insulation co–ordination and types of neutral grounding.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Circuit Breakers Application oriented evolution of Switchgear - Miniature Circuit Breaker(MCB)– Elementary principles of arc interruption– Restriking Voltage and Recovery voltages– Restriking phenomenon - RRRV– Average and Max. RRRV– Current chopping and Resistance switching– Concept of oil circuit breakers– Description and operation of Air

Blast– Vacuum and SF6 circuit breakers– Circuit Breaker ratings and specifications– Concept of Auto reclosing – Application Spectrum Numerical examples

UNIT II

Electromagnetic Protection Relay connection – Balanced beam type attracted armature relay - induction disc and induction cup relays–Torque equation - Relays classification– Instantaneous– DMT and IDMT types– Applications of relays: Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison.

UNIT III

Generator Protection Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth fault and inter turn fault protection– Numerical examples.

Transformer Protection Percentage differential protection– Design of CT's ratio– Buchholz relay protection–Numerical examples.

UNIT IV

Feeder and Bus bar Protection & Static Relays: Over current Protection schemes – PSM - TMS – Numerical examples – Carrier current and three zone distance relay using impedance relays.

Protection of bus bars by using Differential protection. Static relays: Introduction – Classification of Static Relays – Basic Components of Static Relays.

UNIT V

Protection against over voltage and grounding Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc oxide lighting arresters.

Grounded and ungrounded neutral systems – Effects of ungrounded neutral on system performance – Methods of neutral grounding: Solid–resistance–Reactance–Arcing grounds and grounding Practices.

TEXT BOOKS:

1. Power System Protection and Switchgear by Badri Ram and D.N Viswakarma - Tata McGraw Hill Publications - 2 nd edition - 2011.

2. Power system protection- Static Relays with microprocessor applications by T.S.Madhava Rao - Tata McGraw Hill - 2 nd edition.

REFERENCE BOOKS:

1. Fundamentals of Power System Protection by Paithankar and S.R.Bhide. - PHI - 2003.

2. Art & Science of Protective Relaying – by C R Mason - Wiley Eastern Ltd.

3. Protection and SwitchGear by BhaveshBhalja - R.P. Maheshwari - Nilesh G.Chothani - Oxford University Press - 2013.

BIG DATA ANALYTICS
(Professional Elective-II)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

Course Outcomes

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

CO1	Understand how to leverage the insights from big data analytics
CO2	Analyze data by utilizing various statistical approaches
CO3	Analyze data by utilizing various data mining approaches
CO4	perform analytics on real-time streaming data
CO5	Understand the various NoSql alternative database models
CO6	To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Introduction To Big Data Big Data, Definition, Characteristic Features, Big Data Applications, Big Data vs Traditional Data, Risks of Big Data, Structure of Big Data, Challenges of Conventional Systems, Web Data, Evolution of Analytic Scalability.

UNIT II

Hadoop Framework Distributed File Systems, Large-Scale File System Organization, HDFS concepts, Map Reduce Execution, Algorithms using Map Reduce, Hadoop YARN.

UNIT III

Data Analysis Statistical Methods: Regression modelling, Multivariate Analysis,

Classification: SVM & Kernel Methods, Rule Mining, Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Predictive Analytics, Data analysis using R.

UNIT IV

Mining Data Streams Streams: Concepts, Stream Data Model and Architecture, Sampling data in a stream, Mining Data Streams and Mining Time-series data, Real Time Analytics Platform (RTAP) Applications, Case Studies, Real Time Sentiment Analysis.

UNIT V

Big Data Frameworks Introduction to NoSQL, Aggregate Data Models, Hbase: Data Model and Implementations, Hbase Clients, Examples, Cassandra: Data Model, Examples, Cassandra Clients, Hadoop Integration.

TEXT BOOKS:

1. Big Java 4th Edition, Cay Horstmann, Wiley John Wiley & Sons, INC
2. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly
3. Hadoop in Action by Chuck Lam, MANNING Publ.

REFERENCE BOOKS:

1. Hadoop in Practice by Alex Holmes, MANNING Publ.
2. Hadoop MapReduce Cookbook, SrinathPerera, ThilinaGunarathne
3. Michael Berthold, David J. Hand, ―Intelligent Data Analysis‖, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley

BATTERY MANAGEMENT SYSTEMS AND CHARGING STATIONS
(Open Elective-II)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- Able to understand the working of different batteries for EV applications
- Able to know the fundamentals of battery charging methods and their advantages
- Able to know the different kinds of equipment in charging station
- Able to know the requirements of battery management.
- Able to know method of modelling batteries and their simulation studies.

Course Outcomes

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

CO1	Describe the construction of different batteries for EV applications
CO2	Describe the operation of different batteries for EV applications
CO3	Describe charging algorithms of different batteries and balancing methods of battery packs
CO4	Describe the different kinds of infrastructure needed in the charging stations
CO5	Describe the requirements of battery management and their maintenance.
CO6	Obtain the modelling of batteries and develop their simulation models.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

EV Batteries Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel. Lead Acid Batteries: Lead acid battery basics, special characteristics of lead acid batteries, battery life and maintenance, Li-ion batteries. Nickel-based Batteries: Nickel cadmium, Nickel metal hydride batteries.

Sodium-Based Batteries: Introduction, sodium sulphur batteries, sodium metal chloride (Zebra) batteries. Lithium Batteries: Introduction, the lithium polymer battery, lithium ion battery.

UNIT II

Battery charging strategies Charging algorithms for a single battery: Basic terms for charging performance evaluation and characterization, CC charging for NiCd/NiMH

batteries, CV charging for lead acid batteries, CC/CV charging for lead acid and Li-ion batteries, MSCC charging for lead acid, NiMH and Li-ion batteries, TSCC/CV charging for Li-ion batteries, CVCC/CV charging for Li-ion batteries, Pulse charging for lead acid, NiCd/NiMH and Li-ion batteries, Charging termination techniques, Comparisons of charging algorithms and new development; Balancing methods for battery pack charging: Battery sorting Overcharge for balancing, Passive balancing, Active balancing.

UNIT III

Charging Infrastructure Domestic Charging Infrastructure, Public charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.

UNIT IV

Battery-Management-System Requirements Battery-pack topology, BMS design requirements, Voltage sense, Temperature sense, Current sense, Contactor control, Isolation sense, Thermal control, Protection, Charger control, Communication via CAN bus, Log book, SOC estimation, Energy estimation, Power estimation, Diagnostics .

UNIT V

Battery Modelling General approach to modelling batteries, simulation model of rechargeable Li-ion battery, simulation model of a rechargeable NiCd battery, Parameterization of NiCd battery model, Simulation examples.

TEXT BOOKS:

1. Electric Vehicles Technology Explained by James Larminie Oxford Brookes University, Oxford, UK John Lowry Acenti Designs Ltd., Uk. (Unit-1)
2. Energy Systems for Electric and Hybrid Vehicles by K.T. Chau, IET Publications, First edition, 2016. (Unit-2)

REFERENCE BOOKS:

1. Modern Electric Vehicles Technology by C.C.Chan, K.T Chau, Oxford University Press Inc., New york , 2001. (Unit-3)
2. Battery Management Systems Vol. – II Equivalent Circuits and Methods, by Gregory L.Plett, Artech House publisher, First edition 2016. (Unit-4)
3. Battery Management Systems: design by Modelling by Henk Jan Bergveld, Wanda S. Kruijt, Springer Science & Business Media, 2002. (Unit-5)

FUNDAMENTALS OF UTILIZATION OF ELECTRICAL ENERGY
(Open Elective-II)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To study the various types of Illumination equipment, measurement of Illumination, Illumination techniques.
- To know the various technologies used for heating applications using electrical energy.
- To understand the various welding techniques and operations of welding equipment and comparison.
- To know the various systems of traction, equipment used for traction.
- To understand the importance and operation of various Energy storage systems and comparison & applications.

Course Outcomes

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

CO1	Know the concepts of illumination
CO2	Know the concepts of various illumination methods.
CO3	Know about the resistance - induction and dielectric heating.
CO4	Learn about the resistance and arc welding and welding equipment
CO5	Know about the mechanisms - equipment and technology used in the electric traction.
CO6	Differentiate the importance of various energy storage systems

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Illumination fundamentals Introduction - terms used in illumination–Laws of illumination–Lux meter–Sources of light.

Various Illumination Methods Tungsten filament lamps and fluorescent lamps - Comparison –Basic principles of light control– Types and design of lighting and flood lighting–LED lighting - Energy conservation.

UNIT II

Electric Heating Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

UNIT III

Electric Welding Electric welding–Resistance and arc welding–Electric welding equipment– Comparison between AC and DC Welding

UNIT IV

Electric Traction System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves. Calculations of tractive effort– power – Specific energy consumption for given run–Effect of varying acceleration and braking retardation– Adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

UNIT V

Introduction to Energy Storage Systems Need for energy storage - Types of energy storage-Thermal - electrical - magnetic and chemical storage systems - Comparison of energy storage technologies-Applications.

TEXT BOOKS:

1. Electrical Power Systems(Generation, Transmission, Distribution, Protecection and Utilization of Electrical Energy) – Dr. S.L.Uppal and Prof. Sunil S.Rao – Khanna Publisher, 15th edition, 1987.
2. Electric Power Distribution – A S Pabla – McGrawHill.

REFERENCE BOOKS:

1. Generation Distribution and Utilization of Electrical Energy – C.L.Wadhwa- New Age International Publishers- revised third edition.

INDIAN ELECTRICITY ACT
(Open Elective-II)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To acquire knowledge on national policy, plan and joint responsibilities of state and central governments.
- To understand the licensing procedures in transmission and distribution companies.
- To learn the regulatory body rules and protocols.
- To understand the offences and penalties related issues with respect to different tribunals.
- To learn the legal related issues and their resolutions.

Course Outcomes

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

CO1	Learn the national policy and plan and the joint responsibilities of state and central governments
CO2	Analyze the licensing and the provisions related to transmission and distribution of electricity.
CO3	Remember the composition and powers of Regulatory commissions and CEA.
CO4	Learn the functions of Appellate Tribunal for electricity
CO5	Know the constitution procedure in Special courts and dispute resolutions.
CO6	Know the constitution provisions in Special courts and dispute resolutions.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

National Electricity Policy and Plan - **Generation of Electricity** Electricity Act: commencement - definitions - comments; national policy on standalone systems - nonconventional energy systems - electrification and local distribution for rural areas; joint responsibilities of state and central governments in rural electrification - requirement for setting up of generating station - hydro-electric generation - captive generation; duties of generating companies.

UNIT II

Licensing -Transmission and Distribution Of Electricity Licensing: powers - procedures - conditions - amendments - revocation - provisions - directions - suspension and sale; inter-state and intra-state transmission; other provisions relating to transmission; provisions with respect to distribution licenses - electricity traders - supply generally; consumer protection: standard performance. Electrical Wiring, Estimation & Costing

UNIT III

Tariff - CEA and Regulatory Commissions Works of licenses - provisions relating to overhead lines; Constitution and functions of Central Electricity Authority (CEA) - directions and certain powers; Constitution - powers and functions of state and central commissions - other provisions - proceedings and powers of Appropriate commission - Grants - Fund - Accounts Audit and Report

UNIT IV

Appellate Tribunal - Reorganisation of Boards - Offences and Penalty Appellate Tribunal for electricity; investigation and assessment; reorganisation of boards; Offences and penalties.

UNIT V

Special Courts - Dispute Resolution - Other Provisions and Miscellaneous Constitution of special courts - procedures - powers - appeal - revision; arbitration; protective clauses; miscellaneous and enactments.

TEXT BOOKS:

1. The Electricity Act - 2003 {Act 36 of 2003 - dt.2-6-2003 - w.e.f. 10-6-2003 vide S.O. No. 669(E) - dt. 10-6-2003] published by Commercial Law Publishers (I) Pvt. Ltd.

REFERENCE BOOKS:

1. The Electricity Act - 2003 {Act 36 of 2003 - dt.2-6-2003 - w.e.f. 10-6-2003 vide S.O. No. 669(E) - dt. 10-6-2003] published by Commercial Law Publishers (I) Pvt. Ltd.

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Course Objectives:

- To understand students how different types of meters work and their construction.
- To make the students understand how to measure resistance, inductance and capacitance by AC & DC bridges.
- To understand the testing of CT and PT.
- to Understand and the characteristics of Thermo couples, LVDT, Capacitive transducer, piezoelectric transducer.
- To understand the measurement of strain and choke coil parameters.
- To study the procedure for standardization and calibration of various methods.

List of Experiments

(Any 10 of the following experiments are to be conducted)

1. Calibration of dynamometer wattmeter using phantom loading
2. Measurement of resistance using Kelvin's double Bridge and Determination of its tolerance.
3. Measurement of Capacitance using Schering Bridge.
4. Measurement of Inductance using Anderson Bridge.
5. Calibration of LPF Wattmeter by direct loading.
6. Measurement of 3 phase reactive power using single wattmeter method for a balanced load.
7. Testing of C.T. using mutual inductor – Measurement of % ratio error and phase angle of given C.T. by Null deflection method.
8. P.T. testing by comparison – V.G as Null detector – Measurement of % ratio error and phase angle of the given P.T.
9. Determination of the characteristics of a Thermocouple.
10. Determination of the characteristics of a LVDT.
11. Determination of the characteristics for a capacitive transducer.
12. Measurement of strain for a bridge strain gauge.

13. Measurement of Choke coil parameters and single phase power using three voltmeter and three ammeter methods.
14. Calibration of single phase Energy Meter.
15. Dielectric oil Test using HV Kit.
16. Calibration of DC ammeter and voltmeter using Crompton DC Potentiometer.
17. AC Potentiometer: Polar Form / Cartesian Form - Calibration of AC voltmeter - Parameters of choke.

MICROPROCESSORS AND MICROCONTROLLERS LAB

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Course Objectives:

- To study programming based on 8086 microprocessor and 8051 microcontroller.
- To study 8086 microprocessor based ALP using arithmetic, logical and shift operations.
- To study to interface 8086 with I/O and other devices.
- To study parallel and serial communication using 8051& PIC 18 micro controllers.

List of Experiments

(Any 10 of the following experiments are to be conducted)

8086 Microprocessor Programs:

1. Arithmetic operations – Two 16-bit numbers and multibyte addition - subtraction - multiplication and division – Signed and unsigned arithmetic operations - ASCII – Arithmetic operations.

2. Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD - BCD to ASCII conversion.

3. Arrange the given array in ascending and descending order 4. Determine the factorial of a given number

5. By using string operation and Instruction prefix: Move block - Reverse string Sorting - Inserting - Deleting - Length of the string - String comparison. 6. Find the first and nth number of 'n' natural numbers of a Fibonacci series.

7. Find the number and sum of even and odd numbers of a given array

8. Find the sum of 'n' natural numbers and squares of 'n' natural numbers

9. Arithmetic operations on 8051

10. Conversion of decimal number to hexa equivalent and hexa equivalent to decimal number

11. Find the Sum of elements in an array and also identify the largest & smallest number of a given array using 8051.

Programs on Interfacing:

12. Interfacing 8255–PPI with 8086.

13. Stepper motor control using 8253/8255.

14. Reading and Writing on a parallel port using 8051

15. Timer in different modes using 8051

16. Serial communication implementation using 8051

17. Understanding three memory areas of 00 – FF Using 8051 external interrupts.

18. Traffic Light Controller using 8051.

POWER SYSTEMS AND SIMULATION LAB

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Course Objectives:

- To study programming based on 8086 microprocessor and 8051 microcontroller.
- To study 8086 microprocessor based ALP using arithmetic, logical and shift operations.
- To study to interface 8086 with I/O and other devices.
- To study parallel and serial communication using 8051& PIC 18 micro controllers.

List of Experiments

Any of 5 experiments are to be conducted from each section:

Section I: Power Systems Lab:

1. Estimation of sequence impedances of 3-phase Transformer

2. Estimation of sequence impedances of 3-phase Alternator by Fault Analysis 3. Estimation of sequence impedances of 3-phase Alternator by Direct method

4. Estimation of ABCD parameters on transmission line model

5. Performance of long transmission line without compensation

6. Performance of long transmission line with shunt compensation

7. Analyze the Ferranti effect on long transmission line Section II: Simulation Lab

8.Determi nation of Ybus using direct inspection method

9.Load flow solution of a power system network using Gauss-Seidel method

10. Load flow solution of a power system network using Newton Raphson method.

11. Formation of Zbus by building algorithm.

12. Economic load dispatch with & without losses

13. Load frequency control of a two area Power System without & with PI controller

14. Transient Stability analysis of single machine connected to an infinite bus (SMIB) using equal area criterion.

SKILL ADVANCED COURSE: MACHINE LEARNING WITH PYTHON

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	15
Credits:	2	**External Marks:**	35
Course Objectives:			
➢ This course will enable students to learn and understand different Data sets in implementing the machine learning algorithms.			

Requirements: Develop the following program using Anaconda/ Jupiter/ Spider and evaluate ML models.

LIST OF EXPERIMENTS

1) Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

2) For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

3) Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

4) Exercises to solve the real-world problems using the following machine learning methods: a) Linear Regression b) Logistic Regression c) Binary Classifier

5) Develop a program for Bias, Variance, Remove duplicates , Cross Validation

6) Write a program to implement Categorical Encoding, One-hot Encoding

7) Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

8)Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.

9) Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

10)Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

11)Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

12) Exploratory Data Analysis for Classification using Pandas or Matplotlib.

13) Write a Python program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set

14) Write a program to Implement Support Vector Machines and Principle Component Analysis

15) Write a program to Implement Principle Component Analysis

RESEARCH METHODOLOGY

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	30
Credits:	0	**External Marks:**	70

Course Objectives:

- To understand the objectives and characteristics of a research problem.
- To analyze research related information and to follow research ethics
- To understand the types of intellectual property rights.
- To learn about the scope of patent rights.
- To understand the new developments in IPR.

Course Outcomes

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

CO1	Understand objectives of a research problem
CO2	Understand characteristics of a research problem
CO3	Analyze research related information and to follow research ethics.
CO4	Understand the types of intellectual property rights.
CO5	Learn about the scope of IPR.
CO6	Understand the new developments in IPR.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**	**1**	**1**							**1**	
CO3	**3**	**3**	**1**	**1**							**1**	
CO4	**3**	**3**	**1**	**1**							**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**								**1**	

UNIT I

Research problem: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II

Literature study: Effective literature studies approaches, analysis Plagiarism, Research ethics, Technical writing: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright.

Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc, Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

ext Books: 1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"

2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

REFERENCE BOOKS:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

2. Mayall, "Industrial Design", McGraw Hill, 1992.

3. Niebel, "Product Design", McGraw Hill, 1974.

4. Asimov, "Introduction to Design", Prentice Hall, 1962.

5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

DIGITAL CONTROL SYSTEMS
(Honors Engineering Course)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To understand the concepts of digital control systems and assemble various components associatedwith it. Advantages compared to the analog type.
- The theory of z–transformations and application for the mathematical analysis of digital control systems.
- To represent the discrete–time systems in state–space model and evaluation of state transition matrix, the design of state feedback control by "the pole placement method.", design of state observers.
- To examine the stability of the system using different tests and study the conventional method of analyzing digital control systems in the w–plane.
- Design of state feedback controller through pole placement.

Course Outcomes

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

CO1	Illustrate advantages of digital systems, sampling and data reconstruction.
CO2	Calculate Z Transform and Inverse Z Transfer function, pulse transfer functions of open andclosed loop response.
CO3	Construct various canonical forms and concepts of controllability and observability.
CO4	Compute the absolute and relative stability of discrete time systems using Routh Stabilitycriterion and Root Locus
CO5	Design lag and lead compensators to improve system performance using bode diagrams.
CO6	Design of state feedback controllers and state observers.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I

Introduction to Signal Processing

Introduction to analog and digital control systems – Advantages of digital systems – Typical examples – Continuous and Discrete Time Signals – Sample and hold devices – Sampling theorem and data reconstruction – Frequency domain characteristics of zero order hold.

UNIT II

Z–Transformations

Z–Transforms – Theorems – Finding inverse Z–transforms – Formulation of difference equations and solving – Block diagram representation – Pulse transfer functions and finding open loop and closed loop responses.

UNIT III

State Space Analysis and the Concepts of Controllability and Observability

State space representation of discrete time systems – Solving Discrete Time state space equations – State transition matrix and its properties – Discretization of continuous time state equations – Concepts of controllability and observability – Tests(without proof).

UNIT IV

Stability Analysis

Mapping between the S–Plane and the Z–Plane – Primary strips and Complementary strips – Stabilitycriterion – Modified Routh's stability criterion and Jury's stability test.

Design of Discrete–Time Control Systems By Conventional Methods

Transient and steady state specifications – Design using frequency response in the w–plane for lag andlead compensators – Root locus technique in the z–plane.

UNIT V

State Feedback Controllers and State Observers

Design of state feedback controller through pole placement – Necessary and sufficient conditions –Ackerman's formula – Design of state observers (Full Order and Reduced Order).

TEXT BOOKS:

1. Discrete–Time Control systems – K. Ogata - Pearson Education/PHI - 2nd Edition.
2. Digital Control and State Variable Methods by M.Gopal - TMH - 4th Edition.

REFERENCE BOOKS:

1. Digital Control Systems - Kuo - Oxford University Press - 2nd Edition - 2003.

ANALYSIS OF POWER ELECTRONIC CONVERTERS

(Honors Engineering Course)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To learn the characteristics of switching devices & functionality of gate drive circuits.
- To illustrate the working of AC-DC converters.
- To learn functionality of PWM inverters in controlling the voltage and mitigating the harmonics.
- To understand the basic concepts of multi-level inverters.
- To learn PWM control of CHB and diode clamped multi-level inverters

Course Outcomes

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

CO1	Describe and analyze the characteristics of Switching devices
CO2	Demonstrate the operation and perform harmonic analysis of AC-DC power converters
CO3	Analyze the operation of single-phase and three-phase inverters with PWM control.
CO4	Illustrate the principles of operation of multilevel inverters
CO5	PWM Control of CHB multilevel inverters
CO6	PWM Control of diode clamped multilevel inverters

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I

Overview of Switching Devices

Power MOSFET, IGBT, GTO -static and dynamic characteristics, gate drive circuits for switching devices.

UNIT II

AC-DC Converters

Single-phase fully-controlled converters with RL load– Continuous and Discontinuous load current operation-Evaluation of input power factor and harmonic factor Power factor improvements using extinction angle control, symmetrical angle control, PWM control. Three-Phase AC-DC fully-controlled Converters with RL load- Continuous and Discontinuous load current operation-Evaluation of input power factor and harmonic factor -three-phase dual converters.

UNIT III

PWM Inverters

Operation of single-phase inverters -Voltage control of single-phase inverters - phase displacement Control –Bipolar PWM – Unipolar PWM- staircase PWM. Voltage Control of Three-Phase Inverters- Sinusoidal PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques- Three phase current source inverters-Variable dc link inverter.

UNIT IV

Multilevel Inverters

Introduction, Multilevel Concept, Types of Multilevel Inverters- Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter- Flying-Capacitors Multilevel Inverter-Principle of Operation, Features of Flying-Capacitors Inverter- Cascaded H-bridge Multilevel Inverter, Principle of Operation, Features of Cascaded H-bridge Inverter- Comparisons of Multilevel inverters.

UNIT V

PWM Multilevel Inverters

CHB Multilevel Inverter: SHE PWM- Phase shifted PWM-Level shifted PWM- Diode clamped Multilevel inverter: SHE PWM-Sinusoidal PWM- Space vector PWM-Capacitor voltage balancing

TEXT BOOKS:

1. 1. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland,William P. Robbins, John Wiley& Sons, 2nd Edition, 2003.
2. Power Electronics-Md.H.Rashid –Pearson Education Third Edition- First IndianReprint-2008.
3. HIGH-POWER CONVERTERS AND AC DRIVES – Bin Wu, Wiley-IEEE Press, 2006.

REFERENCE BOOKS:

1. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
2. Power Converter Circuits – William Shepherd & Li Zhang-Yes Dee CRC Press, 2004.
3. Power Electronics Daniel W. Hart - McGraw-Hill, 2011.

HVDC TRANSMISSION

(Honors Engineering Course)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To analyse the operation of HVDC converters.
- To learn the principles of HVDC system control.
- To learn about converters faults and protection schemes of HVDC systems.
- To understand the requirements of reactive power control and filtering technique in HVDCsystem.
- To learn about MTDC systems and DC circuit breakers.

Course Outcomes

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

CO1	Learn the basic concepts of HVDC Transmission & their converters.
CO2	Learn HVDC converters.
CO3	Understand the HVDC System Control Strategies with respect to protection.
CO4	Understand the concepts of HVDC systems protection
CO5	Understand the various sources of reactive power
CO6	Understand the Multi Terminal HVDC Systems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I

DC Power Transmission Technology

Introduction - Historical Development - Comparison of AC and DC transmission - types of DC links -Existing HVDC Projects in INDIA. Modern Trends in HVDC Technology.

Analysis of HVDC Converters

Three Phase 6-Pulse bridge converter - simplified analysis - waveform with and without overlap - Current and voltage relationship - Equivalent circuits of converters - Analysis of a 12 pulse converters.

UNIT II

HVDC System Control

Principles of DC link control - converter control characteristics - constant current and constant extinction angle control - constant ignition angle control - starting and stopping of HVDC link - powercontrol & power reversal in HVDC link.

UNIT III

Converter Faults and Protection

Over voltages in converter station - Surge arrestors - Protection against over voltages and over currents.Converter faults - Protection against faults in voltage source converter-Smoothing Reactor - Transient over voltages for DC line – Protection of DC lines.

UNIT IV

Reactive Power Control

Sources of reactive power - Static VAR system – SVC and STATCOM - Reactive power control duringtransients.

Harmonics & Filters

Generation of harmonics – Types and design of various AC filters - DC filters – Active Filters.

UNIT V

Multi Terminal HVDC Systems & DC Circuit Breakers

Types of MTDC systems - Control and Protection of MTDC system – HVDC insulation – DC lineinsulators – DC breakers – Characteristics and types of DC breakers.

TEXT BOOKS:

1. K. R. Padiyar - “HVDC Power Transmission Systems Technology and System Interactions” -New Age International (p) Limited - New Delhi - 2003.
2. Edward Wilson Kimbark - “Direct current Transmission” - Wiley Interscience - Vol. I - NewYork - 1971.

REFERENCE BOOKS:

1. Vijay K. Sood - “HVDC and FACTS Controller: Application of Static Converters in power systems” - IEEE Power Electronics and Power Systems series - Kluwer Academic publishers - Boston - First edition January 2004.
2. C. Adamson and N.G. Hingorani - “High voltage DC power Transmission” - GarrawayLimited - England - 1960.
3. Mohan - Undeland and Robbins - “Power Electronics Converters - Applications and Design - JohnWiley & Son - Inc. - 2003.
4. J. Arrialga - “HVDC Transmission” - Peter Peregrinus Ltd. - London - 1983.

EVOLUTIONARY ALGORITHMS
(Minors Engineering Course)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To classify optimization problems and learn the features of soft computing algorithms.
- To learn the steps of GA and PSO algorithms and their applications to solve Rosenbrock &Rastrigin function test problems.
- To learn HSA and ABC algorithms & their application to solve Rosenbrock & Rastrigin functiontest problems.
- To illustrate the steps of SFLA & Bat optimization algorithms & their application to solvestandard single objective test problems.
- To learn the basic concepts of multi-objective optimization & steps of NSGA-II algorithm

Course Outcomes

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

CO1	State and formulate the optimization problem, without and with constraints, by using designvariables.
CO2	Apply GA and PSO algorithms to solve single objective optimization problems
CO3	Apply HSA algorithms to solve single objective optimization problemS.
CO4	Apply ABC algorithms to solve single objective optimization problemS.
CO5	Apply Bat and SFL algorithms to solve single objective optimization problems
CO6	Formulate multi-objective optimization problem and use NSGA-II to solve two objectiveoptimization problem

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I

Fundamentals of Soft Computing Techniques

Definition-Classification of optimization problems- Unconstrained and Constrained optimization Optimality conditions- Soft computing techniques- Conventional Computing versus Soft Computing - Classification of meta-heuristic techniques - Single solution based and population based algorithms – Exploitation and exploration in population based algorithms - Discrete and continuous optimization problems - Single objective and multi-objective problems.

UNIT II

Genetic Algorithm and Particle Swarm Optimization

Genetic algorithms- Genetic Algorithm versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators- different types of crossover and mutation operators -Bird flocking and Fish Schooling – anatomy of a particle- equations based on velocity and positions -PSO topologies - control parameters – GA and PSO algorithms for solving standard Rosenbrock, Rastrigin function test problem

UNIT III

Harmony Search Optimization and Artificial Bee Colony Algorithms

Harmony Search algorithm – steps – Harmony memory initialization, New harmony improvisation,Harmony memory update – Improved Harmony search algorithm.
Task partitioning in honey bees - Balancing foragers and receivers - Artificial bee colony (ABC)algorithms-HSA and ABC algorithms to solve Rosenbrock & Rastrigin function test problems.

UNIT IV

Shuffled Frog-Leaping Algorithm and Bat Optimization Algorithm

Bat Algorithm- Echolocation of bats- Behaviour of microbats- Acoustics of Echolocation- Movement of Virtual Bats- Loudness and Pulse Emission- Shuffled frog algorithm-virtual population of frogs- comparison of memes and genes -memeplex formation- memeplex updation- BA and SFLA algorithms to solve Rosenbrock & Rastrigin function test problems..

UNIT V

Multi Objective Optimization

Multi-Objective optimization Introduction- Concept of Pareto optimality - Non-dominant sorting technique-Pareto fronts-best compromise solution-min-max method-NSGA-II algorithm and application to solve general two objective optimization problem.

TEXT BOOKS:

1. Xin-She Yang, „Recent Advances in Swarm Intelligence and Evolutionary Computation‟, Springer International Publishing, Switzerland, 2015.
2. Kalyanmoy Deb „Multi-Objective Optimization using Evolutionary Algorithms‟, John Wiley & Sons, 2001.
3. James Kennedy and Russel E Eberheart, „Swarm Intelligence‟, The Morgan Kaufmann Series in Evolutionary Computation, 2001.

REFERENCE BOOKS:

1. Eric Bonabeau, Marco Dorigo and Guy Theraulaz, „Swarm Intelligence-From natural to Artificial Systems‟, Oxford university Press, 1999.
2. David Goldberg, „Genetic Algorithms in Search, Optimization and Machine

Learning‟, Pearson
Education, 2007.
3. Konstantinos E. Parsopoulos and Michael N. Vrahatis, „Particle Swarm Optimization andIntelligence: Advances and Applications‟, InformatIon scIence reference, IGI Global, , 2010.
4. N P Padhy, „Artificial Intelligence and Intelligent Systems‟, Oxford University Press, 2005.

REFERENCE PAPERS

1. “Shuffled frog-leaping algorithm: a memetic meta-heuristic for discrete optimization” by Muzaffar eusuff, Kevin lansey and Fayzul pasha, Engineering Optimization, Taylor & Francis, Vol. 38, No. pp.129–154, March 2006.
2. “A New Metaheuristic Bat-Inspired Algorithm” by Xin-She Yang, Nature Inspired Cooperative Strategies for Optimization (NISCO 2010) (Eds. J. R. Gonzalez et al.), Studies in Computational Intelligence, Springer Berlin, 284, Springer, 65-74 (2010).
3. K. Nekooei, M. M. Farsangi, H. Nezamabadi-Pour and K. Y. Lee, "An Improved Multi-Objective Harmony Search for Optimal Placement of DGs in Distribution Systems," in IEEE Transactions on Smart Grid, vol. 4, no. 1, pp. 557-567, March 2013, doi: 10.1109/TSG.2012.2237420.

FUNDAMENTALS OF POWER ELECTRONICS

(Minors Engineering Course)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To know the characteristics of various power semiconductor devices.
- To learn the operation of single phase full–wave converters and perform harmonic analysis ofinput current.
- To learn the operation of three phase full–wave converters and AC/AC converters.
- To learn the operation of different types of DC-DC converters.
- To learn the operation of PWM inverters for voltage control and harmonic mitigation.

Course Outcomes

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

CO1	Illustrate the static and dynamic characteristics SCR - Power MOSFET and Power IGBT
CO2	Analyse the operation of phase controlled rectifiers.
CO3	Analyse the operation of Three-phase full–wave converters
CO4	Analyse the operation of AC Voltage Controllers and Cyclo-converters
CO5	Examine the operation and design of different types of DC-DC converters.
CO6	Analyse the operation of PWM inverters for voltage control and harmonic mitigation

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

UNIT I

Power Semi-Conductor Devices

Silicon controlled rectifier (SCR) – Two transistor analogy - Static and Dynamic characteristics

Static and Dynamic Characteristics of Power MOSFET and Power IGBT– Gate Driver Circuits forPower MOSFET and IGBT - Numerical problems.

UNIT II

Single-phase AC-DC Converters

Single-phase half wave controlled rectifiers - R load and RL load with and without freewheeling diode - Single-phase fully controlled bridge converter with R load - RL load and RLE load - Continuous and Discontinuous conduction - Expression for output voltages – Single-phase Semi-Converter with R load - RL load and RLE load – Continuous and Discontinuous conduction - Harmonic Analysis - Numerical Problems.

UNIT III

Three-phase AC-DC Converters & AC – AC Converters

Three-phase fully controlled rectifier with R and RL load - Three-phase semi converter with R and RLload - Expression for Output Voltage - Harmonic Analysis - Numerical Problems.

AC-AC power control by phase control with R and RL loads - Expression for rms output voltage-Numerical problems.

UNIT IV

DC–DC Converters

Analysis of Buck - Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressions for output voltage ripple and inductor current ripple- Numerical Problems.

UNIT V

DC–AC Converters

Introduction - Single-phase half bridge and full bridge inverters with R and RL loads – Three-phase square wave inverters - 120^0 conduction and 180^0 conduction modes of operation - PWM inverters - Sinusoidal Pulse Width Modulation - Numerical Problems.

TEXT BOOKS:

1. Power Electronics: Converters - Applications and Design by Ned Mohan - Tore M Undeland -William P Robbins - John Wiley & Sons.
2. Power Electronics: Circuits - Devices and Applications – by M. H. Rashid - Prentice Hall of India
   - 2nd edition - 1998
3. Power Electronics: Essentials & Applications by L. Umanand - Wiley - Pvt. Limited - India - 2009.

REFERENCE BOOKS:

1. Elements of Power Electronics–Philip T.Krein. Oxford University Press; Second edition
2. Power Electronics – by P.S.Bhimbra - Khanna Publishers.
3. Power Electronics: by Daniel W.Hart - Mc Graw Hill.

RENEWABLE AND DISTRIBUTED ENERGY TECHNOLOGIES
(PROFESSIONAL ELECTIVE-III)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To understand the basic concepts on wind energy systems with concept on aerodynamics, horizontal and vertical axis wind turbines.
- To understand the various relations between speed, power and energy in the wind systems.
- It provides the knowledge in fundamentals of solar energy systems, various components of solar thermal systems, applications in the relevant fields and design of PV systems.
- To understand the Hydel system components and their design concepts.
- To get an idea on different other sources like tidal, geothermal and gas based units.
- To understand the use of various renewable sources as distributed generators

Course Outcomes

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

CO1	Illustrate basic concepts of renewable and distributed sources
CO2	Demonstrate the components of wind energy conversion systems.
CO3	Model PV systems and analyse MPPT Techniques
CO4	Illustrate the concept of Energy Production from Hydro - Tidal and Geothermal.
CO5	Distinguish between standalone and grid connected DG systems
CO6	Design hybrid renewable energy systems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**									**1**	
CO2	**3**	**3**									**1**	
CO3	**3**	**3**									**1**	
CO4	**3**	**2**										
CO5	**3**	**2**										
CO6	**3**	**2**										

UNIT I

Brief idea on renewable and distributed sources - their usefulness and advantages; Wind Energy Systems: Estimates of wind energy potential - wind maps - Instrumentation for wind velocity measurements - Aerodynamic and mechanical

aspects of wind machine design - Conversion to electrical energy - Aspects of location of wind farms.

UNIT II

Wind speed and energy - Speed and power relations - Power extraction from wind - Tip speed ratio (TSR) - Functional structure of wind energy conversion systems - Pitch and speed control - Power- speed-TSR characteristics - Fixed speed and variable speed wind turbine control - Power optimization - Electrical generators - Self-Excited and Doubly-Fed Induction Generators operation and control.

UNIT III

Solar PV Systems: Present and new technological developments in photovoltaic - estimation of solar irradiance - components of solar energy systems - solar-thermal system applications to power generation - heating - Types of PV systems - Modelling of PV cell - current-voltage and power-voltage characteristics - Effects of temperature - Solar array simulator - Sun tracking - Peak power operations - PV system - MPPT techniques - Effects of partial shading on the characteristic curves and associated MPPT techniques - Solar park design outline.

UNIT IV

Hydel Power: Water power estimates - use of hydrographs - hydraulic turbine - characteristics and part load performance - design of wheels - draft tubes and penstocks - plant layouts; Brief idea of other sources viz. - tidal - geothermal - gas-based - etc.

UNIT V

Requirements of hybrid/combined use of different renewable and distributed sources - Need of energy storage; Control of frequency and voltage of distributed generation in Stand-alone and Grid-connected mode - use of energy storage and power electronics interfaces for the connection to grid and loads - Design and optimization of size of renewable sources and storages.

TEXT BOOKS:

1. Math J. Bollen - Fainan Hassan 'Integration of Distributed Generation in the Power System' - IEEE Press - 2011.
2. Loi Lei Lai and Tze Fun Chan 'Distributed Generation: Induction and Permanent Magnet Generators' - Wiley-IEEE Press - 2007.
3. Studies' Craig Anderson and Rudolf I. Howard 'Wind and Hydropower Integration: Concepts - Considerations and Case - Nova Publisher - 2012.
4. Amanda E. Niemi and Cory M. Fincher 'Hydropower from Small and Low-Head Hydro Technologies' - Nova Publisher - 2011.
6. D. Yogi Goswami - Frank Kreith and Jan F. Kreider 'Principles of Solar Engineering' - Taylor & Francis 2000.
7. G. N. Tiwari 'Solar Energy Technology' - Nova Science Publishers - 2005.

REFERENCE BOOKS:

1. Math J. Bollen - Fainan Hassan 'Integration of Distributed Generation in the Power System' - IEEE Press - 2011.
2. S. Heier and R. Waddington 'Grid Intergration of Wind Energy Conversion Systems' – Wiley - 2006.

HIGH VOLTAGE ENGINEERING
(PROFESSIONAL ELECTIVE – IV)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To understand HV breakdown phenomena in gases.
- To understand the breakdown phenomenon of liquids and solid dielectrics.
- To acquaint with the generating principle of operation and design of HVDC, AC voltages.
- To understand the generating principles of Impulse voltages & currents.
- To understand various techniques for AC, DC and Impulse measurements of high voltages and currents.

Course Outcomes

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

CO1	Recognise the dielectric properties of gaseous materials used in HV equipment
CO2	Differentiate the break down phenomenon in liquid and solid dielectric materials
CO3	Acquaint with the techniques of generation of high AC and DC voltages
CO4	Acquaint with the techniques of generation of high Impulse voltages and currents
CO5	Getting the knowledge of measurement of high AC - DC - Impulse voltages
CO6	Getting the knowledge of measurement of high AC - DC - Impulse currents

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**											
CO2	**3**											
CO3	**3**	**2**										
CO4	**3**	**2**										
CO5	**3**											
CO6	**3**	**2**										

UNIT I

Break down phenomenon in Gaseous:

Insulating Materials: Types - applications and properties. Gases as insulating media – Collision process – Ionization process – Townsend's criteria of breakdown in gases and its limitations – Streamers Theory of break down – Paschen's law- Paschens curve.

UNIT II

Break down phenomenon in Liquids: Liquid as Insulator – Pure and commercial liquids – Breakdown in pure and commercial liquids.

Break down phenomenon in Solids: Intrinsic breakdown – Electromechanical breakdown

– Thermal breakdown –Breakdown of composite solid dielectrics

UNIT III

Generation of High DC voltages: Voltage Doubler Circuit - Voltage Multiplier Circuit – Vande- Graaff Generator. **Generation of High AC voltages**: Cascaded Transformers – Resonant Transformers –Tesla Coil

UNIT IV

Generation of Impulse voltages: Specifications of impulse wave – Analysis of RLC circuit only- Marx Circuit. **Generation of Impulse currents:** Definitions – Circuits for producing Impulse current waves – Wave shape control - Tripping and control of impulse generators.

UNIT V

Measurement of High DC & AC Voltages: Resistance potential divider - Generating Voltmeter - Capacitor Voltage Transformer (CVT) - Electrostatic Voltmeters – Sphere Gaps.

TEXT BOOKS:

1. High Voltage Engineering: Fundamentals by E.Kuffel - W.S.Zaengl - J.Kuffel by Elsevier - 2 nd Edition.
2. High Voltage Engineering and Technology by Ryan - IET Publishers - 2 nd edition.

REFERENCE BOOKS:

1. High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications - 3 rd Edition.
2. High Voltage Engineering by C.L.Wadhwa - New Age Internationals (P) Limited – 1997.
3. High Voltage Insulation Engineering by RavindraArora - Wolfgang Mosch - New Age International (P) Limited - 1995.

POWER SYSTEM OPERATION AND CONTROL
(PROFESSIONAL ELECTIVE –V)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To understand optimal dispatch of generation with and without losses.
- To understand the optimal scheduling of hydro thermal systems.
- To understand the optimal unit commitment problem.
- To understand the load frequency control for single area system with and without controllers
- To understand the load frequency control for two area system with and without controllers
- To understand the reactive power control and compensation of transmission lines.

Course Outcomes

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

CO1	Compute optimal load scheduling of Generators.
CO2	Formulate hydrothermal scheduling and unit commitment problem..
CO3	Analyse effect of Load Frequency Control for single area systems
CO4	Analyse effect of Load Frequency Control for two area systems
CO5	Describe the effect of reactive power control for transmission lines.
CO6	Describe understand the reactive power control and compensation of transmission lines.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**	**2**					**3**	**2**			
CO2	**3**	**3**	**3**					**2**	**2**			
CO3	**3**	**3**	**2**					**2**	**2**			
CO4	**3**	**3**	**2**					**3**	**2**			
CO5	**3**	**3**	**3**									
CO6	**3**	**3**	**2**									

UNIT I

Economic Operation of Power Systems Optimal operation of Generators in Thermal power stations - – Heat rate curve – Cost Curve – Incremental fuel and Production costs – Input–output characteristics – Optimum generation allocation with line losses neglected – Optimum generation allocation including the effect of transmission line losses – Loss Coefficients – General transmission line loss formula.

UNIT II

Hydrothermal Scheduling Mathematical Formulation – Solution Technique.

Unit Commitment Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Priority ordering – Dynamic programming.

UNIT III

Load Frequency Control-I Modelling of steam turbine – Generator – Mathematical modelling of speed governing system – Transfer function – Necessity of keeping frequency constant. Definitions of Control area – Single area control system – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case. Proportional plus Integral control of single area and its block diagram representation – Steady state response.

UNIT IV

Load Frequency Control-II Block diagram development of Load Frequency Control of two area system uncontrolled case and controlled case – Tie-line bias control – Load Frequency Control and Economic dispatch control.

UNIT V

Compensation in Power Systems Overview of Reactive Power control – Reactive Power compensation in transmission systems – Advantages and disadvantages of different types of compensating equipment for transmission systems – Load compensation – Specifications of load compensator – compensated transmission lines. Introduction of FACTS devices – Need of FACTS controllers – Types of FACTS devices.

TEXT BOOKS:

1. Power Generation - Operation and Control by Allen J Wood - Bruce F WollenBerg 3rd Edition - Wiley Publication 2014.
2. Electric Energy systems Theory – by O.I.Elgerd - Tata McGraw–hill Publishing Company Ltd. - Second edition. 3. Modern Power System Analysis – by I.J.Nagrath&D.P.Kothari Tata McGraw Hill Publishing Company Ltd - 2nd edition.

REFERENCE BOOKS:

1. Power System Analysis and Stability by S.S.Vadhera - Khanna Publications - 4 th edition - 2005.
2. Power System Analysis by Grainger and Stevenson - Tata McGraw Hill.
3. Power System Analysis by HadiSaadat – – Tata McGraw–Hill 3rd edition - 2010.
4. Power System stability & control - Prabha Kundur - TMH - 1994.

HIGHWAY ENGINEERING
(OPEN ELECTIVE –III)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

1. To impart knowledge on highway development and materials.
2. To teach concepts of Geometric design and alignment.
3. To throw light on traffic volume studies and regulation.
4. To teach design of highway intersections.
5. To impart knowledge on design of pavements.

Course Outcomes

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

CO1	Carry out highway surveying and planning.
CO2	Understand characteristics of highway materials.
CO3	Geometric design and alignment
CO4	Design components of highway
CO5	Design highway intersections.
CO6	Design highway pavements.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**2**											
CO2	**2**											
CO3	**2**	**3**	**3**			**2**		**1**				
CO4	**2**	**3**	**3**			**2**		**1**				
CO5	**2**	**3**	**3**			**2**		**1**				
CO6	**2**	**3**	**3**			**2**		**1**				

UNIT I

HIGHWAY DEVELOPMENT AND PLANNING: Highway development in India – Necessity for Highway Planning- Road Development Plans- Classification of RoadsRoad Network Patterns – Highway Alignment and influencing Factors - Engineering Surveys

UNIT II

HIGHWAY GEOMETRIC DESIGN: Importance of Geometric Design- Design controls and Criteria-Highway Cross Section Elements-Sight Distance Elements-Stopping sight Distance, Overtaking Sight Distance and Intermediate Sight Distance.

UNIT III

TRAFFIC ENGINEERING: Basic Parameters of Traffic-Volume, Speed and DensityTraffic Volume Studies; Speed studies–spot speed and speed & delay studies; Parking Studies; Road Accidents-Causes and Preventive measures-,

Capacity of Highways – Factors Affecting; LOS Concepts; Road Traffic Signs; Road markings; Traffic Signals–Webster Method–IRC Method.

UNIT IV

HIGHWAY MATERIALS: Sub grade soil: classification–Group Index–Subgrade soil Strength-California Bearing Ratio– Modulus of Subgrade Reaction. Stone aggregates: Desirable properties–Tests for Road Aggregates–Bituminous Materials: Types–Desirable properties–Tests on Bitumen

UNIT V

PAVEMENT DESIGN: Flexible and rigid pavements – Components and Functions – design of Flexible pavement (G.I method and CBR Method as per IRC 37-2018 – Design of Rigid pavements – Westergaard's stress equations – CC pavements - Design of Expansion and contraction joints.

TEXT BOOKS:

1) S. K. Khanna and C. E. G. Justo, Highway Engineering, Nemchand & Bros., 7th edition (2000).
2) R. Srinivasa Kumar, Text Book of Highway Engineering, Universities Press Pvt Ltd, Hyderabad. 2011.

REFERENCE BOOKS:

1) S K Sharma, A Textbook Of Highway Engineering, S. Chand and Company Limited, New Delhi
2) L. R. Kadiyali and Lal, Principles and Practice of Highway Engineering Design, Khanna Publications.

SAFETY ENGINEERING
(OPEN ELECTIVE –IV)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

1) To understand the concepts of industrial safety and management.
2) To demonstrate the accident preventions and protective equipment.
3) To understand and apply the knowledge of safety acts
4) To have the knowledge about fire prevention and protection systems
5) To understand and apply fire safety principles in buildings

Course Outcomes

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

CO1	Students learn the concepts of industrial safety and management
CO2	Learn about the smart machines and smart sensors
CO3	Apply IoT to Industry 4.0 and they are able to make a system tailor-made as per requirement of the industry
CO4	Students learn about fire prevention and protection systems
CO5	Students learn the fire safety principles in buildings
CO6	Students should apply the fire safety principles in buildings

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**	**2**					**3**	**2**			
CO2	**3**	**3**	**3**					**2**	**2**			
CO3	**3**	**3**	**2**					**2**	**2**			
CO4	**3**	**3**	**2**					**3**	**2**			
CO5	**3**	**3**	**3**									
CO6	**3**	**3**	**2**									

UNIT I

INTRODUCTION TO THE DEVELOPMENT OF INDUSTRIAL SAFETY AND

MANAGEMENT: History and development of Industrial safety: Implementation of factories act, Safety and productivity, Safety organizations. Safety committees and structure, Role of management and role of Govt. in industrial safety.

UNIT II

ACCIDENTPREVENTIONS AND PROTECTIVE EQUIPMENT: Personal protective

equipment, Survey the plant for locations, Part of body to be protected, Education and training insafety,Preventioncausesandcostofaccident,Housekeeping,Firstaid,Accidentre

porting,Investigations.Industrialpsychologyinaccidentprevention,Safetytrials,Safetyrelatedtooperations.

UNIT III

SAFETY ACTS: Features of Factory Act, Introduction of Explosive Act, Boiler Act, ESI Act,Workman'scompensationAct,Industrialhygiene,Occupationalsafety,Diseasespreventio n,Ergonomics, Occupational diseases, stress, fatigue, health, safety and the physical environment, Engineering methods of controlling chemical hazards, safety and the physical environment, Controlof industrial noise and protection against it

UNIT IV

FIRE PREVENTION AND PROTECTION: Sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E-fire extinguishing agents– types of fire extinguishers – fire stoppers –hydrant pipes – hoses – monitors – fire watchers– fire station-fire alarmsand sirens – escape from fire rescue operations – fire drills –first aid for burns.

UNIT V

BUILDINGFIRESAFETY: Objectives of fire safe building design, fire load, fire resistant material and fire testing – structural fire protection – structural integrity – concept of egress design -A case Study on Construction Safety - Contractual Provision on Construction Zone Safety

ELECTRICAL SAFETY- Electrical shock, electrical hazards and preventions, Nature of electrical accidents, National electrical standards

TEXT BOOKS:

1) Industrial Maintenance Management Srivastava,S.K.-S. Chand and Co.
2) OccupationalSafetyManagementandEngineeringWillieHammer–PrenticeHall

REFERENCE BOOKS:

1) Installation, Servicing and Maintenance Bhattacharya, S.N.-S. Chand and Co.
2) OccupationalSafetyManagementandEngineeringWillieHammer–PrenticeHall
3) Reliability, Maintenance and Safety Engineering by Dr.A. K.Guptha
4) Atext bookof Reliability and Maintenance Engineering byAlakeshManna

GREEN ENERGY

(OPEN ELECTIVE)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To study the solar radiation data, equivalent circuit of PV cell and its I-V & P-V characteristics.
- To understand the concept of Wind Energy Conversion & its applications.
- To study the principles of biomass and geothermal energy.
- To understand the principles of Ocean Thermal Energy Conversion (OTEC), motion of waves and power associated with it.
- To study the various chemical energy sources such as fuell cell and hydrogen energy along with their operation and equivalent circuit.

Course Outcomes

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

CO1	Analyze solar radiation data, extra-terrestrial radiation; radiation on earth's surface and solar Energy Storage.
CO2	Illustrate the components of wind energy systems.
CO3	Illustrate the working of biomass, digesters and geothermal plants.
CO4	Demonstrate the principle of Energy production from OTEC, Tidal and Waves.
CO5	Evaluate the concept of Fuel cells & MHD power generation.
CO6	Evaluate the working of Fuel cells & MHD power generation.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**						**2**			**1**	
CO2	**3**	**3**										
CO3	**3**	**3**						**2**				
CO4	**3**	**3**										
CO5	**3**	**3**						**2**				
CO6	**3**	**3**						**2**				

UNIT I

Solar Energy: Introduction - Renewable Sources - prospects, Solar radiation at the Earth Surface - Equivalent circuit of a Photovoltaic (PV) Cell - I-V & P-V Characteristics - Solar Energy Collectors: Flat plate Collectors, concentrating collectors - Solar Energy storage systems and Applications: Solar Pond - Solar water heating - Solar Green house.

UNIT II

Wind Energy: Introduction - basic Principles of Wind Energy Conversion, the nature of Wind - the power in the wind - Wind Energy Conversion - Site selection considerations - basic components of Wind Energy Conversion Systems (WECS) - Classification - Applications.

UNIT III
Biomass and Geothermal Energy: Biomass: Introduction - Biomass conversion technologies - Photosynthesis, factors affecting Bio digestion - classification of biogas plants - Types of biogas plants - selection of site for a biogas plant **Geothermal Energy**: Introduction, Geothermal Sources – Applications - operational and Environmental problems.
UNIT IV
Energy From oceans, Waves & Tides: Oceans: Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC in India. **Waves**: Introduction - Energy and Power from the waves - Wave Energy conversion devices. **Tides:** Basic principle of Tide Energy -Components of Tidal Energy.
UNIT V
Chemical Energy Sources: Fuel Cells: Introduction - Fuel Cell Equivalent Circuit – **Hydrogen Energy**: Introduction - Methods of Hydrogen production - Storage and Applications **Magneto Hydro Dynamic (MHD) Power generation**: Principle of Operation - Types.
TEXT BOOKS:
1. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011. 2. John Twidell & Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013.
REFERENCE BOOKS:
1. S.P.Sukhatme & J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011. 2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd Edition, 2013. 3. Shoba Nath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015.

UNIVERSAL HUMAN VALUES-2: UNDERSTANDING HARMONY

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Course Objectives:

- To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence to understand (or developing clarity) of the harmony in the human being, family, society and nature/existence, to strengthen self-reflection and to develop the commitment and courage to act.

Course Outcomes

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

CO1	Discuss a holistic perspective based on self-exploration about themselves
CO2	Discuss a holistic perspective based on self-exploration about family,
CO3	Discuss a holistic perspective based on self-exploration about society and nature/existence
CO4	To explain (or developing clarity) of the harmony in the human being, family
CO5	To explain society and nature/existence, to strengthen self-reflection
CO6	To judge the commitment and courage to act.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	**3**	**2**	**1**	**1**				**2**			**1**	
CO2	**3**	**3**	**1**	**1**				**2**			**1**	
CO3	**3**	**3**	**1**	**1**		**2**		**2**		**2**	**1**	
CO4	**3**	**3**	**1**	**1**				**2**			**1**	
CO5	**3**	**3**	**1**								**1**	
CO6	**3**	**3**	**1**	**1**				**3**			**1**	

UNIT I

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

1) Purpose and motivation for the course, recapitulation from Universal Human Values-I

2) Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration

3) Continuous Happiness and Prosperity- A look at basic Human Aspirations

4) Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority

5) Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

6) Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance

in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT II

Understanding Harmony in the Human Being - Harmony in Myself!
1) Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2) Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3) Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4) Understanding the characteristics and activities of 'I' and harmony in 'I'
5) Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail 6) Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

UNIT III

Understanding Harmony in the Family and Society- Harmony in Human Relationship
1) Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2) Understanding the meaning of Trust; Difference between intention and competence
3) Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4) Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5) Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT IV

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence
1) Understanding the harmony in the Nature
2) Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self regulation in nature
3) Understanding Existence as Co-existence of mutually interacting units in allpervasive space
4) Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT V

Implications of the above Holistic Understanding of Harmony on Professional Ethics
1) Natural acceptance of human values 2) Definitiveness of Ethical Human Conduct
3) Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

4) Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

5) Case studies of typical holistic technologies, management models and production systems

6) Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations

7) Include practice: Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

TEXT BOOKS:

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

REFERENCE BOOKS:

1) Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2) Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3) The Story of Stuff (Book).

4) The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5) Small is Beautiful - E. F Schumacher. 6) Slow is Beautiful - Cecile Andrews.

7) Economy of Permanence - J C Kumarappa .

8) Bharat Mein Angreji Raj - PanditSunderlal .

9) Rediscovering India - by Dharampal .

10) Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.

11) India Wins Freedom - Maulana Abdul Kalam Azad.

12) Vivekananda - Romain Rolland (English).

13) Gandhi - Romain Rolland (English).

SUMMER INTERNSHIP

Lecture – Tutorial:	-	**Internal Marks:**	30
Credits:	3	**External Marks:**	70
INDUSTRIAL / RESEARCH INTERNSHIP 2 MONTHS (MANDATORY) AFTER THIRD YEAR (TO BE EVALUATED DURING VII SEMESTER)			

PROJECT

Lecture – Tutorial:	-	**Internal Marks:**	30
Credits:	12	**External Marks:**	70
PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY (6 MONTHS)			