JAIDEV EDUCATION SOCIETY'S

JD COLLEGE OF ENGINEERING AND MANAGEMENT

KATOL ROAD, NAGPUR

Website: www.jdcoem.ac.in E-mail: info@jdcoem.ac.in

Education to Eternity

An Autonomous Institute, with NAAC "A" Grade

Department of Electrical Engineering

AY-2021-22

VISION	MISSION
"To develop competent and committed Electrical Engineers to serve the society"	1. To impart quality education in the field of Electrical Engineering. 2. To be excellent learning centre through research and industry interaction.

Teaching Scheme

Branch code: EE

I Semester

Sr. No.	Category of Subject	Course Code	Course Name	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE/Ext. Pra.	Total	
1	HSMC	HU2T001	Communication Skills	2	0	0	60	0	40	100	2
2	BSC	MA2T001	Engineering Mathematics- II	3	1	0	20	20	60	100	4
3	BSC	EE2T002	Engineering Chemistry	3	1	0	20	20	60	100	4
4	ESC	EE2T003	Engineering Graphics	1	0	0	20	20	60	100	1
5	HSMC	HU2L001	Communication Skills Lab.	0	0	4	60	0	40	100	2
6	BSC	EE2L002	Engineering Chemistry Lab	0	0	2	60	0	40	100	1
7	ESC	EE2L003	Engineering Graphics Lab	0	0	4	60	0	40	100	2
8			Induction Programme	3 Weeks							
9	ESC	EE2T004	Basic Civil and Mechanical Engineering	2	0	0	10	15	25	50	Audit
				11	**2**	**10**					**16**

II Semester

Sr. No.	Category of Subject	Course Code	Course Name	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE/Ext. Pra.	Total	
1	HSMC	HU1T002	Introduction to Computer programming	2	0	0	20	20	60	100	2
2	BSC	MA1T001	Engineering Mathematics- I	3	1	0	20	20	60	100	4
3	BSC	EE1T005	Engineering Physics	3	1	0	20	20	60	100	4
4	ESC	EE1T006	Energy and Environment Engineering	3	0	0	20	20	60	100	3
5	HSMC	HU1L002	Introduction to Computer programming Lab	0	0	4	60	0	40	100	2
6	ESC	WS1L001	Workshop Practices	0	0	4	60	0	40	100	2
7	BSC	EE1L005	Engineering Physics Lab	0	0	2	60	0	40	100	1
8			Societal Internship/ Field Training	Report submission						50	1

9	ESC	EE1T007	Basic Electrical and Electronics Engineering	2	0	0	10	15	25	50	Audit
				13	**2**	**10**					**19**
				25							

III Semester

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	TOTAL	
1	HSMC	EE3T001	Engineering Economics	2	0	0	20	20	60	100	2
2	BSC	EE3T002	Engineering Mathematics –III	3	1	0	20	20	60	100	4
3	ESC	EE3T003	Fundamentals of Electrical Engineering	3	1	0	20	20	60	100	4
4	PCC-EE	EE3T004	Network Analysis and synthesis	3	0	0	20	20	60	100	3
5	PCC-EE	EE3T005	Electrical Machine I	2	1	0	20	20	60	100	3
6	PCC-EE	EE3T006	Measurement and Instrumentation	2	1	0	20	20	60	100	3
7	PCC-EE	EE3L004	Network Analysis and synthesis Lab	0	0	2	60	0	40	100	1
8	PCC-EE	EE3L005	Electrical Machine I Lab	0	0	2	60	0	40	100	1
9	PCC-EE	EE3L006	Measurement and Instrumentation Lab	0	0	2	60	0	40	100	1
10	PROJ-EE	EE3P001	Field trainning/ Internship/ industrial visit	0	0	0	0	0	50	50	1
11	MC	EE3T007	Universal Human Values -II	2	0	0	10	15	25	50	Audit
				17	**4**	**6**	**310**	**135**	**555**	**1000**	
								Total Credits			**23**

IV Semester

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	**TOTAL**	
1	HSMC	EE4T001	Advanced Physics	2	0	0	20	20	60	100	2
2	BSC	EE4T002	Numerical method and probability	2	1	0	20	20	60	100	3
3	ESC	EE4T003	Power Station Practice	4	0	0	20	20	60	100	4
4	PCC-EE	EE4T004	Electronic Devices and circuits	3	0	0	20	20	60	100	3
5	PCC-EE	EE4T005	Power System I	2	1	0	20	20	60	100	3
6	PCC-EE	EE4T006	Electrical Machine II	3	0	0	20	20	60	100	3
7	BSC	EE4L002	Numerical method and probability Lab	0	0	2	60	0	40	100	1
8	PCC-EE	EE4L005	Power System I Lab	0	0	2	60	0	40	100	1
9	PCC-EE	EE4L006	Electrical Machine II Lab	0	0	2	60	0	40	100	1
10	PROJ-EE	EE4P002	Field trainning/ Internship/ industrial visit	0	0	0	0	0	50	50	1
11	MC	EE4T007	Innovation and entrepreneurship Development	2	0	0	10	15	25	50	Audit
				18	**2**	**6**	**310**	**135**	**555**	**1000**	

Total Credits	22

V Semester

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	TOTAL	
1	PCC-EE	EE5T001	Power Electronics	3	0	0	20	20	60	100	3
2	PCC-EE	EE5T002	Control System I	2	1	0	20	20	60	100	3
3	PCC-EE	EE5T003	Power System II	3	0	0	20	20	60	100	3
4	PEC-EE	EE5TE01	**Elective I**	3	0	0	20	20	60	100	3
5	PEC-EE	EE5TE02	**Elective II**	3	0	0	20	20	60	100	3
6	OEC-EE	EE5TO01	**Open Elective I**	4	0	0	20	20	60	100	4
7	PCC-EE	EE5L001	Power Electronics Lab	0	0	2	60	0	40	100	1
8	PCC-EE	EE5L002	Control System I Lab	0	0	2	60	0	40	100	1
9	PCC-EE	EE5L003	Power System II Lab	0	0	2	60	0	40	100	1
10	PROJ-EE	EE5P003	Mini Project (Phase I)	0	0	2	0	0	50	50	2
11	MC	EE5T004	Consumer Affairs	2	0	0	10	15	25	50	Audit
				20	**1**	**8**	**310**	**135**	**555**	**1000**	
							Total Credits				**24**

VI Semester

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	TOTAL	
1	PCC-EE	EE6T001	Microprocessor and microcontroller	3	0	0	20	20	60	100	3
2	PCC-EE	EE6T002	Advanced Control System	3	0	0	20	20	60	100	3
3	PEC-EE	EE6TE03	**Elective III**	3	0	0	20	20	60	100	3
4	PEC-EE	EE6TE04	**Elective IV**	3	0	0	20	20	60	100	3
5	OEC-EE	EE6TO01	**Open Elective II**	4	0	0	20	20	60	100	4
6	PCC-EE	EE6L001	Microprocessor and microcontroller Lab	0	0	2	60	0	40	100	1
7	PCC-EE	EE6L003	Cad Lab	0	0	2	60	0	40	100	1
8	PROJ-EE	EE6P004	Mini Project phase II	0	0	2	0	0	50	50	2
9	MC	EE6T003	Research Methodology	2	0	0	10	15	25	50	Audit
				15	**0**	**6**	**210**	**95**	**395**	**700**	
								Total Credits			**20**

Prof. A. V.Joshi
Member Secretary
Board of Studies, EE Dept

Chairman
Board of Studies, EE Dept

JAIDEV EDUCATION SOCIETY'S
J D COLLEGE OF ENGINEERING AND MANAGEMENT
An Autonomous Institute, with NAAC "A" Grade
At: Khandala, Post- Valni, Kalmeshwar Road, Nagpur
Department Of Electrical Engineering
"Igniting minds to illuminate the world"
Session: 2021-22

Course Structure and Syllabus (Autonomous)

For

B. Tech. Electrical Engineering Programme

VISION AND MISSION OF INSTITUTE

VISION

To be a centre of excellence imparting professional education satisfying societal and global needs.

MISSION

Transforming students into lifelong learners through quality teaching, training and exposure to concurrent technologies. Fostering conducive atmosphere for research and development through well-equipped laboratories and qualified personnel in collaboration with global organizations.

VISION AND MISSION OF THE DEPARTMENT

VISION

To be the eminent department known for producing globally proficient electrical graduates possessing finest human values, to achieve sustainable socio-economic development

MISSION

To transform students into academically and technically sound electrically sound engineers.

To enhance teaching learning process by dedicated qualified professionals.

To promote research and development with current techniques through well developed educational environment.

PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

PEOs	ATTRIBUTES
PEO 1	To prepare the graduates for professional careers with strong fundamental knowledge in science, mathematics, English and Engineering sciences and capable to develop core competency in electrical engineering domain or enable to pursue higher education.
PEO 2	The graduates can comprehend, analyze, design and create novel ideas and provide solutions to electrical engineering problems that are technically sound, economically feasible and socially acceptable.
PEO 3	The graduates will be leaders with strong communication and interpersonal skills, capability to work efficiently in multidisciplinary teams, understanding of ethical and environmental concerns in engineering practices and deal with social and safety issues along with respect for intellectual property.

Dr.S.R.Vaishnav
Chairman
Board of Studies, EE Dept

PROGRAM OUTCOMES (PO's)

POs	ATTRIBUTES
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	**Design/ development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life -long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOS):

At the end of Electrical Engineering program the student will have following Program specific outcomes.

PSO1: Interpret, identify and analyze problems in electrical domain and demonstrate this knowledge to develop, control and assess electrical systems.

PSO2: Solve ethically and professionally various Electrical Engineering problems in societal and environmental context and communicate effectively.

PSO3: Apply modern software tools for design, simulation and analysis of electrical systems to engage in life-long learning and to successfully adapt in multi disciplinary environments

Recommendations for conducting one theory course of curriculum through online Teaching / Learning

1. Only Swayam / NPTEL platform is allowed.

2. One defined subject per semester in online mode and BOS should declare that one subject for online mode based on availability of NPTEL offering before commencement of the semester.

3. Student will be allowed to appear for NPTEL / Institute level / University Examination as applicable.

4. In order to ensure learning, NPTEL lectures to be telecast in the class by including it in regular time table if required.

5. 75% assignment submission is mandatory for these online classes also like regular lecture attendance.

6. One faculty to be allotted for this subject, who will discuss and solve student's doubts. Allot 3 hrs/week load to teacher who is allotted to work as facilitator of online course.

7. For Autonomy Students: For online mode the student should submit all assignment given by nptel then his/her score has weightage of 40% for CA & MSE. And if student clear the nptel final exam and producing certificate then 60% weghtage should be given as ESE, otherwise he/she has to appear for Makeup exam of Institute.

If student cannot enroll for NPTEL then he/she has to study online videos / material and these students should appear for Mid Semester, CA-I , CA-II and End sem exams of the Institute.

8. For DBATU students: For online mode he has to appear for CA-I, CA-II, Mid sem exam of the institute and End sem exam of University.

If student can't enroll for NPTEL then he/she has to study online videos / material and these students should appear for Mid Semester, CA-I , CA-II of the institute and End sem exams of the University.

10. If the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

This system will ensure real learning; avoid any problem arising due to cancellation of NPTEL exam as it happened in this semester. At least for first year and in the unpredictable situation of covid pandemic these provisions will avoid any last moment chaos.

Course Structure and Syllabus

For

B. Tech. Electrical Engineering Programme

Curriculum for Semester- I [First Year]

Sr. No.	Category of Subject	Course Code	Course Name	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE/Ext. Pra.	Total	
1	HSMC	HU1T002	Introduction to Computer programming	2	0	0	20	20	60	100	2
2	BSC	MA1T001	Engineering Mathematics- I	3	1	0	20	20	60	100	4
3	BSC	EE1T005	Engineering Physics	3	1	0	20	20	60	100	4
4	ESC	EE1T006	Energy and Environment Engineering	3	0	0	20	20	60	100	3
5	HSMC	HU1L002	Introduction to Computer programming Lab	0	0	4	60	0	40	100	2
6	ESC	WS1L001	Workshop Practices	0	0	4	60	0	40	100	2
7	BSC	EE1L005	Engineering Physics Lab	0	0	2	60	0	40	100	1
8			Induction Programme	3 Weeks							
9	ESC	EE1T007	Basic Electrical and Electronics Engineering	2	0	0	10	15	25	50	Audit
				13	**2**	**10**					**18**

HU1T002	Introduction to Computer Programming	4 Credit

COURSE OBJECTIVES:

1. To understand the importance of Programming
2. To understand the application of C Programming.
3. To investigate the key concepts of C Programming.
4. To enable students build a applications based on C programming

COURSE OUTCOME:

CO1: Define the algorithms, flowcharts, array, pointer, structure, function, and python.

CO2: Discuss and differentiate between variables, operators, statements, loops, array dimensions.

CO3: Demonstrate working programs using functions, loops, conditional statements, array, pointer, structure and files in C and python language.

CO4:Distinguish between different steps of programming and prioritize levels of programming.

CO5:Find errors and predict outcome in C and python programming.

CO6:Compose and develop any application using C and python programming.

Unit I: Basic of Programming Language (6 Hrs)

HLL, LLL, Language translator, Error checking, Debugging, Programming processes, Flowcharts, Algorithms along with asymptotic notation.

Unit II: Types, Operators and Expressions in C language (6 Hrs)

Variable names, Data types, sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and order of evaluation.

Unit III: Control Flow: (6 Hrs)

Statements and Blocks. If-else, else-if, switch, Loops: while and for, do-while break and continue go to and Labels. Initializing arrays, Initializing character arrays, multidimensional arrays, Introduction to pointers.

Unit IV: Functions and Pointers in Python (6 Hrs)

Functions and Program Structure: Basic of functions, functions returning non-integers external variables scope rules.

Pointers in Python: Pointers to integers, characters, floats, arrays.

Unit V: **(6 Hrs)**

Structures in Python: Basics of structures, structures with functions, arrays of structures.

File handling in Python: Basics of file handling.

Text Books

1. Let Us C by Yashavant Kanetkar.
2. Let Us C Solutions by Yashavant Kanetkar
3. Data Structure through C by Yashavant Kanetkar.

Reference Books

1. C Programming: A Modern Approach (2nd Edition) - K. N. King (2008). A good book for learning C.
2. Programming in C (4th Edition) - Stephen Kochan (2014). A good general introduction and tutorial.
3. C Primer Plus (5th Edition) - Stephen Prata (2004)
4. A Book on C - Al Kelley/Ira Pohl (1998).
5. The C Book (Free Online) - Mike Banahan, Declan Brady, and Mark Doran (1991).

HU1L002	Introduction to Computer Programming Lab	2 Credit

List of Practical:-

1. A simple program to display a message “Hello World” on screen.
2. Write a Program to print addition, subtraction Multiplication and Division of a entered number.
3. Write a Program to LCM of the entered number..
4. Write a program to find GCD of the entered number.
5. Write a program to find the greatest among three number.
6. Write a any menu driven program using if…else statement.
7. Write a any menu driven program using Switch case statement.
8. Write a program to find count of even no ,count of odd number , sum of even no and sum of odd number between 1 to 50.
9. Write a Program to generate prime number up to inputted number.
10. Write a program to check entered no is Armstrong no or not.
11. Write a program to find transpose of a matrix.
12. Write a Program to find multiplication of a two matrix elements.
13. Write a Program to find length of a string.(with and without using a library function)
14. Write a Program to find addition of two numbers using pointer.
15. Open ended Program. (How to execute C program on Linuxoperating system)
16. Write a Python program to print “Hello World”.
17. Write a Python program to display the current date and time.
18. Write a Python program which accepts the radius of a circle from the user and compute the area.
19. Write a Python program to find reverse of the entered number.
20. Write a Python program to get the Python version you are using

MA1T001	Engineering Mathematics-1	4 Credit

COURSE OBJECTIVES

1. To understand the importance of Mathematics
2. To understand the application of Mathematics in engineering and in real life.
3. To investigate the key concepts of Mathematics.
4. To enable students to analyse a problem

COURSE OUTCOMES

At the end of the course students will be able to

1. Describe rank, Bernoulli's theorem, Taylor's and Maclaurin's theorems for functions of two variables, , Euler's Theorem for functions containing two and three variables, Lagrange's theorem
2. Illustrate the examples of ordinary differential equation, partial differential equation, matrices.
3. Solve questions related to ordinary differential equation, partial differential equation, matrices and their applications.
4. Apply the knowledge of matrices, ordinary differential equation, partial differential equation, and their applications to real world problems.
5. Interpret the results of matrices, ordinary differential equation, partial differential equation and their applications.
6. Design a method or modal on matrices, ordinary differential equation, and partial differential equation.

Unit 1: Linear Algebra- Matrices [09 Hours]

Determinants & Matrix, Inverse of Matrix by adjoint method, Inverse by partitioning method, solution of system of linear equations, Rank of Matrix, Consistency of linear system of equation.

Unit 2: Ordinary Differential Equations of First Order and First Degree and Their Applications [09 Hours]

Linear equations; Reducible to linear equations (Bernoulli's equation); Exact differential equations; Equations reducible to exact equations; Applications to orthogonal trajectories, mechanical systems and electrical systems.

Unit3: Linear Differential Equations with Constant Coefficients [09 Hours]

Introductory remarks - complementary function, particular integral; Rules for finding complementary functions and particular integrals; Method of variation of parameters; Cauchy's homogeneous and

Legendre's linear equations.

Unit 4:Partial Differentiation [09 Hours]

Partial derivatives of first and higher orders; Homogeneous functions , Euler's Theorem for functions containing two and three variables (with proofs); Total derivatives; Change of variables.

Unit 5:Applications of Partial differentiation [09 Hours]

Jacobians - properties; Taylor's and Maclaurin's theorems (without proofs) for functions of two variables; Maxima and minima of functions of two variables; Lagrange's method of undetermined multipliers.

Text Books

1) Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.

2) Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.

3)A Course in Engineering Mathematics (Vol I) by Dr. B. B. Singh, Synergy Knowledgeware,Mumbai.

4) A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.

5) Higher Engineering Mathematics by H. K. Das and Er. RajnishVerma, S. Chand & CO. Pvt.Ltd., New Delhi.

Reference Books

1) Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

2) A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.

3) Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

ET1T005	Engineering Physics	4 Credit

COURSE OBJECTIVES:-

1. To provide a firm grounding in the basic physics principles and concept to resolve many Engineering and technological problems.
2. To understand and study the Physics principles behind the developments of Engineering materials.

COURSE OUTCOMES

At the end of the course students will be able to

1. Define the concept of laser, optical fiber, Hall effect, electron Ballistics, Bethe's law, Brewster law, polarization, electromagnetic wave.
2. Illustrate different types of laser, and optical fiber, Band-theory, Effect of electric and magnetic fields, Electric and Magnetic focusing, Interference in thin films, Interference in Wedge shape thin film and electromagnetic wave.
3. Apply the concept of Three and four level laser, pumping, population inversion, Numerical aperture, Attenuation and dispersion, V-I characteristics of PN-junction diode, CRO, Interference in thin films and electromagnetic waves.
4. Analyze the different types of laser and optical fiber, semiconductors, Motion of charged particles in uniform electric and magnetic fields, polarization, relation between electric and magnetic fields of an electromagnetic wave.
5. Interpret different types of laser, and optical fiber, PN- junction diode, Bipolar Transistor action, Velocity filter, polarization, wave plate.
6. Develop models based on laser, optical fiber.

Unit-I: Laser & Optical Fibre [08 Hrs]

Interaction of radiation with matter, Population Inversion and Optical resonance cavity , Three and four level laser, Ruby laser, He-Ne laser, Semiconductor laser , Properties and engineering applications of laser.

Optical fibers: Propagation by total internal reflection, structure and classification (based on material, refractive index and number of modes), Modes of propagation in fiber, Acceptance angle, Numerical aperture, Attenuation and dispersion.. Applications: I) As a Sensors - i) Temperature Sensor ii)

Pollution / Smoke detector iii) Liquid level sensor. II) As a Detectors- i) PIN detector ii) Avalanche Detector.

Unit-II: Semiconductor Physics [09Hrs]

Band-theory based classification of solids into insulators, semiconductors and conductors, Fermi-Dirac distribution Function, Intrinsic semiconductors: Germanium and silicon; Fermi- energy, Typical energy band diagram of an intrinsic semi-conductor, Extrinsic semiconductors, Current conduction in semiconductors.

PN- junction diode; Unbiased, Forward biased& Reverse biased mode with Energy band diagram , Diode rectifier equation, Bipolar Transistor action, Hall effect, Hall coefficient & Hall Angle

Unit-III: Electron Ballistics [08 Hrs]

Lorentz force, Motion of changed particles in uniform electric and magnetic fields (parallel, perpendicular and at an acute angle), Effect of electric and magnetic fields on kinetic energy of charged particle, Crossed electric and magnetic field configurations, Velocity filter, Electrostatic and magneto static deflection.

Bethe's law, Electric and Magnetic focusing, Construction & working of Electrostatic lens, Devices: CRT, CRO, Block Diagram, Function & working of each block.

Unit-IV: Wave Optics [08 Hrs]

Interference in thin films, Interference in Wedge shape thin film, Newton's rings, Anti-reflection coating, advanced applications of interference in thin film.

Polarization by reflection, Brewster's law, polarization by double refraction, Nicol prism, elliptically and circularly polarized light, Quarter wave plate and half wave plate.

Unit-V: Electromagnetic waves [06 Hrs]

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples.

Text Books:

1. Fundamentals of Physics: David Halliday, Robert Resnick and Jerle Walker, John-WileyIndia (8e, extended)
2. A text book of Engineering Physics: M. N. Avadhanulu, S. Chand & Co.
3. Nano the Essentials: Understanding Nanoscience and Nanotechnology, T.Praddep; TMH Publications.

4. Introduction to Nanotechnology:Pooly& Owens; Willey Publication
5. Text Book of Optics: Brijlal and Subramanyam (S. Chand and Company)
6. Laser: M. N. Avadhanulu, S. Chand & Co.

Reference Books:

1. LASERS: Theory and Applications: Thyagarajan K and Ghatak A.K.
2. Nanomaterials& Nanotechnologies and Design:M.F.Ashby, Paulo Ferreira and Daniel L.Schodek, Elsevier Publications.
3. University Physics: Young and Freedman (Pearson Education).
4. Optics: Jenkins and White (Tata Mcgraw Hill)

ET1L005	Engineering Physics Lab	1 Credit

List of Experiment

2. Newton's rings - Determination of radius of curvature of Plano convex lens / wavelength of light
3. Wedge Shaped film - Determination of thickness of thin wire
4. Laser - Determination of wavelength of He-Ne laser light
5. Magnetron Tube - Determination of 'e/m' of electron
6. Hall Effect - Determination of Hall Coefficient
7. Measurement of Band gap energy of Semiconductors
8. Study of I-V characteristics of P-N junction diode
9. Experiment on fibre optics
10. Input, output and current transfer characteristics of PNP/NPN transistor in CB and CE mode
11. Study of Cathode Ray Oscilloscope

ET1T006	Energy and Environment Engineering	3 Credit

COURSE OBJECTIVES

1. To understand the importance of Energy and Environment
2. To understand the application of energy saving tool in real life.
3. To investigate the key concepts of Energy and Environment

COURSE OUTCOMES

At the end of the course students will be able to

1) Describe different kind of pollution eg. Water pollution, air pollution, soil pollution etc.
2) Understand the importance of ecosystem for human beings..
3) Discover innovative method of power generation.
4) Correlate the cost of various method of power generation.
5) Judge the quality of air.

Unit 1 **[4 hrs]**

Air Pollution: Environment and Human health - Air pollution, Particulate emission: sources- effects- control measures -, air quality standards, and measurement of air pollution. Disposal of solid wastes, Bio-medical wastes effects- control measures

Unit 2 **[4 hrs]**

Water Pollution and Conservation: Water pollution- types of pollutants, effects- control measures, Water conservation and its methods, rainwater harvesting,methods of rainwater harvesting Surface runoff harvesting, Rooftop rainwater harvesting, Noise pollution ,effects and control measures, - Thermal pollution , Soil pollution ,Nuclear hazard.

Unit 3 **[4 hrs]**

Conventional Power Generation: Steam power station, Nuclear power plant , Gas turbine power plant- Hydro power station: Schematic arrangement, advantages and disadvantages, Thermo electric and thermionic generators, Environmental aspects for selecting the sites and locations of power plants.

Unit 4 **[4 hrs]**

Renewable Power Generation: Solar, Wind, Biogas and Biomass, Ocean Thermal energy conversion (OTEC), Tidal, Geothermal energy, Magneto Hydro Dynamics (MHD): Schematic arrangement, advantages and disadvantages.

Unit 5 **[4 hrs]**

Energy conservation: Scope for energy conservation and its benefits Energy conservation Principle , Maximum energy efficiency, Maximum cost effectiveness, Methods and techniques of energy conservation in ventilation and air conditioners, refrigerator, compressors, pumps, fans and blowers, Energy conservation in electric furnaces, ovens and boilers, lighting techniques. Triffs and economic aspects in power generation.

Reference/Text Books:

1. A Chakrabarti, M. L Soni, P. V. Gupta, U. S. Bhatnagar, A Text book of Power System Engineering, DhanpatRai Publication.
2. Rai. G. D., Non-Conventional Energy Sources, Khanna Publishers, Delhi, 2006.
3. Rao S., Parulekar B.B., Energy Technology-Non conventional, Renewable and Conventional, Khanna Publishers, Delhi, 2005.
4. Glynn Henry J., Gary W. Heinke, Environmental Science and Engineering, Pearson Education, Inc, 2004.
5. J. M. Fowler, Energy and the Environment, McGraw-Hill, 2 nd Edition, 1984.
6. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Prentice Hall, 2003.

WS1L001	Workshop Practices	2 Credit

Instructions to the student:

Each student is required to maintain a „workshop journal" consisting of drawing / sketches of the jobs and a brief description of tools, equipment, and procedure used for doing the job.

Contents:

a**) Carpentry:** Technical Terms related to wood working, Types of wood, Joining materials, Types of joints - Mortise and Tenon, Dovetail, Half Lap, etc., Methods of preparation and applications, Wood working lathe, safety precautions.

b) Welding: Arc welding - welding joints, edge preparation, welding tools and equipment, Gas welding - types of flames, tools and equipment, Resistance welding - Spot welding, joint preparation, tools and equipment, safety precautions.

c) Fitting: Fitting operation like chipping, filing, right angle, marking, drilling, tapping etc., Fitting hand tools like vices, cold chisel, etc. Drilling machine and its operation.

e) Machine shop: Lathe machine, types of lathes, major parts, cutting tool, turning operations (Demo), safety precautions

List of Practical:

1. Wood sizing exercises in planning, marking, sawing, chiselling and grooving to make half lap joint and cross lap joint.
2. A job involving cutting, filing to saw cut, filing all sides and faces, corner rounding, drilling and tapping on M. S. plates.
3. Exercise in Arc welding (MMAW) to make a square butt joint.
4. A demo job on turning of a Mild Steel cylindrical job using centre lathe.

Electrical workshop:-

1) To wire for a stair case arrangement using a two-way switch.
2) To measure electrical quantities-voltage current, power & power factor in RLC circuit.

ET1T007	Basics of Electrical and Electronics Engineering	Audit

COURSE OBJECTIVES

1. To provide a basic information and use of electrical and electronics components.
2. To understand and study the materials used for the preparation of electrical and electronics components.
3. To provide basic knowledge of operation and functionality of electrical and electronics components.

COURSE OUTCOMES:

CO1: Define fundamentals of electrical system and choose measuring instruments for measurement of electrical quantities & describe the concept PN junction diode and its characteristics.

CO2: Classify wiring system and compare energy resources for electrical energy generation & elaborate the transistor configuration in CE, CB & CC mode.

CO3: Plan and organize the utilization of energy resources of electrical system & apply transistor characteristics to construct Amplifier devices.

CO4: Compare different sources of electrical system & distinguish various logic gates and simplify the Boolean's equations.

CO5: Justify the utilization of various electrical and electronics components into electrical and electronics circuitries.

CO6: Construct various circuits using Resistors, capacitors, inductors, PN junction diode, Zener diode, transformers, transistors and logic gates.

Unit 1: Elementary Electrical Concepts and Circuit Components (8 Hrs)

Fundamental of Electrical system: Potential difference, Ohm's law, Effect of temperature onresister, resistance temperature coefficient, **Electrical wiring system**: Study of different wire gauges and their applications in domestic and industry.

Resistors: colour code, type of resistors, material used for resistors, resistance wires, resistance standards, frequency errors in resistors.

Capacitors: Capacitance standards, variable capacitors, frequency errors in capacitors. Loss angle and power factor of capacitors.

Inductors: standards of inductance, mutual inductance, self-inductance, variable inductance, inductors for high and low frequency work, frequency errors in inductors.

Unit 2: Measurement of Electrical Quantities, Measuring Instruments & Energy Resources (7 Hrs)

Measurement of Voltage, Current, and Power (1ph and 3ph), Introduction to PMMC instrument, Ohmmeter, galvanometer, potentiometers, power factor meter and frequency meters. Study of circuit breakers & Actuators (MCB & Fuse, Power Contactors & Aux contactors, Electro-Mechanical & Solid state Relays). **Energy Resources and Utilization**: Conventional and nonconventional energy resources; Introduction to electrical energy generation from different resources, transmission, distribution and utilization, Concept of Supply Demand, Power Factor, Need of unity factor.

Unit3: Introduction to diodes, diode circuit and Transducers (8 Hrs)

The P-N Junction Diode, V-I characteristics, Diode as Rectifier, specifications of Rectifier Diodes, Half Wave, Full wave, Bridge rectifiers, Equations for IDC VDC VRMS, IRMS, Efficiency and Ripple Factor for each configuration. Zener Diode, Characteristics, Specifications, Zener Voltage Regulator, Types of Diodes: LED, Photodiode. Introduction to transducer, Classification of transducers, characteristics and choice of transducers.

Unit 4: Semiconductor Devices and Applications: (7 Hrs)

Transistors: Introduction, Classification, CE, CB, and CC configurations, α, β, concept of gain and bandwidth. Operation of **BJT** in cut-off, saturation and active regions (DC analysis). BJT as an amplifier, biasing techniques of BJT, BJT as a switch.

Introduction to Digital Electronics: Number System, Basic logic Gates, Universal Gates, Boolean Postulates, De-Morgan Theorems

Reference/Text Books:

1. V. N. Mittal and Arvind Mittal, Basic Electrical Engineering, McGraw-Hill Publication.
2. Brijesh Iyer and S. L. Nalbalwar, A Text book of Basic Electronics, Synergy Knowledgeware Mumbai, 2017. ISBN:978-93-8335-246-3
3. Vincent DelToro, Electrical engineering Fundamentals, PHI Publication, 2nd Edition, 2011.
4. A Textbook of Basic Electrical and Electronics Engineering, J.B.Gupta, Katson Publication.
5. A Textbook of Basic Electrical Engineering by S.B. Bodkhe, N.M.Deskar, Professional Publishing House Pvt. Ltd
6. D. P. Kothari and Nagrath, Theory and Problems in Electrical Engineering, PHI Publication, 2011.

7. B. L. Theraja, Basic Electronics, S. Chand Limited, 2007.
8. Millman Halkias, Integrated Electronics-Analog and Digital Circuits and Systems, McGraw-Hill Publication, 2000.
9. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
10. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
11. Printed Circuit Boards Design & Technology, Walter C. Bosshart, McGraw-Hill Publication.

Note: Students are advised to use internet resources whenever required

Sr. No.	Category of Subject	Course Code	Course Name	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE/Ext. Pra.	Total	
1	HSMC	HU2T001	Communication Skills	2	0	0	60	0	40	100	2
2	BSC	MA2T001	Engineering Mathematics-II	3	1	0	20	20	60	100	4
3	BSC	EE2T002	Engineering Chemistry	3	1	0	20	20	60	100	4
4	ESC	EE2T003	Engineering Graphics	1	0	0	20	20	60	100	1
5	HSMC	HU2L001	Communication Skills Lab.	0	0	4	60	0	40	100	2
6	BSC	EE2L002	Engineering Chemistry Lab	0	0	2	60	0	40	100	1
7	ESC	EE2L003	Engineering Graphics Lab	0	0	4	60	0	40	100	2
8			Societal Internship/ Field Training	Credit to be given in III Sem.							
9	ESC	EE2T004	Basic Civil and Mechanical Engineering	2	0	0	10	15	25	50	Audit
				11	**2**	**10**					**16**
				23							

Curriculum for Semester- II [First Year]

HU2T001	Communication Skills	2 Credit

COURSE OBJECTIVES:

The main objective of the subject is to enhance the employability skills of engineering studentsas well as communication skills at work place.

The sub-objectives are:

1) To develop students' reading skills and pronunciation.
2) To develop technical communication skills through drafting, letter writing, and précis writing.
3) To develop literary skills through essay writing.
4) To develop public speaking skills of the students.
5) To expose the students to the ethics of English language by teaching grammar

COURSE OUTCOMES:

At the end of the course students will be able to

1) Better reading comprehension, pronunciation, and functional English grammar.
2) Write letters and resumes
3) Organize their thoughts for effective presentation and writing.
4) Learn skills to present themselves well in an interview, and handle a Group Discussion

Unit 1: Communication and Communication Processes (06 hrs)

Introduction to Communication, Types and functions of Communication, Barriers to Communication and overcoming them, Role of Communication Skills in Society

Reading: Introduction to Reading, Barriers to Reading, Types of Reading: Skimming, Scanning, Intensive and Extensive, Strategies for Reading Comprehension.

Listening: Importance of Listening, Types of Listening, and Barriers to Listening.

Unit 2: Study of Sounds in English and Vocabulary Building (06 hrs)

Introduction to phonetics, Study of Speech Organs, Study of Phonemic Script, Articulation ofDifferent Sounds in English.

Vocabulary Building: The concept of Word Formation, Root words from foreign languages and their use in English, Use of prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations

Unit 3: English Grammar (06 hrs)

Grammar: Forms of Tenses, Articles, Prepositions, Use of Auxiliaries and Modal Auxiliaries, Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation,Common Errors. Misplaced modifiers

Unit 4: Professional Verbal Communication (06 hrs)

Components of an effective talk, Idea of space and time in public speaking, Tone of voice, Body language, Timing and duration of speech, Audio-Visual Aids in speech. Presentation Skills, Group Discussion and Job Interviews

Unit 5: Developing Business Writing Skills, Styles and Practice (06 hrs)

Writing Emails, Report Writing: Format, Structure and Types, Letter Writing**:** Types, Parts, Layouts, Writing Job Application Letter and Resume.

Nature and Style of sensible Writing and Practice: Describing, Defining, Classifying, Providing examples or evidence, writing introduction and conclusion, Writing Practices: Comprehension, Précis Writing, Essay Writing

Text book:

Mohd. Ashraf Rizvi, Communication Skills for Engineers, Tata McGraw Hill

Reference Books:

1) Sanjay Kumar, PushpLata, Communication Skills, Oxford University Press, 2016

2) Meenakshi Raman, Sangeeta Sharma, Communication Skills, Oxford University Press, 2017

3) Teri Kwal Gamble, Michael Gamble, Communication Works, Tata McGraw Hill Education, 2010

4) Anderson, Kenneth. Joan Maclean and Tossny Lynch. Study Speaking: A Course in Spoken English for Academic Purposes. Cambridge: CUP, 2004.

5) Aswalthapa, K. Organisational Behaviour, Himalayan Publication, Mumbai (1991).

6) Atreya N and Guha, Effective Credit Management, MMC School of Management, Mumbai (1994).

7) Balan,K.R. and Rayudu C.S., Effective Communication, Beacon New Delhi (1996).

8) Bellare, Nirmala. Reading Strategies. Vols. 1 and 2. New Delhi. Oxford University Press, 1998.

9) Bhasker, W. W. S &Prabhu, N. S.: English through Reading, Vols. 1 and 2. Macmillan, 1975.

10) Black, Sam. Practical Public Relations, E.L.B.S. London (1972).

11) Blass, Laurie, Kathy Block and Hannah Friesan. Creating Meaning. Oxford: OUP, 2007.

12) BoveeCourtland,L and Thrill, John V. Business Communication, Today McGraw Hill, New York, Taxman Publication (1989).

HU2L001	Communication Skills Lab	2 Credit

List of Practical Sessions (Any 10 PR sessions can be conducted):

1) Pronunciation, Intonation, Stress and Rhythm(02 hrs)
2) Introduction to Phonemic symbols (02 hrs)
3) Articulation of sounds in English with proper manner (02 hrs)
4) Practice and exercises on articulation of sounds (02 hrs)
5) Read Pronunciations/transcriptions from the dictionary (02 hrs)
6) Practice and exercises on pronunciations of words (02 hrs)
7) Introduce yourself (02 hrs)
8) Importance of Business Communication with the help of a case study.(02hrs)
9) Listening Skills/ Comprehension(02 hrs)
10) Common Everyday Situations: Conversations and Dialogues(02 hrs)
11) Communication at Workplace(02 hrs)
12) Rapid reading sessions (02 hrs)
13) Draft Email(02 hrs)
14) Resume Writing(02hrs)
15) Drafting Business Letter(02 hrs)
16) Preparing technical paper using IEEE format(02 hrs)
17) Extempore (02 hrs)
18) Elocution (02 hrs)
19) Group discussion (02 hrs)
20) Participating in a debate (02 hrs)
21) Presentation techniques (02 hrs)
22) Interview techniques , Job Interviews, Telephonic Interviews(02hrs)
23) Mock interviews and practice sessions(02 hrs)

MA2T001	Engineering Mathematics-II	4 Credit

COURSE OBJECTIVES

1. To understand the importance of Mathematics
2. To understand the application of Mathematics in engineering and in real life.
3. To investigate the key concepts of Mathematics.
4. To enable students to analyse a problem

COURSE OUTCOMES

At the end of the course students will be able to

1. Describe concept of complex numbers, integral calculus & multiple integrals, Fourier series & transform, vector differential calculus, vector integral calculus.
2. Illustrate the concept of complex numbers, integral calculus & multiple integrals, Fourier series & transform, vector differential calculus, vector integral calculus by using examples.
3. Apply the knowledge of complex numbers, integral calculus & multiple integrals, Fourier series & transform, vector differential calculus, vector integral calculus to solve the engineering problems.
4. Analyse the problems and results of complex numbers, integral calculus & multiple integrals, Fourier series & transform, vector differential calculus, vector integral calculus to solve the engineering problems.
5. Evaluate the problems by using complex numbers, integral calculus & multiple integrals, Fourier series & transform, vector differential calculus, vector integral calculus to solve the engineering problems.
6. Create the methods or model by using complex numbers, integral calculus & multiple integrals, Fourier series & transform, vector differential calculus, vector integral calculus to solve the engineering problems.

Unit 1: Complex Numbers [09 Hours]

Definition and geometrical representation; De-Moivre'stheorem (without proof); Roots of Complex numbers by using De-Moivre'stheorem; Circular functions of complex variable ,definition; Hyperbolic functions; Relations between circular and hyperbolic functions; Real and Imaginary parts of circular and hyperbolic functions; Logarithm of Complex quantities.

Unit 2: Integral calculus & Multiple Integrals [09 Hours]

Beta, Gamma functions; tracing of the curves given in Cartesian, parametric & polar forms. Double integration in Cartesian and polar co-ordinates; Evaluation of double integrals by changing the order of integration and changing to polar form; Triple integral

Unit3: Fourier Series & Transform[09 Hours]

Fourier Series , Definition and Properties (excluding FFT), Fourier Integral Theorem, Relation with Laplace Transform, Applications of Fourier Transform to Solve Integral Equations.

Unit4: Vector Differential Calculus [09 Hours]

General rules of vector Differentiation; Scalar and vector fields: Gradient, divergence and curl; Solenoidal and irrotational vector fields; Vector identities

Unit5: Vector Integral Calculus [09 Hours]

Vector Integration: line integral, surface integral and volume integral; Green's lemma, Gauss' divergence theorem and Stokes' theorem (without proofs).

Text Books

1) Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.

2) Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.

3)A Course in Engineering Mathematics (Vol I) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.

4) A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.

5) Higher Engineering Mathematics by H. K. Das and Er. RajnishVerma, S. Chand & CO. Pvt.Ltd., New Delhi.

Reference Books

1) Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

2) A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.

3) Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., NewDelhi.

ET2T002	Engineering Chemistry	4 Credit

COURSE OBJECTIVES

1. To understand the importance of Chemistry
2. To understand the application of Chemistry in engineering and in real life.
3. To investigate the key concepts of Chemistry knowledge
4. To enable students to analyse a Chemistry problem so that appropriate problem solving techniques may be applied

COURSE OUTCOMES

At the end of the course students will be able to

1. Describe various properties of water, fuel, transition metal ions and their magnetic properties, Debye-Hückel theory, Quinonoid theory, various electrode, polymer and batteries
2. Illustrate the various types of water, Ostwald's theory of acid-base indicator, polymer, various batteries, and fuel cell.
3. Analyze the question on water characteristics, electrochemistry and various types of instrumental titration, various batteries and fuel cell.
4. Apply the Knowledge of zeolite process, Ion exchange process, Hot Lime ,Soda process, acid base concept, fuel cell and batteries..
5. Develop a Modal on softening of water, standardization of acid and base by various instruments, polymers, fuel cell and batteries..
6. Organize water as per quality, and fuel, types of electrodes, polymers and fuel cell and batteries.

Unit1: Water Treatment **6 Hrs**

Introduction, hard and soft water, softening of water , Zeolite process, Ion exchange process, Hot Lime ,Soda process, water characteristics- Hardness, Domestic water treatment

Unit2: Fuels **6 Hrs**

Introduction, classification of fuel, essential properties of fuel, characteristics of good fuel, solid fuel- Coal, Various types of Coal, Analysis of coal-Proximate and Ultimate analysis, liquid fuel- Refining of Petroleum.

Unit3: Electrochemistry **8 Hrs**

Introduction-basic concepts, Transport number and its determination by Moving Boundary method, Debye-Hückel theory, Conductometric titrations, Ostwald's theory of acid-base indicator, Quinonoid theory, Electrodes , Glass electrode, Quinhydrone electrode.

Unit4: Advanced Polymeric Materials: **8 Hrs**

Introduction to reactions involving substitution, addition, elimination, cyclization and ring opening. Liquid crystals and liquid crystal polymers (thermotropic and lyotropic), phases of thermotropic polymers: nematic, smectic, cholesteric; advantages, disadvantages and applications

Unit5: Battery Technology: **6 Hrs**

Classification of batteries: Primary, Secondary- Electricity storage density, power density, energy efficiency, cycle life, shelf life. Rechargeable alkaline storage batteries, Ni-metal hydride,
Lithium ion batteries and H2-O2 Fuel cell.

Text Books:

1. A Text book of Engineering Chemistry, Dr. S. S. Dara, Dr. S. S. Umre,S. Chand and Company Ltd., Twelfth/ 2011
2. Selected Topics in Inorganic Chemistry, Dr. Wahid U. Malik, Dr. G. D. Tuli and Dr. R. D. Madan, S. Chand and Company Ltd., Seventh/2001

Reference Books:

Engineering Chemistry, P. C. Jain and Monika Jain, Dhanpatrai Publishing Company Ltd., 15th Ed/ 2009

Principles of Physical Chemistry, B. R. Puri, L. R. Sharma and Madan S. Pathania, Vishal Publishing Company, First/2002

Chemistry, John E McMurry and Robert C Fay, Pearson, First/2008

EL2L002	Engineering Chemistry Lab	1 Credit

List of Experiments: (Perform any 8, 10 Experiments)

1. Determination of Hardness of water sample by EDTA method.
2. Determination of flash point by Pensky Martin Apparatus
3. Determination of Dissolve Oxygen by Iodometric method.
4. Determination of percent purity of Bleaching Powder.
5. pH , metric Titration (any one type of Acid Base titration)
6. Conductometric Titration (any one type of Acid Base titration)
7. Surface tension: Determination of relative surface tension of liquid with respect to water using drop number method.
8. Viscosity:Determination of relative viscosity of liquid with respect to water using Ostwald's viscometer method.
9. To determine the normality in Normal term and Strength in gms/lit of HCl solution by titrating with Na_2CO_3 solution.
10. To find out Morality, Normality and Strength of the given $KMnO_4$ solution by titrating against N/10 Mohr's solution.
11. Determination of Acid value of an oil sample.
12. Determination of Saponification value of an oil sample.

Reference Books:

1. Systematic experiments in Chemistry, A. Sethi, New Age International Publication, New Delhi.
2. Practical Inorganic Chemistry, A. I. Vogel, ELBS Pub.
3. Practical in Engineering Chemistry, S. S. Dara.

ET2T003	Engineering Graphics	1 Credit

COURSE OBJECTIVES

1. To understand the concepts like dimensioning, conventions and standards related to engineering graphics in order to become professionally efficient
2. To understand theory of projection and simple machine parts in first and third angle of projection systems.
3. To understand the key concepts CAD software.
4. To enable students to analyze a 2-dimensional & 3-dimensional problem.

COURSE OUTCOMES:

1. Define various concepts like dimensioning, conventions and standards related to engineering graphics in order to become professionally efficient.
2. Interpret drawings of simple machine component in first and third angle of projection systems
3. Apply theory of projections in projection of lines, projection of planes and projection of solid.
4. Classify solid geometry in different positions.
5. Assess the two dimensional and three dimensional drawing in CAD software.
6. Create the three dimensional engineering objects into two dimensional drawings and vice versa using CAD software

Unit I Introduction to Computer Aided Drawing [03 hrs]

Theory of CAD software, Demonstration knowledge, layout of the software, standard tool bar/menus and description of most commonly used tools bars, Navigational tools. Creation of 2D/3D environment. Commands and creation of co-ordinate points, lines, axes, polyline, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, offset, mirror, rotate, trim, extend, break, chamfer, fillet, zoom, pan, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line conventions, lettering. Line properties, 3D modeling& topology of engineering component.

Unit II Drawing standards & Orthographic Projections: [03 hrs]

Drawing standard SP: 46, type of lines, lettering, dimensioning. Basic geometrical construction, drawing of regular polygon, Theory of projection, introduction to orthographic projection, drawing of orthographic views of objects from their isometric views by using first angle method of projection.

Unit III Projections of Points & Projections of Straight Lines: [03 hrs]

Projection of point lying in four quadrants. Projections of lines parallel and perpendicular to one or both planes, projections of lines inclined to one or both reference planes.

Unit IV Projections of Planes & Projections of Solids: [03 hrs]

Projections of planes parallel and perpendicular to one or both planes, projection of planes inclined to one or both planes.

Types of solids, Projection of solid when axis is perpendicular to one of the reference planes, when axis is inclined to one and parallel to other reference plane, when axis is inclined to both the reference planes

Unit V Isometric Projections [03 hrs]

Isometric projections: Isometric scale, drawing of isometric projections from given orthographic views.

Text Books:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 46th Edition, 2003.
2. Dhananjay A. Jolhe, Engineering Drawing with an Introduction to AutoCAD, McGraw Hill Education, 2017

Reference Books:

1. K. V. Nataraajan, A text book of Engineering Graphic, Dhanalakshmi Publishers, Chennai, 2006.
2. K. Venugopal and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd, 2008.
3.Engineering Drawing, R. K. Dhawan, S. Chand Publication, 1998.
4. Engineering Graphics, A. R. Bapat, Allied Publishers, 2004.
5. Fundamentals of Engineering Drawing, Luzadder& Duff, Eastern Economy, 11th Edition.

ET2L003	Engineering Graphics Lab	2 Credit

COURSE OBJECTIVES:

The objective of the course is to enable students to

1. Provide basic foundation in CAD software.
2. Understand the fundamentals used to create and manipulate geometric models.
3. Get acquainted with the basic CAD software for to design geometric modeling.

COURSE OUTCOMES:

1. Define basic structure of CAD workstation, CAD commands, Memory types, input/output devices and display devices to become professionally efficient to operate CAD software.
2. Explain drawing of simple machine component in CAD software.
3. Acquire the knowledge of geometric modeling in CAD software.
4. Analyze the steps required in CAD software for 2-dimensional and 3-dimensional models.
5. Assess the two dimensional and three dimensional drawing in CAD software.
6. Create the three dimensional engineering objects into two dimensional drawings and vice versa using CAD software.

List of Practical:

1. Introduction of CAD software and to study and practice basic draw commands exists in the CAD software.
2. Lines, lettering and dimensioning. (Drafting work)
   Identify the different types of Lines in the given object, draw lettering and give the Required dimensions in the given object.
3. Geometric Construction. (Drafting work)
4. Orthographic projections first sheet. (Using CAD software)
5. Orthographic projections second sheet. (Using CAD software)
6. Projections of straight lines. (Drafting work)

7. Projections of planes & solids. (Drafting work)

8. Isometric Projections first sheet. (Using CAD software)

9. Isometric Projections second sheet. (Using CAD software)

10. Design of basic hardware components using CAD Software.

11. Design of advance hardware components using CAD Software.

12. Design of assembly drawing using CAD Software.

13. Design of assembly drawing with animation and rendering using CAD Software.

ET2T004	Basic Civil and Mechanical Engineering	Audit

COURSE OBJECTIVES

1. To understand the basic stream of Mechanical engineering and Civil Engineering.

2. To understand the concepts of product manufacturing, Energy engineering, design engineering, Automobile engineering, construction technique and civil surveying.

3. To have basic knowledge of Casting, Machining, Designing, Manufacturing, different materials for building construction and surveying.

COURSE OUTCOMES:

Students would be able to

1. Define basic stream of Mechanical & Civil Engineering.
2. Explain the concepts of product manufacturing, Energy engineering, design engineering, Automobile engineering, construction technique and civil surveying.
3. Apply Basic knowledge of Casting, Machining, Designing, Manufacturing & Civil Construction technique.
4. Analyzed the different mechanical system and properties of construction & surveying material.
5. Interpret the problem in mechanical system and civil structure.
6. Solve the problem in mechanical system and civil structure.

Part I Basic Civil Engineering

Unit 1: Introduction to civil engineering

Various branches introduction to civil engineer in various construction activities basic engineer properties and various materials: earth bricks timber, stone, sand Aggregate cement motor steel bituminous glass FRP composite material.

Unit 2: Building component and planning material

Foundation and superstructure function of foundation type of shallow and deep foundation suitability in different situation plinth wall lintels beam column slab roof staircase floor door window and study of building plans ventilation and basic plumbing and sanitation

Unit 3: Surveying

Principal of surveying element of distance angular measurement plotting of area base line and off set introduction of plane table survey introduction to levelling concept of bench mark reduce level and counting

Part II Basic Mechanical Engineering

Unit 1: Introduction to Mechanical Engineering, Introduction to Laws of Thermodynamics with simple examples pertaining to respective branches, IC Engines: Classification, Applications, Basic terminology, 2 and 4 stroke IC engine working principle, Power Plant: Types of Power plant; Gas power plant, Thermal power plant, Nuclear power plant, Automobiles: Basic definitions and objectives

Unit 2: Design Basics, Machine and Mechanisms, Factor of safety, Engineering Materials: types and applications, basics of fasteners, machining and machinability. Introduction to lathe machine, drilling machine, milling machine, basics of machining processes such as turning, drilling and milling. Introduction to casting

Text Books:

1. AnuragKandya, “Elements of Civil Engineering”, Charotar Publishing, Anand
2. M. S. Palani Gamy, “Basic Civil Engineering”, Tata Mc-Graw Hill Publication
3. G. K. Hiraskar, “Basic Civil Engineering”, DhanpatRai Publications
4. GopiSatheesh, “Basic Civil Engineering”, Pearson Education

Reference Books:

1. M. G. Shah, C. M. Kale, and S. Y. Patki, “Building Drawing”, Tata McGraw Hill
2. Sushil Kumar, “Building Construction”, Standard Publishers Distributors
3. Kanetkar T. P. and Kulkarni S. V., “Surveying and Levelling”, Vols. I, II and III, Vidyarthi
4. GruhPrakashan, Pune
5. B. C. Punmia, “Surveying”, Vol.- I, Vol.-II, Vol.-III, Laxmi Publications
6. P. K. Nag “Engineering Thermodynamics”, Tata McGraw Hill, New Delhi 3rd ed. 2005
7. A. Ghosh, A K Malik, “Theory of Mechanisms and Machines”, Affiliated East West Press Pvt. Ltd. New Delhi.

8. SeropeKalpakaji and Steven R Schimd "A manufacturing Engineering and Technology" Addison WsleyLaongman India 6th Edition 200
9. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi.

Curriculum for Semester- III [Second Year]

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	TOTAL	
1	HSMC	EE3T001	Engineering Economics	2	0	0	20	20	60	100	2
2	BSC	EE3T002	Engineering Mathematics –III	3	1	0	20	20	60	100	4
3	ESC	EE3T003	Theory of electrical engineering	3	1	0	20	20	60	100	4
4	PCC-EE	EE3T004	Network Analysis	3	0	0	20	20	60	100	3
5	PCC-EE	EE3T005	Electrical Machine I	2	1	0	20	20	60	100	3
6	PCC-EE	EE3T006	Measurement and Instrumentation	2	1	0	20	20	60	100	3
7	PCC-EE	EE3L004	Network Analysis Lab	0	0	2	60	0	40	100	1
8	PCC-EE	EE3L005	Electrical Machine I Lab	0	0	2	60	0	40	100	1
9	PCC-EE	EE3L006	Measurement and Instrumentation Lab	0	0	2	60	0	40	100	1
10	PROJ-EE	EE3P001	Field trainning/ Internship/ industrial visit	0	0	0	0	0	50	50	1
11	MC	EE3T007	Innovation and entrepreneurship Development	2	0	0	10	15	25	50	Audit
				17	**4**	**6**	**310**	**135**	**555**	**1000**	
								Total Credits			**23**

EE3T001	Engineering Economics	2 Credit

COURSE OBJECTIVE

1. To learn the basics of Economics.
2. Ability to take Economically Sound Decision.
3. Ability To understand the interaction of World Economy.
4. To be able to work in an Industrial atmosphere.

COURSE OUTCOME

1. Remember and define basics of the Economics
2. Understand Mechanism of Price Fixation
3. Identify Time value of Money.
4. Analyze and classify basic Factors of Production
5. Interpret Indian Economy and Globalization .
6. Plan To become Self Employed

COURSE CONTENTS:

UNIT 1: [05 hrs]

Introduction, Micro And Macro Economics .Economics and its relation with other subjects, Nature of Economic laws. Basic Economic problems, Basic Economic terms, Engineering and Economics

UNIT 2: [05 hrs]

Meaning of demand ,Factors affecting demand, Law of Elasticity ,Types of elasticity, Practical applications of Laws of Elasticity ,Demand Forecasting, Techniques of Demand forecasting. Law of supply, Role of demand and Supply in Price Fixation.

UNIT 3: [04 hrs]

Time value of Money ,Capital Budgeting ,Traditional and modern methods of Payback, IRR, ANR, Case studies

UNIT 4: **[05 hrs]**

Factors of Production, Concepts of cost, Break even Analysis, Law of variable Proportions ,Internal and External Economies of scale, Depreciation.

UNIT 5: **[05 hrs]**

ENTERPRISE Meaning and definition, factors required for growth of Enterprise, Institutions to support the growth of MSME's, Sources of finance for MSME's and scope for self Employment Opportunities.

UNIT 6: **[04 hrs]**

Features of Indian Economy, Fiscal and Monetary policy, LPG, Inflation, Banking,
World Economic bodies

Text Books:

1. Chopra P. N., Principle of Economics, Kalyani Publishers
2. Dewett K. K., Modern economic theory, S. Chand
3. H. L. Ahuja., Modern economic theory, S. Chand
4. Dutt Rudar & Sundhram K. P. M., Indian Economy
5. SMALL-SCALE INDUSTRIES AND ENTREPRENEURSHIP by Vasant DEASAI,

Reference Books:

1. Dewett K.K. Elemntary Economic Theory.
2. Entrepreneurial Development By S.S.Khanka.
3. Financial Management: Theory and Practice: Author: Prasanna Chandra, Mc Graw Hill India .

EE3T002	Engineering Mathematics –III	4 Credit

COURSE OBJECTIVES:

1. The basic concept of Laplace Transform , Fourier Transform, Function of Complex variable.
2. Ability to solve the problem on Laplace transform Fourier integral , Parseval's identity.
3. Apply the knowledge of the Laplace Transform ,Fourier Transform , Partial differential equation, function of complex variable to real life problem.

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to

1.Remember properties of Laplace transform , Convolution Theorem, Fourier integral theorem , Parseval‟s identity , Cauchy's integral theorem , Cauchy's residue theorem

2.Describe properties of Laplace transform , Convolution Theorem, Fourier integral theorem , Parseval‟s identity , Cauchy's integral theorem , Cauchy's residue theorem .

3.Illustrate the examples using Laplace transform, Fourier Transform, Partial differential equation, Function of Complex Variables, Matrices.

4.Apply the knowledge of Laplace transform ,Z-transform, function of complex variable, Advance partial differential equation.

5.Analyze the question on Laplace transform, Fourier Transform, Partial differential equation , Function of Complex Variables

6.Create a modal using Laplace transform, Fourier Transform, Partial differential equation, Function of Complex Variables, Matrices.

COURSE CONTENTS

UNIT 1 : Matrices **[07 hrs]**

Characteristics equation, Eigen values and Eigen vectors, Statement and Verification of Cayley Hamilton Theorem [without proof], Reduction to Diagonal form, Sylvester's theorem [without proof.]

UNIT 2: Laplace Transform **[07 hrs]**

Definition , conditions for existence; Properties of Laplace transforms; Transforms of some special functions- periodic function, Heaviside-unit step function.

UNIT 3: Inverse Laplace Transform **[07 hrs]**

Introductory remarks ; Inverse transforms of some elementary functions ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of differential equations

UNIT 4: Z- Transform **[07 hrs]**

Defination, Convergence of Z-transform and Properties, Inverse Z-transform by Partial Fraction Method, Residue Method (Inversion Integral Method), Solutions of Difference Equations with Constant Coefficients by Z- transform.

UNIT 5: Advance Partial Differential equations **[07 hrs]**

Introduction Partial differential equation, method of separation of variables, Application of partial differential equations .(Heat equation ,wave equation , Laplace Equation)

UNIT 6: Functions of Complex Variables **[07 hrs]**

Analytic functions; Conjugate functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form, Cauchy's integral theorem; Bilinear transform Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorem without proofs)

Text Books:

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books:

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.

3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and Their Engineering Applications by Dr. B. B. Singh, Synergy . Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York.

EET3003	Theory of Electrical Engineering	4 Credit

COURSE OBJECTIVE

Students will learn:

1 Remember fundamental principles of electrical and magnetic circuit

2 Understand simplified methods such as series parallel reductions, voltage and current dividers, and the mesh - node method.

3 To apply laws of electric and magnetic system.

4 To analyze electrical circuit, magnetic circuit and illumination system

5 To utilize various lighting system and electric system and evaluation of same.

6 Design parameters of electrical circuit, magnetic circuit and illumination system.

COURSE OUTCOMES

Upon completion of this course, the students shall be able to,

1. Remember the basic laws of electric and magnetic circuits also Define various A.C. and D.C Quantities
2. Understand and interpret the sinusoidal electrical quantities mathematically as well as graphically in the form of waveforms/phasors and illustrate the 1-phase/3-phase AC circuits.
3. Apply knowledge to calculate the power loss, voltage drop of electric and magnetic circuit also identify illumination required and the knowledge related with its need.
4. Analyze various electric, magnetic circuit and distinguish between properties.
5. Evaluate lighting system, recommend various lighting as per requirement also able to Explain A.C. fundamentals.
6. Design lighting system and also able to give solutions on single phase, poly phase and magnetic circuit unknown quantities.

Course Contents:

Unit 1: D. C. Circuits (Only Independent sources) [08 hrs]

Ohm's law, resistances in series and parallel, current and voltage division rules, Kirchhoff's law, ideal and practical voltage and current sources. Mesh and Nodal analysis (Super node and super Mesh excluded). Source transformation. Star delta transformation. Superposition theorem.

Unit 2: Electromagnetism [10 hrs]

Magnetic effect of electrical current cross and dot convention, right hand thumb rule and cork screw rule, nature of magnetic field of long straight conductor, concepts of solenoid and torrid. Concepts of m.m.f, flux, flux density, reluctance, permeability and field strength, their units and relationship. Simple series and parallel magnetic circuits. , comparison between electrical and magnetic circuits , force on current carrying conductor placed in magnetic field, Fleming's left hand rule.

Faraday's law of electromagnetic induction, Fleming's right hand rule, statically and dynamically induced EMF's self and mutual inductance coefficient of coupling, energy stored in magnetic field.

Unit 3: A.C. Fundamentals [12 hrs]

Sinusoidal voltage and currents, their mathematical and graphical representation, concept of cycle period, frequency, instantaneous, peak, average, r.m.s. values, peak factor , and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors. Study of A.C circuits of pure resistance, inductance and capacitance and corresponding voltage- current phasor diagrams, voltage , current and power waveforms.

Unit 4: Single phase and poly phase A. C. circuits [12 hrs]

Single phase AC Circuits: Study of series and parallel R-L, R-C, R-L-C circuits, concept of impedance and admittance for different combinations, wave form and relevant voltage current phasor diagrams. Concept of active, reactive, apparent, complex power and power factor, resonance in series and parallel RLC circuit. Q- factor and bandwidth.

Polyphase AC circuits: Concept of three phase supply and phase sequence. Balanced and unbalanced loads voltage current and power relations in three phase balance star and delta loads and their phasor diagrams.

Unit 5: Electrostatics [07 hrs]

Electrostatics: electrostatic field, electric flux density, electric field strength, absolute permittivity, relative permittivity and capacitance, composite dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors and concept of time constant.

Unit 6 : Illumination and Electrical Energy Tariff [07Hrs]

Definitions of luminous flux, luminous intensity, candle power, illumination, luminance, luminous efficiency (lumens/watt) of different types of lamps, working principle of Fluorescent/ Sodium Vapour/ Mercury vapour & CFL Lamps. Simple numerical to determine number of

lamps to attain a given average lux level in an area.

Types of Tariff, One part (KWH based) tariff with simple numerical: (Students should be able to calculate the domestic electricity charges.)

Text Books:

1. Elements of Electrical sciences: P. Mukhopadhyay, N. Chand & Bros Roorkee (1989).
2. Electrical Technology: B. L. Thareja, S. Chand Publications.
3. Basic Electrical Engineering: S. B. Bodkhe, N. M. Deshkar, P. P. H. Pvt. Ltd.

Reference Books:

1. V. N. Mittal and Arvind Mittal;, " Basic Electrical Engineering" McGraw Hill
2. Vincent DelToro, " Electrical engineering Fundamentals", PHI second edition 2011
3. Bolestaad, :"Electronics Devices and Circuits Theory", Pearson Education India
4. Edward Hughes, " Electrical Technology,", Pearson Education
5. D.P. Kothari and Nagrath " Theory and Problems in electrical Engineering", PHI edition 2011.

EE3T004	Network Analysis	3 Credit

COURSE OBJECTIVE

Students will learn:

1. The fundamental principles of electrical circuit analysis
2. To become adept at using various methods of circuit analysis, including simplified methods such as series parallel reductions, voltage and current dividers, and the mesh - node method.
3. To appreciate the consequences of linearity, in particular the principle of superposition and Thevenin - Norton equivalent circuits.
4. To analyze energy storage elements.
5. To utilize Laplace transforms for circuit analysis.
6. To analyze four terminal networks using two-port parameters.

Course Outcomes:

Students should be able to:

1. Define basic concepts and principles related to Circuit Analysis
2. Identify the super mesh & super nodal problems.
3. Apply a variety of circuit analysis methods including theorems and Laplace transform
4. Solve two port network problems.
5. To design and develop network equations and their solutions.
6. Select best possible method of circuit analysis for a given situation

COURSE CONTENTS

Unit 1: Terminal Element Relationships [06 Hrs]

V-I relationship for Inductance and Capacitance - Constant Flux Linkage Theorem and Constant Charge Theorem. Dependent and Independent Sources, Active & Passive Elements, Source Transformation, Duality.

Unit 2: Mesh And Nodal analysis [08 Hrs]

Mesh analysis of circuits containing resistors, inductors, capacitors, transformers, and both independent and dependent sources to determine current, voltage, power, and energy. Concept of super mesh, mutual inductance, coefficient of coupling, Dot convention, dot marking in coupled coils. Nodal analysis of circuits containing resistors, inductors, capacitors, transformers, and both independent and dependent sources to determine current, voltage, power, and energy. Concept of super node.

Unit 3: Network Theorems [07 Hrs]

Linearity theorem, Thevinin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Tellegen's theorems (Both AC & DC)

Unit 4: Time Domain Analysis of Circuits [07 Hrs]

Linear Differential Equations for Series RC, Parallel RC, Series RL, Parallel RL, Series RLC, Parallel RLC and Coupled Circuits- Complete Solution for step/impulse/sinusoid voltage/current inputs. Natural Response-Transient Response-Time Constant-Rise and Fall times-Concept of D.C. steady state and sinusoidal steady state-Frequency Response of simple circuits from steady state solution-Solution of two mesh circuits by differential equation method Determination of initial conditions

Unit 5: Laplace Transform & Properties [07 Hrs]

Review of Laplace Transform & Properties Partial fractions, Concept of initial and final condition, Singularity functions, Waveforms synthesis, Steady state and transient state analysis of RL, RC, RLC network with and without initial conditions with Laplace transforms. Network Functions: Driving points and transfer functions, poles, zeros of transfer function, their properties.

Unit 6: Two Port Networks [07 Hrs]

Two port networks, characterizations in terms of impedance, admittance, hybrid and transmission parameters, Conditions for symmetry and Reciprocal, inter relationships among parameter sets Reciprocity Theorem-Interconnection of Two port networks: Series, Parallel and Cascade connection.

Ref Books:

1. Mac.E Van Valkenburg, "Network Analysis"
2. Franklin Fa-Kun. Kuo, "Network Analysis & Synthesis", John Wiley & Sons.
3. M. L. Soni, J. C. Gupta, "A Course in Electrical Circuits and Analysis"
4. Mac.E Van Valkenburg, "Network Synthesiss"

5. Joseph A. Edminister, Mahmood Maqvi, “Theory and Problems of Electric Circuits”, Schaum's Outline Series
7. Sudhakar Shyammohan Tata Mc Graw Hill 2005, “Circuit and Network Analysis”\

EE3L004	Network Analysis Lab	1 Credit

COURSE OBJECTIVE

Students will learn:

8. The fundamental principles of electrical circuit analysis
9. To become adept at using various methods of circuit analysis, including simplified methods such as series parallel reductions, voltage and current dividers, and the mesh - node method.
10. To appreciate the consequences of linearity, in particular the principle of superposition and Thevenin - Norton equivalent circuits.
11. To analyze energy storage elements.
12. To utilize Laplace transforms for circuit analysis.
13. To analyze four terminal networks using two-port parameters.

COURSE OUTCOMES

Students should be able to:

1. Define basic concepts and principles related to Circuit Analysis
2. Identify the super mesh & super nodal problems.
3. Verifies principles of network
4. Solve two port network problems.
5. To Analyze RLC Circuit

List of Practical

1 To Study & Verify Superpostion theorem

2 To Study & Verify Thevinion’s theorem

3 To Study & Verify Norton’s theorem

4 To Study & Verify maximum power transfer theorem

5 To Study & Verify reciprocating theorem

6 Determination of transient response of current in RL & RC circuits with step voltage input

7 Analysis of RL/ RC and RLC circuits

8 Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values

9 Determination of z and h parameters (dc only) for a network and computation of Y and ABCD parameters.

EE3T005	Electrical Machine-I	3 Credit

COURSE OBJECTIVE

The course objective is to impart knowledge of,

1. The basic principle of transfer of electrical power, operation, construction of Single phase and Three phase transformers, their classification, connections and phasor diagrams.
2. The basic principle, construction, operation, Performance characteristics, steady state analysis and applications of DC generators and motors.
3. The basic principle, construction, operation, Performance characteristics, steady state analysis, Speed control and applications of Single Phase and Three phase Induction motors.

COURSE OUTCOMES

Upon completion of this course, the students shall be able to,

1. Recall the basic laws and rules of electromagnetic induction, electric and magnetic circuits.
2. Understand constructional features, working principles of electrical machines and explain different types of starting & speed control methods of electric motors.
3. Apply knowledge to calculate the power loss, voltage regulation, efficiency of transformer and operating speed of electric motor and choose type of motor, its starting and speed control methods with respect to applications.
4. Analyse performance indices, vector diagrams of electrical machines and examine the need of parallel operation, O.C. & S.C. test, Polarity test on transformer, and blocked rotor test on induction motors.
5. Evaluate braking methods of DC, and induction motor.
6. Design motoring system able to give solutions for single phase, three phase and DC supply with respect to supply available and load requirements.

COURSE CONTENTS

Unit 1: Single Phase Transformer **[05 Hrs]**

Transformer construction, classification, principle and operation of single phase transformer, Excitation phenomenon in transformers, Ideal and practical transformer, equivalent circuits, NO load and ON load operation, Phasor diagrams, Power and Energy Efficiency, Voltage regulation, Polarity test, Parallel operation, O.C. & S.C. test on single phase transformer, Effect of load on power factor, Applications-Auto transformers, Variable frequency transformer, Voltage and Current transformers, Welding transformers, Pulse transformer and applications.

Unit 2: Three Phase Transformer **[05 Hrs]**

Constructional features, principle and operation of three phase transformer, Regulation, Efficiency, Three winding transformers and its equivalent circuit, Magnetizing current and harmonics, Winding identifications, Various connections with vector group, On load tap changing of transformers, O.C. & S.C. test on three phase transformer, Determination of equivalent circuit parameters calculation using O.C. & S.C. test, Parallel operation of three phase transformer, Scott Connection, Back to Back test, Type and routine tests.

Unit 3: DC Generator **[05 Hrs]**

Construction, Magnetic structure, Principle and operation, Field and Armature systems, Field and Armature windings (Both Lap and Wave Types), EMF Equation,Armature reaction - Demagnetizing and Cross magnetizing mmfs and their estimation; Remedies to overcome the armature reaction, commutation, straight line commutation, inter-poles, compensating winding, Causes of bad commutation and remedies, Building of Emf in D.C. Shunt generator, Characteristics and Applications of Different types of D.C. Generators.

Unit 4: DC Motor **[05 Hrs]**

Principles of working, Significance of back emf, Torque Equation, Types, Characteristics and Applications of various types of D.C. Motors, Starting of DC Motors, Speed control of Series, Shunt and Compound motors, Power flow in DC machines, Losses and Efficiency, Condition for Maximum Efficiency, Braking of DC Motors, Effect of saturation and armature reaction on losses &Applications

Unit 5: Three Phase Induction Motor **[04Hrs]**

Types of 3-Ø induction motor and production of torque. Torque-slip characteristics, Torque-speed characteristics & Applications, NO load blocked rotor test, Losses & efficiency, Double cage motor, Operating characteristics & Influence of machine parameter on the performance of motor, Various methods of starting of 3 phase I.M, Methods of speed control of I.M., Braking Methods-Braking regenerative braking, Plugging, Dynamic braking, Crawling & cogging.

Unit 6: Single Phase Induction Motor **[04Hrs]**

Construction, Double Field revolving theory of Single phase induction motor, Types of IM on the basis of self-starting methods: Split phase induction motor: Capacitor start inductor motor, Capacitor start capacitor run induction motor (two value capacitor method), Permanent split capacitor (PSC) motor; Shaded pole induction motor; Phasor diagrams, Losses and Efficiency, Load characteristics & Applications.

Text Books:

1. Electrical Machines: Dr. P.S. Bimbhra
2. Electrical Machines: Ashfaq Hussain; Dhanpat Rai Publication
3. A Text Book of Electrical Technology: B. L. Theraja (Vol. II)
4. Electrical Machines 2nd -1993 :Dr. P. K. Mukherjee and S. Chakravarti, Dhanpat Rai Publications (P) Ltd
5. Electrical Machines 3rd -2010: J.Nagrath and Dr. D.P.Kothari; Tata McGraw Hill

Reference Books:

1. Performance & Design of A.C. Machine: M. G. Say
2. Laboratory Courses in Electrical Engineering: Tarnekar, Kharbanda, Bodkhe& Naik
3. D.C. Machines: Langsdorf
4. Electrical Machines and Transformers: Nasser Syed
5. Laboratory manual for Electrical machines: Dr. D.P. Kothari and Prof. Umre; S. S.CHAND publications.

EE3L005	**Electrical Machine-I Lab**	**1 Credit**

COURSE OBJECTIVE

The course objective is to impart knowledge of,

1. The basic principle of transfer of electrical power, operation, construction of Single phase and Three phase transformers, their classification, connections and phasor diagrams.
2. The basic principle, construction, operation, Performance characteristics, steady state analysis and applications of DC generators and motors.
3. The basic principle, construction, operation, Performance characteristics, steady state analysis, Speed control and applications of Single Phase and Three phase Induction motors.

COURSE OUTCOMES

Upon completion of this course, the students shall be able to,

1. Define the basic laws and rules of Transformer and Electric machines.
2. Demonstrate the constructional features of Transformer and Electrical Machines and illustrate the different machine parameters for transformer and Electrical Machines.
3. Identify the parameters like power loss, voltage regulation, efficiency of transformer and operating speed of electric motor and select the type of motor, its starting and speed control methods with respect to applications.
4. Examine the performance indices, vector diagrams of different electrical machines and inspect the need of parallel operation, O.C. & S.C. test, Polarity test on transformer, and blocked rotor test on induction motors.
5. Interpret different methods of braking for different electrical motors.
6. Develop the motoring system able to give solutions for single phase, three phase and DC supply with respect to supply available and load requirements.

List of Experiments:

1 To verify turns ratio of Transformer.
2 To perform polarity test on Single Phase Transformer.
3 To determine equivalent circuit diagram of transformer through O.C & S.C Test.
4 To determine efficiency by direct loading test on Single Phase Transformer.
5 To verify V-I relationship & draw Phasor diagram of 1.Star-Star 2.Star-delta 3.delta-star 4.Delta-Delta connection of single phase transformer.
6 To study the construction of field and armature of DC Machine.
7 To determine external characteristics of DC Generator.
8 To perform Load test on DC shunt motor.
9 To perform speed control of DC shunt motor using armature and field control method.

EE3T006	Measurement And Instrumentation	3 Credit

COURSE OBJECTIVE

Students will learn:

1. Remembering the fundamental principles of electrical instruments and measurements
2. Classification of various electrical measuring instruments
3. Make a use of operating principles of various electrical measuring instruments.
4. To distinguish between variety of measuring instruments available.
5. To utilize various electrical measuring instruments for different measurements.
6. Estimate various parameters of electrical measuring instruments.

COURSE OUTCOMES

Upon completion of this course, the students shall be able to,

1. Remember the different types of instruments used in electrical measurements.
2. Understand the operating principles of various electrical measuring instruments.
3. Apply knowledge of variety of instruments available for required parameter and identify the appropriate one.
4. Analyze and classify different electrical measuring instruments on basis of type of electrical/ physical quantity to be measured.
5. Evaluate different electrical measuring instruments
6. Test and solve various problems on electrical measuring instruments

UNIT 1: General principles of measurements [05 hrs]

Measurement system measurement standards , characteristics - errors in measurement. Calibration of meters- significance of IS standards of Instruments. Classification of meters - operating forces - essentials of indicating instruments - deflecting, damping, controlling torques. Ammeters and voltmeters - moving coil, moving iron, constructional details and operating, principles shunts and multipliers , extension of range.

UNIT 2: Measurement of resistance **[05 hrs]**

Classification of resistance. Measurement of medium resistances , ammeter and voltmeter method, substitution method, Wheatstone bridge method.

Measurement of low resistances , Potentiometer method and Kelvin's double bridge method. Measurement of high resistance: Loss of Charge Method, Direct Deflection Method, Price's Guard wire method. Measurement of earth resistance.

UNIT 3: AC bridges **[05 hrs]**

Generalized treatment of four-arm AC bridges. Sources and detectors. Maxwell's bridge, Hay's bridge Anderson bridge, Owens Bridge for self inductance measurement. Heaviside's bridge for mutual inductance measurement. De Sauty Bridge, Schering bridge for capacitance measurement. Wien's bridge frequency measurements. Sources of error in bridge measurements and precautions. Screening of bridge components.

UNIT 4: Introduction to high voltage and high current measurements **[04 hrs]**

Measurement of high DC voltages - measurement of high AC voltages - electrostatic voltmeters , sphere gaps - DC Hall effect sensors - high current measurements. Study of Phasor Measurement Units (PMU). Current transformers and potential transformers , principle working, ratio and phase angle errors , numerical problems, Clamp on meters

UNIT 5: Measurement of Power & Energy **[05 hrs]**

Principle of Measurement of active, reactive and apparent power single and in polyphase circuits. Measurement of Energy in single and polyphase circuits. Electrodynamometer Wattmeters, Construction, Working, Errors in wattmeter, Single phase Energy meter, Theory and operation , compensation and adjustment. Testing and calibration of single-phase energy meter by phantom loading

UNIT 6: Transducers **[04 hrs]**

Definition and classification - common transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain and temperature - basic principles and working of LVDT, electromagnetic and ultrasonic flow meters, piezoelectric transducer, load cell, strain gauge, RTD, Thermistors, thermocouple, Need for instrumentation system, data acquisition system.

Text Book:

1. Sawhney A.K., A course in Electrical and Electronic Measurements & instrumentation, DhanpatRai .

2. J. B. Gupta, A course in Electrical & Electronic Measurement & Instrumentation., S K Kataria& Sons

3. Kalsi H. S., Electronic Instrumentation, 3/e, Tata McGraw Hill, New Delhi, 2012

References:

1. Golding E.W., Electrical Measurements & Measuring Instruments, Wheeler Pub.

2. Cooper W.D., Modern Electronics Instrumentation, Prentice Hall of India

3. Stout M.B., Basic Electrical Measurements, Prentice Hall

4. Oliver & Cage, Electronic Measurements & Instrumentation, McGraw Hill

5. E.O Doebelin and D.N Manik, Doebelin's Measurements Systems, sixth edition, McGraw Hill Education (India) Pvt. Ltd.

6. P.Purkait, B.Biswas, S.Das and C. Koley, Electrical and Electronics Measurements and Instrumentation, McGraw Hill Education (India) Pvt. Ltd.,2013

EE3L006	Measurement and Instrumentation Lab	1 Credit

COURSE OBJECTIVE

Students will learn:

1. Remembering the fundamental principles of electrical instruments and measurements
2. Classification of various electrical measuring instruments
3. Make a use of operating principles of various electrical measuring instruments.
4. To distinguish between variety of measuring instruments available.
5. To utilize various electrical measuring instruments for different measurements.
6. Estimate various parameters of electrical measuring instruments.

COURSE OUTCOMES

Upon completion of this course, the students shall be able to,

1. Choose correct instrument for measuring given electrical/ physical quantity.
2. Compare various methods and instruments available for measurement of single quantity.
3. Apply understanding about instrumentation concepts which can be applied to electrical measurements.
4. Analyse the testing and measuring set up for electrical systems
5. Evaluate efficiency of different instruments
6. Design circuit for measuring given quantity.

List of Practical:-

1. To measure low resistance by Kelvin's double bridge
2. To measure medium resistance by Wheatstone bridge
3. To measure self inductance by Hay's bridge
4. To measure capacitance by De Sauty Bridge
5. To calibrate a given single phase induction type energy meter.
6. To Study and Calibrate Three Phase Wattmeter.
7. To measure active and reactive power in three phase balanced load by one wattmeter method

8. To find the effect of various parameters on output of given LVDT
9. To Study the change in resistance of RTD probe depending on the process temperature and to Study the dynamic response of RTD probe.
10. To Study the change in EMF of a thermocouple in response to the process temperature.
11. To study impulse voltage generator
12. To study impulse current generator

Note : Some practicals will be conducted through simulations tools.

EE3T007	Innovation and Entrepreneurship Development	Audit

Course Outcomes:

At the end of the Course, Student will be able to:

1. Discover the creative / innovative side within her/him.
2. Hone entrepreneurial and leadership skills within his/her personality.
3. Develop new ways of thinking and Learn the entire innovation cycle from Ideation to GoToMarket.
4. Study frameworks, strategies, techniques and business models for conceived ideas.
5. Develop skills for evaluating, articulating, refining, and pitching a new product or service.

Course Contents:

Introduction to Innovation, Personal thinking preferences, 'Innovation' mind set, Everyday creativity and eliminating mental blocks, Introduction to Innovation, Creative thinking techniques, Innovation types, Idea management and approaches, Teaming techniques for creativity, Idea Conception, Idea Scoping, Self-Evaluation, Idea Brainstorming sessions, Idea Verification, Market Evaluation, Concept Evaluation, Idea Verification, Prototype Evaluation, Protection/Patent review, Innovation Case Study, Idea Presentations, Idea Incubation, Product and Market Plan, Product and Market Development, Innovation Case Studies, Idea Incubation and Product Launch, Marketing and selling, Post Launch Review

Reference Books:

1. Jeff Dyer, Hal Gregersen, Clayton M. Christensen, " The Innovator's DNA: Mastering the Five Skills of Disruptive Innovators, Harvard Business Review Press, 2011.
2. Paddy Miller, Thomas Wedell-Wedellsborg, "Innovation as Usual: How to Help Your People Bring Great Ideas to Life, Harvard Business Review Press, Kindle Edition.

Sr. No.	Subject Category	Subject Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
				L	T	P	CA	MSE	ESE	**TOTAL**	
1	HSMC	EE4T001	Constitution of India	2	0	0	20	20	60	100	2
2	BSC	EE4T002	Numerical method and probability	2	1	0	20	20	60	100	3
3	ESC	EE4T003	Power Station Practice	4	0	0	20	20	60	100	4
4	PCC-EE	EE4T004	Electronic Devices and circuits	3	0	0	20	20	60	100	3
5	PCC-EE	EE4T005	Power System I	2	1	0	20	20	60	100	3
6	PCC-EE	EE4T006	Electrical Machine II	3	0	0	20	20	60	100	3
7	BSC	EE4L002	Numerical method and probability Lab	0	0	2	60	0	40	100	1
8	PCC-EE	EE4L005	Power System I Lab	0	0	2	60	0	40	100	1
9	PCC-EE	EE4L006	Electrical Machine II Lab	0	0	2	60	0	40	100	1
10	PROJ-EE	EE4P002	Field training/ Internship/ industrial visit	0	0	0	0	0	50	50	1
11	MC	EE4T007	Universal Human Values	2	0	0	10	15	25	50	Audit
				18	**2**	**6**	**310**	**135**	**555**	**1000**	

Total Credits	22

Curriculum for Semester- IV [Second Year]

EE4T001	Constitution of India	Credit 2

COURSE OBJECTIVES

1. Understand the concept of Constitution and its importance.
2. Know the need and importance of protecting Constitution.
3. Familiarize students (Prospective engineers) with elementary knowledge of laws that would be of utility in their profession.
4. To be supplemented by the historical development of laws wherever required.

COURSE OUTCOME

1. To define Constitution and basic knowledge about Indian Constitution.
2. To demonstrate Constitution and its importance.
3. To identify constitution law and constitutionalism

4. Classify Responsibilities, Fundamental Duties and its legal status values of an engineer.
5. To evaluate the Parliamentary Form of Government in India.
6. To create awareness on Constitutional Scheme in India

COURSE CONTENTS:

COURSE CONTENT

Unit 1: Introduction to constitution law and constitutionalism [06 hrs]

Meaning of the constitution law and constitutionalism. Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution of India. Scheme of the fundamental rights.

Unit 2: The Fundamental Duties and its legal status [06 hrs]

The scheme of the Fundamental Duties and its legal status. The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and the States.

Unit 3: The constitution powers [06 hrs]

Parliamentary Form of Government in India – The constitution powers and status of the President of India. Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments in India. Emergency Provisions : National Emergency, President Rule, Financial Emergency

Unit 4: Constitutional Scheme in India [06 hrs]

Local Self Government – Constitutional Scheme in India. Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article 19. Scope of the Right to Life and Personal Liberty under Article 21

Text Books:

1. The Constitutional Law Of India 9th Edition, by Pandey. J. N.
2. The Constitution of India by P.M.Bakshi
3. Constitution Law of India by Narender Kumar
4. Bare Act by P. M. Bakshi

EE4T002	Numerical method and probability	Credit 3

Course Outcome

1. Define approximation and errors in numerical differentiation and Integration.
2. Evaluate the roots of the equation using Bracketing methods: Bisection methods, Open methods: Newton Raphson method
3. Apply the Cramer's rule, Gauss- Elimination Method, pivoting, scaling, Heun's method, Runge–Kutta Method,to engineering problem.
4. Analyze the question Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson's rule, engineering applications Numerical differentiation using Finite divide Difference method.
5. Compute the linear and non linear equation, regression, Interpolation and ordinary differential equation using MATLAB programming
6. Develop computer program for linear and non linear equation.

Course Contents:

Unit 1: Error Analysis [08 Hours]
Significant figures, round-off, precision and accuracy, approximate and true error, truncation error and Taylor series, machine epsilon, data uncertainties, error propagation, importance of errors in computer programming.

Unit 2: Roots of Equations [06 Hours]
Motivation, Bracketing methods: Bisection methods, Open methods: Newton Raphson method, Engineering applications.

Unit 3: Numerical Solution of Algebraic Equations [07 Hours] :
Cramer's rule, Gauss- Elimination Method, pivoting, scaling, engineering applications, Heun's method, Runge–Kutta Method, engineering applications.

Unit 4: Numerical Integration and Differentiation [06 Hours]
Motivation, Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson's rule, engineering applications Numerical differentiation using Finite divide Difference method

Unit 5: Curve Fitting and Interpolation [08 Hours]
Motivation, Least Square Regression: Linear Regression, Polynomial regression. Interpolation: Newton's Divide Difference interpolation, engineering applications.Motivation, Euler's and Modified Euler's Method.

Unit 6: Introduction to MATLAB Programming : [07 Hours]
Array operations ,Loops and execution control lecture ,working with file: Scripts and function ,Plotting and program output. Overview of programming language, Algorithms and Flowchart of method based on each unit,Development of at least one computer program based on each unit.

Texts:

1. Steven C Chapra, Reymond P. Canale, "Numerical Methods for Engineers", TataMcGraw Hill Publications, 2010.
2. E.Balagurusamy, "Numerical Methods", TataMcGraw Hill Publications,1999.

References:

1. V. Rajaraman, "Fundamental of Computers", Prentice Hall of India,NewDelhi,2003.
2. S. S. Sastri,"IntroductoryMethodsofNumericalMethods",PrenticeHallofIndia,NewDelhi,
3 rdedition,2003. 3. K. E. Atkinson, "An Introduction to Numerical Analysis",Wiley,1978.
4. M.J. Maron, "Numerical Analysis: A Practical Approach", Macmillan, New York, 1982

EE4L002	Numerical method and probability	Credit 1

Course Outcome

1. Define approximation and errors in numerical differentiation and Integration.

2. Evaluate the roots of the equation using Bracketing methods: Bisection methods, Open methods: Newton Raphson method
3. Apply the Cramer's rule, Gauss- Elimination Method, pivoting, scaling, Heun's method, Runge–Kutta Method,to engineering problem.
4. Analyze the question Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson's rule, engineering applications Numerical differentiation using Finite divide Difference method.
5. Compute the linear and non linear equation, regression, Interpolation and ordinary differential equation using MATLAB programming

Develop computer program for linear and non linear equation.

List of Experiments

1. Program for plotting a circle centre at the point (4,3) with a radius=2 and also 3D circle.
2. Program to plot filled in black circle at x=50, y=55 and with radius =1.
3. Program to plot a sphere
4. Program to plot a straight line
5. Program to plot an ellipsoid
6. Program to plot a cylinder
7. Program for finding roots of f(x)=0 by bisection method.
8. Program for finding roots of equation by newton raphson method.
9. Program for solving numerical integration by simpson's 1/3 rule.
10. Program for solving ordinary differential equation by runge kutta method.

EE4T003	Power Station Practice	Credit 4

COURSE OBJECTIVE

Students will learn:

1 Remember fundamental principles of power plant system

2 Understand various power plant and its practices

3 To apply Economic Operation of Power Systems.

4 To analyze Economic Operation of Power Systems

5 To utilize concept of power plant operations and demand also evaluation of same.

6 Design parameters of basics of power plant operation and its economy.

COURSE OUTCOMES

Upon completion of this course, the students shall be able to,

1. Remember the basic operations of various power plants.
2. Understand and interpret the requirements and basics of power plant installation and site selection.
3. Apply knowledge to Economic Operation of Power Systems and the knowledge related with its need.
4. Analyze various electric power plants operations and distinguish between properties.
5. Evaluate thermal, hydro, nuclear, gas power plant also able to Explain its fundamentals.
6. Design Economic Operation of Power Systems and also able to give solutions implementation of power plant on its basics.

Course Contents:

Unit 1: Introduction

Electric energy demand and growth in India, electric energy sources. Thermal Power Plant: Site selection, general layout and operation of plant, detailed description and use of different parts. Hydro Electric Plants: Classifications, location and site selection, detailed description of various components, general layout and operation of Plants, brief description of impulse, reaction, Kaplan and Francis turbines, advantages & disadvantages, hydro-potential in India

Unit 2: Nuclear Power Plant

Location, site selection, general layout and operation of plant. Brief description of different types of reactors Moderator material, fissile materials, control of nuclear reactors, disposal of nuclear waste material, shielding. Gas Turbine Plant: Operational principle of gas turbine plant & its efficiency, fuels, open and closed-cycle plants, regeneration, inter-cooling and reheating, role and applications. Diesel Plants: Diesel plant layout, components & their functions, its performance, role and applications

Unit 3: Sub-stations Layout

Types of substations, bus-bar arrangements, typical layout of substation. Power Plant Economics and Tariffs: Load curve, load duration curve, different factors related to plants and consumers, Cost of electrical energy, depreciation, generation cost, effect of Load factor on unit cost. Fixed and operating cost of different plants, role of load diversity in power system economy. Objectives and forms of Tariff; Causes and effects of low power factor, advantages of power factor improvement, different methods for power factor improvements.

Unit 4: Economic Operation of Power Systems

Characteristics of steam and hydro-plants, Constraints in operation, Economic load scheduling of thermal plants Neglecting and considering transmission Losses, Penalty factor, loss coefficients, Incremental transmission loss. Hydrothermal Scheduling

Unit 5: Non Conventional Energy Sources

Power Crisis, future energy demand, role of Private sectors in energy management, concepts & principals of MHD generation, Solar power plant, Wind Energy, Geothermal Energy, Tidal energy, Ocean Thermal Energy.

Text Books:

1. B.R. Gupta, "Generation of Electrical Energy", S. Chand Publication.
2. Soni, Gupta & Bhatnagar, "A text book on Power System Engg.", Dhanpat Rai & Co.
3. P.S.R. Murthy, "Operation and control of Power System" BS Publications, Hyderabad. Reference Books:
4. W. D. Stevenson, "Elements of Power System Analysis", McGraw Hill.
5. S. L. Uppal, "Electrical Power", Khanna Publishers

EE4T004	Electronics Devices and Circuits	3 Credit

COURSE OBJECTIVE

Students will learn:

1 To understand operation of semiconductor devices
2 To be exposed to the characteristics of basic electronic devices
3 To apply concepts for the design of Regulators and Amplifiers
4 To verify the theoretical concepts through laboratory and simulation experiments.
5 To implement mini projects based on concept of electronics circuit concepts.

COURSE OUTCOMES

Upon completion of this course, the students shall be able to:

1. Understand the characteristics of the p-n junction, the diode and some special function diodes and these diodes' application in electronic circuits
2. Familiarize the operation and applications of transistor like BJT
3. Develop design competence in power amplifiers using BJT.
4. Apply the knowledge of amplifier in order to Design various differential amplifier
5. Design Various Oscillator Circuits and Understand the concept of FETs as well as MOSFETs
6. Apply the knowledge of Digital Electronics in order to develop the truth tables for various logic Gates

Unit 1: Diode theory and Diode Circuits [07 Hrs]

Theory of PN-junction diodes, operation and characteristics, Zener diodes and voltage regulators, Half and Full Wave Rectifiers, Filters, Ripple factor, Voltage doublers.

Unit 2: Bipolar Junction Transistor [07 Hrs]

BJT, Theory of operation, characteristics, Biasing arrangements, Stability factor, Small signal analysis of CE, CB, CC amplifiers and their comparison, Power Transistors, Transistor as a switch

Unit 3: Power Amplifiers [07 Hrs]

Power amplifiers- classification as A,B, AB, C, Push pull amplifiers, Cross over distortion, Positive and Negative amplifiers- classification, feedback amplifiers, advantages and applications

Unit 4: Differential Amplifiers [07 Hrs]

Differential amplifier circuits and their stages, current source, biasing, level Shifting techniques, Common mode and differential mode gain, Impedance of different stages**.**

Unit 5: Oscillators [07 Hrs]

Oscillators- Barkhausen‟s criterion, RC and Crystal oscillators. Field effect transistors and MOSFETs- Principle of operation and characteristics, biasing arrangements.

Unit 6: Digital Electronics [07 Hrs]

Boolean Identities, Binary, Gray, Octal, Hex & ASCII, Codes, Logic gates and their truth tables, De Morgan‟s Laws, Concept of Sum of Products and Product of Sums.

Text Books:

1. Sanjeev Gupta, "Electronic Devices and Circuits" Dhanpat Rai Publication
2. P. Godse, U. A. Bakshi, "Electronic Devices and Circuits" Technical Publication

3. R P Jain, “Modern Digital Electronics” Tata McGraw-Hill Education

Reference Books:

1. Millman and Halkias;, “Electronic Devices and Circuits” McGraw Hill
2. Millman and Halkias, “Integrated Electronics”, McGraw Hill
3. H. Taub,“ Digital Integrated Electronics”, McGraw Hill
4. Wait, “Introduction to Operation Amplifiers”, Tata McGraw Hill

EE4T005	Power System-I	3 Credit

COURSE OBJECTIVE

Students will develop the ability

1 To calculate the basic parameters of transmission line of power systems.

2 To know the power flow through transmission lines under different circumstances.

3 To model and represent the system components used in power system

4 To represent and understand the transmission line

COURSE OUTCOMES

Upon completion of this course, the students shall be able to,

1. To define basic components of power system and remember the structure of power system.
2. To understand the working of transmission and distribution system and relate the different parameters of transmission and distribution system
3. To do Modeling and representation of the system component used in power system

4. To Analyze the per unit system of power system
5. To select the proper parameter of power system and determine the value of inductance, capacitance, voltage regulation and efficiency of transmission line and explain the effect of sag and corona on transmission line.
6. To create the structure of power system with suitable components and improve the efficiency of power system

COURSE CONTENTS

UNIT 1: General Structure of Electrical Power System [04 hrs]

Introduction to Power System, Generation, Transmission, Distribution and Utilization- Overview Single Line Diagram (SLD) Representation, Use of high voltage, idea about substation (indoor and outdoor), concept of real, reactive and complex power unit system, load and their characteristics, voltage and frequency dependence of loads, overhead v/s underground transmission

UNIT 2: Inductance [05 hrs]

Definition, Inductance due to internal flux of two wire single phase line of composite conductor line, Concept of GMD, Inductance of three phase line with equal & unequal spacing, vertical spacing.

Capacitance: Concept of electric field, Potential difference between two points in space, Effect of earth's surface on electric field, Computation of capacitance of single phase, three phase transmission lines with & without symmetrical spacing for solid & composite conductors.

UNIT 3: Representation of power system elements [05 hrs]

Representation of power system elements, models and parameters of generator, transformer and transmission lines, Transmission line parameters calculation (R,L,C), per unit system representation. Elementary distribution scheme: Feeders and distributors. Introduction to distribution automation.

UNIT 4: Transmission [06 hrs]

Transmission: Types of conductors, Choice of conductor materials, Stranded copper & ACSR conductor, Current and Voltage relation: Representation of short, medium & long transmission lines, voltage regulation and efficiency of power transmission lines using equivalent pi and T representation. Representation using circle diagram with generalized constants. Ferrant effect, Skin Effect, Proximity Effect.

Unit 5: Insulators and Cables Types [03 hrs]

Insulators and Cables Types: Classification of Insulators, Potential distribution over suspension insulator string, String efficiency, Numericals on string efficiency. CABLES: Construction, classification, insulation resistance, capacitance, Dielectric stress, economical size, Grading of cables, Numericals.

Unit 6:Mechanical Design of Transmission Line [04 hrs]

Mechanical Design of Transmission Line: Effect of wind & ice coating on transmission line, sag due to equal & unequal supports, with their derivation, Numericals. Corona: Phenomenon of corona, factors affecting the corona, Power loss & disadvantages of corona.

Textbook:

1. J. B. Gupta, "Power System Analysis",(Katson Books)
2. Kothari Nagrath, "Electric Power System", (Tata McGraw Hill Publications)
3. Wadhva C. L.,"Electric Power System",(Tata McGraw Hill Publications)
4. Asfaque Hussain, "Power System Analysis" CBS

Reference:

1. W.D. Stevenson Jr., Elements of power system analysis, McGraw-Hill publications
2. John J Grainger, W.D. Stevenson, Power System Analysis, McGraw-Hill (India) Pub. , 2003

EE4T006	Electrical Machine II	3 Credit

COURSE OBJECTIVES

This course provides the fundamental knowledge to the students to

1. Understand the concept of MMFs and rotating magnetic fields in synchronous motor.
2. Understand basic principle, construction and operation of synchronous machines.
3. Understand transient and steady state analysis of synchronous machines.
4. Analyse performance characteristics of synchronous machines.

COURSE OUTCOMES

Upon completion of this course, the students shall be able to,

1. Define voltage regulation, load torque angle and MMF of windings.
2. Classify reactances under transient conditions and effects of variable excitation.
3. Apply the method of synchronous impedance and Potier triangle to find voltage regulation.

4. Develop phasor diagram of three phase synchronous machine.
5. Analyze the V curves and effects of excitation and load on motor operation.
6. Compare various methods of cooling in synchronous machine.

Unit 1: Synchronous Machines [08hrs]

Construction, types, armature reaction, introduction to armature winding and field windings MMF of armature and field windings induced EMF, circuit model of synchronous machine, power angle characteristics, two axis theory, synchronous motor operation, characteristic curves, synchronous condenser, dynamics, Single phase synchronous motors.

Unit 2: Steady State Operation of Three Phase Synchronous Machine [06hrs]

Phasor diagram, voltage regulation using synchronous impedance and Potier triangle method, steady state performance of three phase synchronous machines, circle diagrams

Unit 3: Synchronization [08hrs]

Parallel operation, experimental determination of parameters (positive sequence reactance, negative sequence reactance, Zero sequence reactance), short circuit ratio, losses and efficiency

Unit 4: Synchronous Machines On Infinite Bus [06hrs]

Phasor diagram, expression for torque, load torque angle, V curve and inverted V curve, effectsof variable excitation and power input on generator operation and effect of variable excitation and load on motor operation, asynchronous generator.

Unit 5: Transient Behaviour [07hrs]

Sudden 3, phase short circuit. Transient and sub- transient reactances and their measurement. Time constant and equivalent circuit diagram, hunting & damper windings.

Unit 6: Methods Of Cooling In Synchronous Machines [07Hrs]

Cooling system classification, Open ventilated, Air-to-water cooler, Air-to-air cooler, Radial flow ventilation system, Axial flow ventilation system, Circumferential Ventilation, Direct water cooling, Hydrogen cooling, their advantages and disadvantages.

Text Books:

1. Electrical Machine : Dr.P.K.Mukherjee and S. Chakravarti , DhanpatRai
2. Electrical Machinery : Nagrath and Kothari, 3rd , Tata Mcgraw Hill
3. Generalised Theory of Electrical Machinery: P.S. Bhimbra, Tata Mcgraw Hill

Reference Books:

1. Fitzgerald and Kingsley and Kusco , "Electrical Machinery" McGraw Hill
2. P. S. Bhimbra, "Electrical Machinary"

EE4L006	Electrical Machine II Lab	1 Credit

COURSE OBJECTIVES

This course provides the fundamental knowledge to the students

1. To study the performance characteristics of synchronous machine.
2. To study the predetermination of voltage regulation of synchronous generator.
3. To study the variation in reluctance in salient pole machine.
4. To predetermine the characteristics of three phase synchronous motors.

COURSE OUTCOMES

Upon completion of this course, the students shall be able to correlate the theory and practice of the study of

1. Performance characteristics of synchronous machines using direct and indirect methods
2. Regulation of three phase alternator using the predetermination methods
3. Saliency nature of synchronous machine
4. Starting and Speed control of ac machines
5. Synchronization of two three phase alternators
6. Measurement of impedances and short circuit ratio of alternator

List of Experiments

1. Predetermination of regulation of three phase alternator using emf, mmf and Potier triangle method
2. To determine Xd and Xq of the salient pole type synchronous machine
3. To plot V curves and inverted V curves for three phase synchronous machine.
4. Study of prime mover and damper windings in synchronous motor
5. To measure the synchronous reactance of a synchronous generator by measured values of open circuit voltage and short circuit current
7. To study and measure positive, negative and zero sequence impedance of alternator.
8. To measure short circuit ratio of synchronous generator
9. To perform synchronization of two three phase alternators by
    a) Synchroscope method
    b) Three dark lamp method

c) Two bright one dark lamp method

10. To perform OC test on synchronous generator and determine full load regulation of a three phase synchronous generator by synchronous impedance method
11. To study synchronization of the alternator with infinite bus bar

EE4T007	Universal Human Values	Audit

COURSE OBJECTIVES

1. Sensitization of student towards self, family (relationship), society and nature.

2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.

3. Strengthening of self reflection.

4. Development of commitment and courage to act.

COURSE OUTCOMES

1. Students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind.
2. They would have better critical ability.

3. They would also become sensitive to their commitment towards what they believe in (humane values. Humane relationships and humane society).
4. they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education [10 hrs]

Purpose and motivation for the course, recapitulation from Universal Human Values-I . Self-Exploration– what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations . Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil 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 2: Understanding Harmony in the Human Being - Harmony in Myself! [12 hrs]

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensureSanyam 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 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship [12 hrs]

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive

Human Goals. 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

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

[10 hrs]

Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self- regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.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.

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

[12 hrs]

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. 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. Case studies of typical holistic technologies, management models and production systems. 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.

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)

Recommendations for specialization B.Tech. with Honor (Major) and B. Tech. with Minor Engineering Degree

1. The concept of Honour and Minors at B. Tech. level is introduced, to enhance learning skills of students, acquisition of additional knowledge in domains and other than the discipline being pursued by the student through online mode, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

2. Eligibility Criteria and rules to award Honours

i) The Student should have Minimum CGPA of 7.5 up to 2nd Semester.

ii) Student willing to opt for honors has to register in 2nd year.

iii) The Student has to complete 6 to 7 additional advanced courses from the same discipline specified in the curriculum. Total credits of these courses should be between 18 to 20. The students should complete these credits before the end of last semester.

iv) Student to opt for the courses from NPTEL/SWAYAM platform as recommend by concern BOS.

v) If the credits of NPTEL/ SWAYAM courses do not match then proper scaling will be done).

Student complying with above criteria will be awarded B. Tech. with Honour Degree.

3. Eligibility Criteria and rules to award Minor Degree

i) The Student should have Minimum CGPA of 7.5 up to 2nd Semester.

ii) Student willing to opt for honors has to register in 2nd year.

iii) The Student has to complete 6-7 additional courses from other discipline of their interest, which are specified in the respective discipline. These courses are of total 18-20 credits.

iv) Student to opt for the courses from NPTEL/SWAYAM platform as recommended by concern BOS.

v) If the credits of NPTEL / SWAYAM courses do not match then proper scaling will be done).

Student complying with above criteria will be awarded B. Tech. with Minor Degree.

4. Availability of course from MOOC platform will be reviewed by the Major and Minor committee before beginning of semester.

Dr.S.R.Vaishnav
Chairman
Board of Studies, EE Dept

VISION	MISSION
"To develop competent and committed Electrical Engineers to serve the society"	1. To impart quality education in the field of Electrical Engineering. 2. To be excellent learning centre through research and industry interaction.

SYLLABUS of V Semester

EE5T001	Power Electronics	3 Credit

PRE REQUISITES: Electronic Devices And Circuits

COURSE OBJECTIVES:

1 .To review principle of construction, operation and characteristics of basic Semiconductor devices.
2. To understand and analyze performance of controlled and uncontrolled converters.
3. To understand and analyze performance of DC to DC converters. Dc to AC converters.
4 .To understand and analyze performance of AC voltage controllers.

COURSE OUTCOME:

CO1: To remember the principle of operation of various basic semiconductor devices
CO2: To understand the characteristics of various types of semiconductor device and its working as converters.
CO3: To make use of various semiconductor device for the converters operation under various load types.
CO4: Examine the performance of various types of converters.
CO5: Compare various types of converters based on performance parameter.
CO6:Todesign the converters based on real time industrial applications.

Unit I :Power semiconductor devices & their characteristics (6 Hrs)
SCR, triac, diac-construction, characteristics & applications, two transistor analogy for turning ON-OFF SCR, turn ON mechanism, different methods of turning ON-OFF SCR, turn OFF mechanism, series and parallel connections of SCRs, Protection of SCR gate circuit protection, over voltage and over current protection, snubber circuit design

Unit II : Turn on and Turn off circuits for power semiconductor devices (6Hrs)
Introduction to GTO, power transistor, power MOSFET & IGBT & their construction &characteristics.Uni-junction transistors, Triggering circuits and optocouplers and Pulse transformer
Introduction to types of power electronic circuits: diode rectifiers, AC-DC converters, AC-AC converters, DC-DC converters, DC-AC converters

Unit III:Diode Rectifiers and AC-DC converters (6Hrs)

Diode Rectifiers: Single phase half wave, full wave rectifiers with R and RL load, Threephase bridge rectifier with R and RL load, Effect of source inductance.

Controlled Rectifiers : Principle of phase controlled rectification, single phase semi andfull converter with R and RL load, power factor improvement in controlled rectifiers, threephase semi and full converter with R and RL load. (only descriptive approach)

Unit IV : DC-AC converters(6 Hrs)

Classification , series inverter, improved series inverter, parallel inverter, out put voltageand waveform control, principle of operation for three phase bridge inverter in 120 deg. and 180 deg. mode, single phase bridge inverter.

Unit V :DC-DC converters (6 Hrs)

Basic principles of chopper, time ratio control and current limit control techniques, voltage commutated chopper ckt., Jones chopper, step-up chopper, step-down chopper and AC chopper.

Unit VI : AC voltage controllers (AC-AC converters) (6 Hrs)

Principle of on-off control, principle of phase control in single phase and three phase circuits, Cycloconverters: single phase cycloconverter operation, three phase cycloconverter operation.

Text Books

1. Rashid M. H – Power Electronics circuits, devices and applications-(New Delhi Pearson Education).

Reference Books

1. Murthi.V. R- Power Electonics Devices, circuits and Industrial Applications.(Oxford).
2. Bimbhra.P. S- Power Electronics.(Khanna Publication).

EE5T002	**Control System-I**	**3 Credit**

PRE REQUISITES: Network Anlysis
COURSE OBJECTIVES:

1. To introduce about fundamental concepts of control system.
2. To understand the concept of stability analysis.

COURSE OUTCOME:
After completion of syllabus, students must be able:

CO1: To remember the basic concept of control system and methods of stability analysis.
CO2: To understand the basic concept of control system and its types
CO3: To apply knowledge of control system analysis to find stability of any system using various methods such as root locus, Bode plot, Nyquist plot etc.
CO4: To analyze any system to find its stability using various methods such as root locus, Bode plot, Nyquist plot etc.
CO5: To evaluate various parameters of system for its stability analysis.
CO6: To design the linear control system in time and frequency domains using various approaches.

EE5T002: CONTROL SYSTEM-I

Unit I: Introduction to Control System [08 Hrs]
Introduction to Control Problem : Industrial Control examples, Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time invariant systems, Feedback control, Open loop and closed loop systems, Benefits of feedback, Block dig and signal flow graph algebra

Unit II: Characteristics of Feedback Control Systems : [08 Hrs]
Effect of negative feedback compared to open loop system such as – sensitivity to parameter variation, speed of time response, bandwidth, disturbance rejection and linearizing effect, Effect of positive feedback

Unit III: Time domain analysis [08 Hrs]
Concept of transient response, Steady state response and time response, standard test signals, Time response of first order systems, Transfer function of second order system, Time response of second order system, Time response specifications of second order system, steady state error (ess) analysis, static error constants and system type, dominant poles, Relation between roots of characteristic equation, damping ratio and transient response, effect of proportional(P), Integral (I) and derivative (D) controllers on the time response concept of transportation lag.

Unit IV: Stability **[08 Hrs]**

Concept of stability, Effect of pole zero location on stability, Routh- Hurwitz criterian. Root Locus Techniques: Concept and use of root locus, Magnitude and angle criteria, Construction of root loci, effect of addition and poles and zeros on root loci

Unit V: Frequency domain analysis of control systems **[08 Hrs]**

Concept of frequency response and sinusoidal transfer function, resonant frequency, resonant peak, cut off frequency, bandwidth, correlation between time and frequency response.

Frequency Response Analysis: Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion, Relative stability using Nyquist criterion gain and phase margin, Closed-loop frequency response.

Unit VI: State Space Approach **[08 Hrs]**

State Variable Analysis : Concept of state, state variables and state model, state model of linear systems, state model using physical variables, phase variables and canonical variables, state model from differential equations, block diagram and signal flow graph, transfer function from state model, stability of systems modeled in state variable form.

Text Book:

1. Benjamin C Kuo, "Automatic Control Systems", Prentice Hall of India.
2. M. Gopal, "Control Systems- Principle of Design", Fourth Edition, 2012, McGraw Hill.
3. I.J. Nagrath, "Control Systems Engineering" ,New Age International Ltd. , 2000

Reference Books:

1. D'AzzoHoupis, Logakusha, Huelsoman, "Linear System Analysis", McGraw Hill.
2. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Pearson Education Inc.
3. Norman S Nise, "Control System Engineering", John Wiley & Sons.
4. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India

EE5T003	Power Systems-II	3 Credit

PRE REQUISITES: Power Systems-I

COURSE OBJECTIVES:

1. To understand the different parameters of power system operation.
2. To understand the different parameters of power system control.
3. To study different issues related to power systems.
4. After learning, students will be able to analyze different solution methods related to power system
5. Understand amongst the different analytical & numerical methods for power flow solutions
6. Understand different problems related to cost load flow, fault, reactive power and Stability constraints in the power systems

COURSE OUTCOMES:

After completion of syllabus, students must be able:
CO1. **Define** the different parameters of power system operation.
CO2. **Illustrate** the different parameters of power system operation and control.
CO3.To **identify** the different issues related to power systems
CO4. **Analyze** the different solution methods related to power system ..
CO5. **Choose** amongst the different analytical & numerical methods for power flow solutions.
CO6. **Solve** the different problems related to cost load flow, fault, reactive power and Stability constraints in the power systems

Unit I: Economic Operation of Power System (7 Hrs)
Introduction, Distribution of Load between Units & within the Plant.Optimum Generation Scheduling considering Transmission Losses, Representation of Transmission Loss Using Loss Formula Co-Efficient, Derivation of Loss Formula Co-Efficient.

Unit II: Load Flow Studies (6 Hrs)
Per Unit System, Ybus formation Simple example of a loadflowsolution ,Network model formulation, (Applications of iterative techniques like Gauss-Siedal method, and Newton-Raphson method, etc.).

Unit III: Reactive Power Control (6 Hrs)
System voltage and reactive power, Reactive power generation by synchronous machine, Excitation control, Automatic voltage regulator for alternator, Reactive power generation by turbo-generator, Synchronous compensators, Reactors, Capacitors, Static compensators. Introduction to power flow control, HVDC and FACTS.

Unit IV: Symmetrical and unsymmetrical fault analysis: (8 Hrs)

Unbalanced System Analysis using Sequence Components, Symmetrical Fault Analysis Without & With Pre-Fault Load Currents. Symmetrical Component Transformation, Three Phase Power in Unbalanced Circuit in Terms of Symmetrical Component Sequence Impedance of Generator Transformer & Transmission Line ,Unsymmetrical Fault Analysis: L-G, L-L-G-, L-L-L, LL-L-G, Open Conductors Fault Using Symmetrical Components.

Unit V: Stability of Power System : (7 Hrs)

Steady State Dynamic and Transient Stability Definition and Comparison Dynamics of Synchronous Machine Swing Equation Swing Equation for Single Machine Connected To Infinite Bus, Power Angle Equation. Steady State Stability Studies Transient Stability Studies: Swing Curve, Equal Area Criterion for Transient Stability Application of Equal Area Criterion for Different Disturbances. Solution of Swing Equation by Point by Point Method, Methods of Improving Transient Stability.

Unit VI: Load dispatch center functions (6 Hrs)

Contingency analysis, preventive, emergency and restorative Control. power quality def., causes, affects, slandered and mitigation methods

Text Books

1. Nagrath& Kothari – Modern Power System Analysis.(Tata Mcgraw Hill).
2. Prof A M Kulkarni IIT "Bombay Web Course on Power System Operation and Control".

Reference Books

1. Stevension .W. D– Power System Analysis. (Tata Mcgraw Hill).
2. AshfaqHussian - Power System Analysis.(Tata Mcgraw Hill).
3. Hadi Sadat- Power System Analysis (Tata Mcgraw Hill).

EE5TE02(A) Elective I- Renewable Energy System 3 Credit

COURSE OBJECTIVES:

1. To give sufficient knowledge about the promising new and renewable sources of energy
2. Understanding basic characteristics of renewable sources of energy and technologies
3. To give review on utilization trends of renewable sources of energy

COURSE OUTCOMES:

CO1 To define basic properties of different renewable sources of energy and technologies for their utilization.
CO2 Describe main elements of technical systems designed for utilization of renewable sources of energy
CO3 Interpret advantages and disadvantages of different renewable sources of energy
CO4 Undertake simple analysis of energy potential of renewable sources of energy
CO5 Interpret the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.
CO6 Discuss the economics of harnessing energy from renewable energy sources.

UNIT I :(05 Hrs)

Overview of conventional &renewable energy sources, need , potential & development of renewable energy sources, types of renewable energy sources ,types of renewable energy system, future of energy use, Global and Indian Energy Scenario, Energy for sustainable development, Physical principle of conversion of solar radiation into heat, Global climate change, CO2 reduction potential of renewable energy.

UNIT II: (05 Hrs)

Solar Radiation & its Measurement: Solar constant, solar radiation on earth's surface, solar radiation geometry, solar radiation measurement, estimation of average solar radiation, solar radiation on tilted surface. Introduction to solar collectors.

Applications of Solar Energy: Solar water heating, Space cooling, Solar thermal heat conversion, Solar photovoltaic energy conversion, Solar pumping, Solar cooking , Online grid connected solar photovoltaic generation system.

UNIT III: (05 Hrs)

Wind Energy: Basic principles of wind energy conversion, Wind energy conversion system, Wind data& energy estimation, Site selection consideration, Basic component of wind energy conversion system (WECS), Classification of WEC system, Energy storage, Advantages and Disadvantages of (WECS), Application of wind energy.

UNIT IV:(04 Hrs)

Geothermal Energy: Geothermal fields, Estimates of geothermal power, Basic geothermal steam power plant, Binary fluid geothermal plant , Geothermal preheat hybrid power plant. Advantages and disadvantages of geothermal energy.Applications of geothermal energy in India.

UNIT V :(05 Hrs)

Energy from Oceans : Oceans thermal electric conversion (OTEC) , Claude & Anderson cycle, Evaporators,Bio-fueling,Hybrid cycle,Site selection, Component of OTEC for power generation.Energy from Tides: Introduction, Basic principles of Tidal power, Component of Tidal Power Plant, Operation methods of utilization of Tidal Energy,Estimation of Energy & Power in simple single basin Tidal system,Estimation of Energy & Power in double basin Tidal system , Advantages & limitations of Tidal Power Generation.

UNIT VI:(04 Hrs)

Other nonconventional Energy Sources: Brief intriduction to operating principles of small scale hydro electric power generation,Energy from Bio-Mass, Ethanol production, MHD power generation, Fuel cell, Energy from waste.

Text Books:

1. Non Conventional Energy Sources : G.D. Rai , Khanna publishers
2. Non Conventional Energy Resources : B. H. Khan, 2 nd , The McGraw Hill Companies
3. Energy Technology : Nonconventional, Renewable and Conventional : S. Rao& B. B. Parulekar, 1 st, Khanna Publisher
4. Solar Energy: Principles of thermal collection and storage : S. P. Sukhatme, 2 nd edition, Tata McGraw Hill Publishing Company Ltd.
5. Solar Photovoltaics : Fundamental, Technologies and Applications : Chetan Singh Solanki, PHI Learning Pvt. Ltd.

Reference Books:

1. A. N. Mathur: Non-Conventional Resources of Energy. 2010
2. V. V. N. Kishore: Renewable Energy Engineering and Technology, TERI. 2006

EE5TE01 (B)	Elective I- Electromagnetic Field	3 Credit

COURSE OBJECTIVES:

1. Static electric and magnetic fields.
2. Laws of electromagnetic & electrostatic fields.
3. The nature of dielectric materials like in parallel plate capacitance

COURSE OUTCOMES:

CO1	Remember, Understand Scalars & vector analysis, vector and scalars conversion for different coordinate system.
CO2	Apply Gauss law, Divergence theorem to electric field intensity.
CO3	Apply Faradays law of electromagnetic induction (as a component of Maxwell's equations) to solve and analyze problems of Performance and behavior of electromechanical devices such as Motors, Generators and Transformers.
CO4	Apply effective analysis tool like Poisson's and Laplace equations to current, current density, dielectrics and capacitances.
CO5	Analyze& Apply Biot-Savorts law.
CO6	Solve & Analyze problems of Capacitance of parallel plate capacitor, Capacitance of two wire line, Poissons.

Unit I: Review of Mathematics (05 Hrs)

Scalar and vector fields, calculus of scalar and vector fields (Vector Algebra, Vector addition, vector subtraction, Dot product, Scalar product) in Cartesian and curvilinear coordinates, conversion of variables from Cartesian to cylindrical of Cartesian to spherical.

Unit II: Electrostatics (06 Hrs)

Electric field, divergence & curl of electric field, Coulombs' law, the principle of superposition, point charges, field due to continuous volume charge distribution, field of line charge, field of sheet charges concept of flux density.

Unit III: Gauss's law, Energy and Potential of charge system (05 Hrs)

Gauss's law, Application of Gauss's law, divergence theorem, definition of potential difference and potential, potential of a point charges, potential field of system of charge, potential gradient, Energy density in Electrostatic field.

Unit IV: Conductors, Dielectric and Capacitance and Poisson's and Laplace's Equations (06 Hrs)

Current and current density, continuity of current, metallic conductors, conductor properties and Boundary conditions, Nature of Dielectric materials capacitance and capacitances, Capacitance of parallel plate capacitor, Capacitance of two wire line, Poissons and Laplace equations.

Unit V: Magneto Statics (08 Hrs)

Magnetic force between two small moving charges and the concept of magnetic field. Bio Savart's law, Magnetic flux density vector B and Magnetic flux .The law of conversation of

magnetic flux, Ampere's law, magnetic scalar potential, application to various configurations. Magnetic fields of currents in presence of magnetic materials— current loop in a magnetic field (torque and behavior), elementary current loop and aggregates of current loops.Magnetization vector.Generalization of Ampere's law. Magnetic fields intensity and its interpretation. Boundary conditions, effect of applied magnetic field on materials substances, magnetic characteristics of ferromagnetic materials, B-H curve of iron and hysteresis loops, magnetic circuit, magnetic field problems.

Unit VI: Maxwell Equations (06 Hrs)

The equation of continuity and displacement current, Maxwell's equations in different forms and the constitutive relations consequence of Maxwell's equations, plane electromagnetic waves in free space, boundary conditions with generalizations.

Text Books:

1. Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University publication, 6 th Edition, 2014.
2. A.Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2nd Edition, 2009.
3. A.Pramanik,"Electromagnetism-Problems with solution", Prentice Hall of India, Pvt. Ltd., 2nd Edition, 2012.

Reference Books:

1. G.W.Carter,"The electromagnetic field in its engineering aspects", Longmans, 1st Edition, 1954.
2. W.J.Duffin,"Electricity and Magnetism", McGraw Hill Publication, 3rd Edition (Rev), 1980.
3. W.J.Duffin,"Advanced Electricity and Magnetism", McGraw Inc. US, 1968.
4. E.G.Cullwick,"The Fundamentals of Electromagnetism", Cambridge University Press, 3rd Edition, 1966.
5. B.D.Popovic,"Introductory Engineering Electromagnetics", Addison-Wesely, Educational Publishers Inc, International Edition, 1971.
6. WiilaimHayt, " Engineering Electromagnetics", Tata McGraw Hill Education Pvt. Ltd., 7th Edition, 2012.

E-notes:

- nptel.ac.in/downloads/

EE5TE01 (C)Elective I-Introduction to Special Machines 3 Credit

PRE REQUISITES: Electrical Machines -I

COURSE OBJECTIVES:

1. To develop a basic foundation of some special electrical machines.
2. Understand the basic principle, construction &operation, of special electrical machines.
3. Understand & evaluate the performance & operational characteristics of special electrical machines
4. Have the detailed knowledge regarding applications of special electrical machines in day today life.

COURSE OUTCOME:

CO1. **Remember** basic principles of some special electrical machines.
CO2. **Understand** the basics of construction & principle of operation of special electrical machines.
CO3. To **identify** the different operational characteristics related to the special electrical machines.
CO4. **Analyze** the performance indices of special electrical machines.
CO5. **Evaluate** the operation & characteristics of special electrical machines.
CO6. **Solve** the different problems related to operation, supply conversion & performance indices of special electrical machines.

UNIT-I: SPECIAL AC MACHINES (07 Hrs)
Inverted Induction Machine, Synchronous Induction motor, Linear induction Motors (LIM), High efficiency Induction motors, Repulsion motors, Schrage motors. (Only Elementary Aspects).

UNIT-II: FRACTIONAL KILOWATT MACHINES (07 Hrs)
Reluctance motors, AC tachometers, AC Series Motor-Universal Motor, Stepper Motor & its types, Hysteresis Motor, (Only Elementary Aspects).

UNIT-III: SPECIAL D.C. MACHINES (06 Hrs)
PMDC motors: Construction, Working, Characteristics & applications,
BLDC Motors: Construction, Working, Characteristics & applications.

UNIT-IV: PERMANENT MAGNET SYNCHRONOUS MOTORS (07 Hrs)
Introduction, Construction, Working, Ideal PMSM, EMF and Torque equations, Armature MMF, Phasor diagram, Torque/speed characteristics, Applications.

UNIT-V: SERVOMOTORS (07 Hrs)

DC servomotors: Construction, working, torque speed characteristics, applications.
AC servomotors: Construction, working, torque speed characteristics, applications, Comparison of servomotors with conventional motors.

UNIT-VI: SOFTWARE APPLICATIONS (03 Hrs)

NPTEL, (Swayam) courses, Software Applications in Electrical Machines.

Text Books

1. I.J Nagrath, D. P. Kothari,"Electric Machines", Fourth Edition, Tata McGraw-Hill Publishing Company Ltd.
2. AshfaqHussain ,"Electric Machines",SecondEdition,DhanpatRai& Co. Ltd.
3. P.S. Bhimbra, "Electrical Machinery", Seventh Edition,1995,Khanna Publishers
4. Miller, T. J. E., Brushless Permanent Magnet and Reluctance Motor Drives, Oxford Science Publications, 1989.
5. Venkataratnam K., Special Electrical Machines, CRC Press, 2009.

Reference Books

1. Krishnan, R., "Permanent Magnet and BLDC Motor Drives", CRC Press, 2009.
2. Chang-liang, X., "Permanent Magnet Brushless DC Motor Drives and Controls", Jun 2012.

EE5TE01 (D) Elective I-Electrical Power Utilization & Practice 3 Credit

COURSE OBJECTIVES:

1. Introduce various methods of effectively and efficiently utilizing Electrical Energy for different and desired applications.
2. Teach the various Electrical Lighting principles and their applications.
3. Impart knowledge on effective utilization of Electro Mechanical process.

COURSE OUTCOMES:

CO1: The students should be able to understand the process and application of different types of Electric Heating equipments.
CO2: The students should be able to understand the process and application of different types of Welding equipments.
CO3: Students should be able to understand basics of illumination and working principles of different light sources.
CO4: The students shall be able to apply the fundamentals of illumination systems for lighting design for indoor/ outdoor installations for residential/ commercial and industrial applications.
CO5: The students should be able to understand the working principles and applications for various electrolytic processes for industrial applications.
CO6: The students should be able to understand the Refrigeration cycle process and electrical circuit used in different cooling system**.**

Unit I: Electric Heating (7 Hrs)

Heating transfer methods, construction, working and applications Resistance heating,Induction heating; principle of core type and coreless induction furnace, Electric arc heating; direct and indirect arc heating, Dielectric heating, Infra-red heating and its applications, Microwave heating

Unit II: Electric Welding (7 Hrs)

Principles of resistance welding, types, Principle of arc production, electric arc welding, characteristics of arc; Power supply required. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminium and copper, Introduction to TIG, MIG Welding

Unit III: Illumination Fundamental (7 Hrs)

Nature of light, visibility spectrum curve of relative sensitivity of human eye andwave length of light, Basic terms in lighting systems ,laws of illumination, polar curves, construction & operation of light sources (Incandescent, Fluorescent Tube, Sodium Vapor Lamp, Mercury Vapor Lamp, Neon tube).

Unit IV: Design of Lightning System (7 Hrs)

Lux level requirements for various applications, classification of light fittings and luminaires, factors affecting the design of indoor lighting installations, total lumen method of calculation,

Illumination schemes; indoor and outdoor. Illumination levels General ideas bout street lighting, flood lighting, monument lighting and decorativelighting, light characteristics etc.

Unit V: Electrolytic Processes (6 Hrs)

Need of electro-deposition, Laws of electrolysis, process of electro-deposition, Equipment and accessories for electroplating, Factors affecting electro-deposition, Principle of galvanizing, anodizing and its applications, Electroplating on non-conducting materials, Manufacture of chemicals by electrolytic process, Manufacturing of chemicals by electrolysis process.

Unit VI: Other Applications of Electrical Energy (6 Hrs)

Terminology, Refrigeration cycle, Vapor compression type, vapor absorption type, Electrical circuit of a Refrigerator, Room Air conditioner window type & split type.
Description of Electrical circuit used in
a) refrigerator,
b) air-conditioner, and
c) water cooler

Text Books

1. Art and Science of utilization of electrical energy by H. Partab, DhanpatRai and Sons, Delhi.
2. Uppal S.L, "Electric Power", Khanna Publishers, 1988
3. Open Shaw Taylor, "Utilization of Electrical Energy", Oriented Longmans Limited (Revised in SI Units), 1971.
4. Soni A. Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, “A text book on Power System Enggineering”, Khanna Publishers, 2000.
5. A.I.Starr, “Generation, Transmission and Utilization of Electric Power”, ELBS, 1978.

Reference Books

Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency.

EE5TE02(A) ElectiveII-Advance Renewable Energy System 4 Credit

PRE REQUISITES: Introduction to Non-Conventional energy sources

COURSE OBJECTIVES:

1. Study working principles of various renewable energy sources and their utilities.
2. Study economics of harnessing energy from renewable energy sources.
3. Study of various features of Ecosystem.

COURSE OUTCOME:

CO1: To Define the principle of energy conversion technique from biomass, geothermal and hybrid energy systems.
CO2: To Summarize the effects of air pollution and ecosystems Unit Contents Contact
CO3: To Identify the essential characteristics and technical requirements of photovoltaic and biomass energy systems.
CO4: To Analyze the need of various forms of non conventional energy sources, historical and latest developments
CO5 : Illustrate design of biogas, geothermal and hybrid power plant.
CO6 : Discuss about the environmental aspects of renewable energy resources.

Unit I: Biomass Energy (8 Hrs)

Introduction, Biomass conversion technologies, Biogas generation, classification of biogas plants and their Operating system.Biomass as a source of energy, methods of obtaining energy from biomass, thermal gasification of biomass, Applications.

Unit II: Geothermal Energy (6 Hrs)

Introduction, Geothermal sources , hydrothermal resources, Vapor dominated systems, Liquid dominated systems, hot water fields, Geo pressure resources, hot dry rocks, magma resources, volcanoes. Interconnection of geothermal fossil systems, geothermal energy conversion and applications.

Unit III: Hybrid energy systems (6 Hrs)

Need for hybrid systems, types of hybrid systems site specific examples; PV–Diesel and battery systems, PV– Gas Hybrid system, Biomass gasifier based thermal back up for Solar systems, natural convection solar driers in combination with biomass back up heater. Biogas and solar energy hybrid system, typical applications.

Unit IV: Air pollution (6 Hrs)

Primary, secondary, chemical and photochemical reactions, effects of CO, NO, CH and particulates, acid rain, global warming and Ozone depletion; monitoring and control of pollutants; noise pollution-sources and control measures; thermal-, heavy metals- and nuclear pollutions; industrial pollution from paper, pharmacy, distillery, tannery, fertilizer, food processing and small scale industries.

Unit V: Environment and Social Structure (6 Hrs)

Environment impact assessment policies and auditing, conflicting world views and environmentally sustainable economic growth, introduction to Design For Environment (DFE), product lifecycle assessment for environment and ISO 14000; triple bottom line of economic, environment and social performance.

Unit VI :Ecosystem(7 Hrs)

Ecosystem definition, concepts, structure, realm of ecology, lithosphere, hydrosphere, biosphere, atmosphere-troposphere-stratosphere; Nonrandom high quality solar energy flow/ balance to earth, greenhouse effect, matter and nutrient recycling in ecosystems; nitrogen, oxygen, carbon and water cycles, food producers, consumers and decomposers, food chains; biodiversity, threat and conservation of biodiversity

Text Books/Reference Books

1. Non-conventional energy sources by G.D. Rai, Khanna Publishers
2. Solar Energy: Principles of Thermal Collection and Storage by S,P Sukhatme, Tata McGraw Hill

EE5TE02 (B)	ElectiveII- Analog Digital Electronics	3 Credit

COURSE OBJECTIVES:

1. Understand the diode Circuits
2. Understand the MOSFET Circuits
3. Understand the sequential Circuits

COURSE OUTCOMES:

CO1 Understand the operation and analyze the characteristics of semiconductor diodes, MOSFET, and BJT

CO2 Examine and design electronic circuits containing non-linear elements such as diodes, MOSFET, & BJT using the concepts of biasing, load lines, operating point and incremental analysis

CO3 Apply feedback techniques in amplifier and examine its effect on parameters of amplifiers (ex. Gain, bandwidth, i/p and o/p impedance, etc) and the stability of amplifier

CO4 Design different combinational circuits for various applications

CO5 Design various sequential circuits for different applications

CO6 Design and verify digital systems using combinational and sequential circuits

Unit I: Diode Circuits: (7 Hrs)

P-N junction diode, V-I characteristics of a diode; half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuit.

Unit II: BJT Circuits (7 Hrs)

Structure and V-I characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuit, high-frequency equivalent circuits.

Unit III: MOSFET Circuits: (7 Hrs)

MOSFET structure and V-I characteristics.MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuit - gain, input and output impedances, trans-conductance, high frequency equivalent circuit

Unit IV:Number Systems(7 Hrs)

Logic Simplification Binary/Hexa/octal/BCD Number system, Binary Arithmetic, Boolean Algebra and De Morgan's Theorem, Logic Gates, SOP & POS forms, Logic Optimization

Technique, Karnaugh maps. Introduction to logic families, TTL and CMOS logic, Tri-state logic, Memory- classification, organization, operation and interfacing.

Unit V: Combinational logic Design: (6 Hrs)
Comparators, Multiplexers, Demultiplexer, Encoder, Decoder, Arithmetic Circuit Design, Barrel Shifter, ALU.

Unit VI: Sequential logic Design: (6 Hrs)
Sequential Logic Design Latches, Flip flop – S-R, J-K, D, T and Master-Slave JK FF, counters, Shift registers.

Text books:-

1. Digital Electronic Principles, By Malvino PHI, 3 Edition.
2. Modern Digital Electronics, R. P. Jain, McGraw Hill Education, 2009.
3. Sergio Franco,"Design with Operational Amplifiers and Analog Integrated Circuits," Fourth Edition, McGraw-Hill Education, 2014.

Reference books: -

1. Digital logic and Computer design, M. M. Mano, Pearson Education India, 2016.
2. Fundamentals of Digital Circuits, A. Kumar, Prentice Hall India, 2016.
3.DonaldNeamen, "Electronic Circuits: Analysis and Design," Third Edition, McGraw-Hill Publication, 2006.
4. Donald Neamen, "Semiconductor Physics and Devices: Basic Principles," Fourth edition, McGraw-Hill, 2011.
5. Jacob Millman, Christos Halkias, Chetan Parikh, "Millman's Integrated Electronics," Second edition, McGraw Hill Education, 2017.
6. J. V. Wait, L.P. Huelsman and G. A. Korn, Introduction to Operational Amplifier theory and applications, 2nd Edition, McGraw Hill, New York, 1992.
7. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

EE5TE02 (C)ElectiveII-Electrical Machine Design	3 Credit

COURSE OBJECTIVES:

1. To study mmf calculation and thermal rating of various types of electrical machines.
2. To design armature and field systems for D.C. machines.
3. To design core, yoke, windings and cooling systems of transformers.
4. To design stator and rotor of induction machines.

COURSE OUTCOMES:

CO1. **Remember** appropriate ratings, material, heating and cooling time constants.
CO2. **Understand** magnetic, electric materials, windings and transformers.
CO3. **Apply** concepts in design of electrical apparatus, devices and computer aided designing of transformer.
CO4. **Analyze** different materials, windings and modes of heat generation and heat dissipation in electrical machines.
CO5. **Evaluate** fault parameters in windings, voltage regulation and efficiency in transformer.
CO6. **Design** different types of transformers, heating coils and field coils.

Unit I: Review of material used in construction of electrical machines(7 Hrs)
Classification of magnetic, electric and insulating materials, Design of Electrical machines along with their parts and special features, rating, Specifications, Standards, Performance and other criteria to be considered

Unit II: Design of Induction Motor (7 Hrs)
Construction, Output equation of Induction motor, Main dimensions, choice of specific loadings,Design of squirrel cage rotor and wound rotor,Operating characteristics, Magnetizing current,Short circuit current, Circle diagram

Unit III: Design of synchronous machines (7 Hrs)
Output equations, choice of specific loadings, Design of salient pole machines, Short circuit ratio, Armature design, Estimation of air gap length, Design of rotor,Design of damper winding, Determination of full load field mmf, Design of field winding, Design of turboalternators

Unit IV: Design of transformer (7 Hrs)
Design of distribution and power transformers, Types,Classification and specifications, Design and main dimensions of core, yoke, winding,tank (with or without cooling tubes) and cooling tubes, Estimation of leakage reactance,resistance of winding, No load current, Losses, Voltage regulation and efficiency,Mechanical force developed during short circuits, Their estimation and measures tocounteract them, Testing of transformers as per I.S.S., Numerical examples.

Unit V: Heating, Cooling and Ventilation (6 Hrs)

Study of different modes of heat generation,Temperature rise and heat dissipation, Heating and Cooling cycles, heating and coolingtime constants, their estimation, dependence and applications, Methods of cooling /ventilation of electrical apparatus, Thermal resistance, radiated heat quantity of cooling medium (Coolant) Numerical.

Unit VI: Computer aided Design of Electrical machine(6 Hrs)

Introduction, advantages various approaches of Computer Aided Designing, Computer Aided Designing of transformer, Winding of rotating Electrical Machines. Optimization of Design.

Text Books

1. Sawhney, A.K., 'A Course in Electrical Machine Design', DhanpatRai& Sons, New Delhi, Fifth Edition, 1984.
2. M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Ltd, 2011
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford andIBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.

Reference Books

1. J Pyrhonen,T. Jokinen and V.Hrabovcova, " Design of Rotating Electrical Machines" , Wiley,2009.
2. K.M.Vishnumurthy 'Computer aided design of electrical machines' B S Publications,2008

EE5TE02(D) Electrical Installation & Design **3 Credit**

PRE REQUISITES: Electrical Installation & Design

COURSE OBJECTIVES:

1. To explain how the Regulations and Codes are intended to be applied in practice, with the emphasis on design and specification of electrical installation.
2. Acquire knowledge of standard clearances, design and estimation methods of service connections and its safety aspects.

COURSE OUTCOME:

CO1: To Define various terms related to electrical installation system.
CO2: To Illustrate methods of installation, testing and commissioning of electrical apparatus and conductors.
CO3: To Apply knowledge to design the distribution system for residential, commercial, industrial applications and utility distribution networks and illumination design.
CO4: To Examine fault level at various locations in radial networks and be able to find rating and location of series reactors.
CO5 : Design single line diagrams with specifications for distribution networks, motor and power control centers for industrial installations and design reactive power compensation.
CO6 : Understand the fundamental principles for the design and installation of associated protective systems relating to electrical installations and understand the fundamental transformer testing and recognizes the limits of acceptance of each test.

Unit 1: **(7 Hrs)**

Electrical load assessment:
Concept of electrical load, categories of load, types of loads, connected load, demand factor, Maximum demand, diversity factor, load factor, power factor, TOD Tariff, Industrial Electric Bills.
Cables, conductors & bus-bars:
Construction, selection, installation, testing of LT/ HT cables, overload & short circuit ratings, rating factors; Overhead line conductors, copper and aluminiumbusbars.

Unit 2:

Switching & protection devices: **(7 Hrs)**
Types, specifications; selections of isolators, switches, switch fuse units, MCB, ELCB, MCCB,ACB, VCB, SF6 breakers, dropout/ horn gap fuses, AB switches, contactors for voltages upto 33 kV.
Symmetrical Short Circuit Calculations: **(7 Hrs)**

Determining symmetrical short circuit currents at various locations for selecting proper circuit breaker rating & determining value of series reactors for limiting short circuit current.

Unit 3:
Electric supply to Induction Motors in industries:**(7 Hrs)**
Types of motors, SLD and working of DOL/ Star-Delta/ Autotransformer starters; types, specifications, selection of power contactors, Overload relays, short circuit protective devices.
Reactive power management in industries:
Reactive power compensation in industries using static capacitors, use of Power Triangle, Calculating payback period for capacitor investment due to reduced system currents.

Unit 4
Transformers: **(6 Hrs)**
Specifications, ratings, selection, installation, testing & commissioning of transformers, protective device for transformers.
Substations: Types of Substation, Substation scheme and components, 11kV & 33 kV, indoor/ outdoor substations, plan/ elevations, Earthing Arrangements.

Unit 5:Earthing: (7 Hrs)
Necessity of earthing, concept of system & equipment earthing, Dimension & drawings of typical earth electrodes 1) Pipe Earthing 2) Plate Earthing , Earth tester & measurement of earth resistance , Megger. Definition of various terms – Referene earth, earth electrode, earth grid, earth electrode resistance, earth leakage current, earthing conductor, earth mat.

Unit 6: (6 Hrs)
General awareness of IS codes (IS 3043,IS 732,IS 2675, IS 5216,IS 2309), The India Electricity act 1910, The Indian Electricity supply Act 1948, Indian Electricity rule 1956, The electricity regulation commission act 1998, Electricity act 2003, National Electric Code (NEC), scope and safety aspects applicable to residential, commercial & Industrial installation.

Text Books

1. Electric Power Distribution system by A.S.Pabla, Tata Mcgraw Hill.
2. Electrical Engineering Handbook, C. L. Wadhwa.
3. Design of Electrical Installations, V.K.Jain,Amitab Bajaj, Laxmi Publications Pvt Limited, 01-Jan-1993.

EE5TO01	OpenElective-I	Electrical Safety & Management	4 Credit

COURSE OUTCOMES

CO1: Explain the objectives and precautions of Electrical Safety, effects of Shocks and their Prevention.

CO2: Summarize the Safety aspects during Installation of Plant and Equipment.

CO3: Describe the electrical safety in residential, commercial and agricultural installations.

CO4: Describe the various Electrical Safety in Hazardous Areas, Equipment Earthing and System Neutral Earthing.

CO5: State the electrical systems safety management and IE rules.

UNIT-I (7Hr)

INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION:

Terms and definitions, objectives of safety and security measures, Hazards associated with electric current, and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

UNIT-II (7Hr)

SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT:

Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

UNIT-III (7Hr)

ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS:

Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

UNIT-IV (7Hr)

ELECTRICAL SAFETY IN HAZARDOUS AREAS:

Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for

various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations. SF6 Breaker, Vaccum Circuit Breaker, AB Switches, HRC Fuses,etc.

UNIT – V

EQUIPMENT EARTHING AND SYSTEM NEUTRAL EARTHING: (7Hr)

Introduction, Distinction between system grounding and Equipment Grounding, Equipment Earthing, Functional Requirement of earthing system, description of a earthing system, , neutral grounding(System Grounding), Types of Grounding, Methods of Earthing Generators Neutrals.

UNIT-VI

SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS: (5Hr)

Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees.Review of IE rules and acts and their significance:

Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage –Rules regarding first aid and fire fighting facility. The Electricity Act, 2003, (Part1, 2, 3,4& 5)

Text books:

1. S. Rao, Prof. H.L.Saluja, “Electrical safety, fire safety Engineering and safety management”, Khanna Publishers. New Delhi, 1988.(units-I to V)
2. www.apeasternpower.com/downloads/elecact2003.pdf (Part of unit-V)

Reference Books:

1. PradeepChaturvedi, “Energy management policy, planning and utilization”, Concept Publishing company, New Delhi, 1997.

EE5L001	**Power Electronics Lab**	**1 Credit**

List of Practical:-

SrNo	Title of Experiment
1	To study Gate drive circuit
2	To study Reverse recovery time of diode
3	To study Single phase half wave controlled converter
4	To study Characteristics of junction gate fet
5	To study Unsymmetrical half wave bridge rectifier
6	To study SCR parallel inverter
7	To study Lamp dimmer using DIAC and TRIAC
8	To study Simulation of 3 phase full wave controlled rectifier
9	To study Simulation of 3 phase inverter
10	To study Simulation of buck converter

EE5L002	**Control Systems Lab**	**1 Credit**

List of Practical:-

Sr No	Title of Experiment
1	Potentiometer error detector
2	Time response of second order systems
3	Characteristics of synchros
4	A.C. position control system
5	D.C. position control system
6	Determination of step & impulse response for a first order unity feedback system
7	Lag and lead compensation - magnitude and phase plot
8	Stability analysis (Bode, Root locus, Nyquist) of linear time invariant system using MATLAB
9	State space model for classical transfer function using MATLAB
10	Study the effect of addition of poles to the forward path transfer function of a closed loop system
11	Effect of P, PD, PI, PID controller on second order systems

EE5L003	Power Systems-II Lab	1 Credit

List of Practical:-

Expt No	Title of Expt
1	Formation of Bus Admittance Matrix Y-BUS
2	Load flow study using Newton Raphsonmethod .
3	Load flow study using Gauss Seidal Iteration Method .
4	Study of AC network analyzer
5	Measurement of sequence reactance of salient pole synchronous machine
6	Measurement of sub transient reactance of salient pole synchronous machine
7	Steady state stability of synchronous motor
8	Steady sate power limit of transmission line
9	Fault study on AC network analyzer
10	Load flow study on AC network analyzer

EE5P003	Mini Project (Phase I)	**2 Credit**

Mini project should consist of Circuit design, PCB fabrication, & software testing of small digital or analog application circuit. Mini Project work should be carried out by a group of maximum three students. Student should use standard software available for drawing circuit schematic, simulating the design and PCB (single/double sided) layout of circuit.

SYLLABUS of VI Semester

EE6T001	Microprocessor and microcontroller	3 Credit

COURSE OBJECTIVES:

1.To know the architecture of 8085 and 8051.
2.To understand interfacing and interrupt features of 8085 and 8051.
3.To develop program for basic applications.

COURSE OUTCOMES:

CO1: To remember the architecture of 8085 and 8051.
CO2: To understand interfacing and interrupt features of 8085 and 8051.
CO3: To develop program for basic applications
CO4: To distinguish and analyze the properties of Microprocessors & Microcontrollers
CO5:To explain programming logic and concepts of 8085 microprocessors and 8051 micro-controller.
CO6:To build strong foundation for designing real world applications using microprocessors and microcontrollers.

Unit 1 : 8085architecture:(6 Hrs)

Architecture, register structure, addressing modes, instruction set of 8085, timing diagrams,Assembly Language Programming of 8085

Unit 2 : Interfacing: (7 Hrs)

Memory Interfacing: Interface requirements, Address space partitioning,Buffering of Buses, timing constraints, Memory control signals, Read and write cycles,interfacing SRAM, EPROM and DRAM sections. I/O Interfacing: Memory mapped I/OScheme, I/O mapped I/O scheme, Input and Output cycles, Simple I/O ports,Programmable peripheral interface (8255). Data transfer schemes: Programmable datatransfer, DMA data transfer, Synchronous, Asynchronous and interrupt driven datatransfer schemes, Interfacing, Simple keyboards and LED displays.

Unit 3 : Interrupts and DMA:(6 Hrs)

Interrupt feature, Need for interrupts, Characteristics of Interrupts,Types of Interrupts, Interrupt structure, Methods of servicing interrupts, Developmentof Interrupt service subroutines, Multiple interrupt request and their handling, need fordirect memory access, Devices for Handling DMA, Programmable DMA controller8237.

Unit 4 : Applications: (7 Hrs)

Interfacing of A/D converters (ADC 0800/ADC 0808/ADC 0809),Interfacing of D/A converters (DAC 0800), Waveform generators, Multiplexed seven segment LED display systems, Measurement of frequency, phase angle and powerfactor-Traffic light controller, Stepper motor control

Unit 5 : Introduction to microcontroller:(6 Hrs)

8051 architectures, 8051 Internal resources, pin diagram, I/O pins, ports and their internal logic circuits, counters, serial ports, interrupt structure, SFRs and their addressing, watch-dog timer, internal code memory, data memory, stack pointer, flags, bit addressable memory, study of instruction set of 8051.

Unit 6 : 8051 Peripheral Functions :(6 Hrs)

8051 interrupt structures, Timer and serial functions, parallelport features : Modes of operation, Power control, features, Interfacing of 8051, Typicalapplications, MCS 51 family features

Text Books

1. Goankar, R.S., "Microprocessor Architecture Programming and Applications with the 8085/8080A", 3rd Edition, Penram International Publishing House, 1997.
2. Singh. I.P., "Microprocessor Systems", Module 9: Microcontrollers and their Applications", IMPACT Learning Material Series IIT, New Delhi, 1997.

Reference Books

1. Douglas, V.Hall. "Microprocessor and Interfacing Programming and Hardware", 2ndEdition, McGraw Hill Inc., 1992.
2. Kenneth, L.Short., "Microprocessors and Programmed Logic", Prentice Hall of India, 2nd Edition, 1987

EE6T001	Advanced Control Systems	3 Credit

PRE REQUISITES: Control System-I

COURSE OBJECTIVES:

1. To introduce students about state variable approach and feedback design problems and also to introduce concept of Optimal Control theory, digital control system, Non Linear Control System
2. To Impart the knowledge of stability analysisforOptimal Control theory, digital control system, Non Linear Control System

COURSE OUTCOME:

After completion of syllabus, students must be able:

CO1: To remember the basic concepts of compensation, State variable analysis, Non linear Control System, Digital Control system.

CO2: To understand the basic concepts of compensation, State variable analysis, Nonlinear Control System, Digital Control system.

CO3: To apply different concepts to find controllability, observability and stability of non-linear control system, sampled data control system.

CO4: To analyze continuous time system using state space technique and investigate Controllability and Observability of the system, digital systems using the Z-transformation, and nonlinear system using the describing function technique and phase plane analysis

CO5: To evaluate various parameters of continuous time system, digital systems using the Z-transformation, and nonlinear system using various methods.

CO6: To design controllers to achieve desired specification

UNIT I: COMPENSATION [07 Hrs]

Need for compensation. Performance Analysis of Lead, Lag and Lag-lead Compensators in time & frequency domain, Bode Plots of Lead, Lag and Lag-lead Compensators.

UNIT II: DESIGN BY STATE VARIABLE FEEDBACK [07 Hrs]

Review of state variable representation. Eigen Values, Eigen Vectors, State Transition Matrix (STM), Model Matrix, Solution of state equation.Controllability and Observability. Design of SVF

UNIT III: OPTIMAL CONTROL SYSTEM [07 Hrs]

Performance Index (PI), Desirability of single P.I., Integral square error.Parameter Optimization with & without constraints. Optimal control problem with T.F. approach for continuous time system only.

UNIT IV: CONTROLLER TUNING [07 Hrs]

Review of analog PID controller, PID tuning methods in process control (Ziegler-Nichols tuning method), digital PID controllers.

UNIT V: NON LINEAR CONTROL SYSTEM (NLCS) [07 Hrs]

Non Linear Control System: Types of non-linearities, characteristics of NLCS. Inherent & intentional non- linearities. Describing function method for Analysis Describing functions of some common non-linearities. Stability analysis. Limit cycles & stability of limit cycles. Phase - Plane Method: Singular points stability from nature of singular points Construction of trajectory by Isocline and Delta Method Computation oftime.

UNIT VI: DIGITAL CONTROL SYSTEM [07 Hrs]

Representation of SDCS.Sample & Hold Circuit. Z – Transform. Inverse Z- Transform & solution of difference equation.Z & S domain relationship.Stability by bilinear transformation & Jury's test.Comparison of time response of continuous and digital control system, Effect of sampling period on transient response characteristic Discretization of continuous time state equation.Solution of Discrete time state equations. Controllability &Observability of Discrete time systems.

Text Book:

4. Benjamin C Kuo, “Automatic Control Systems”, Prentice Hall of India.
5. M. Gopal, “Control Systems- Principle of Design”, Fourth Edition, 2012, McGraw Hill.
6. I.J. Nagrath, “Control Systems Engineering” ,New Age International Ltd. , 2000

Reference Books:

5. D’AzzoHoupis, Logakusha, Huelsoman, “Linear System Analysis”, McGraw Hill.
6. Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Pearson Education Inc.
7. Norman S Nise, “Control System Engineering”, John Wiley & Sons.
8. Katsuhiko Ogata, “Modern Control Engineering”, Prentice Hall of India

EE6TE03(A)	Elective III- Electrical Energy Conservation &Audit	4 Credit

COURSE OBJECTIVES:

To understand the need of energy audit and the mechanism through which it should be carry out and also to manage the electric and thermal energy.

COURSE OUTCOME:

CO1: Know Present energy scenario with need of energy audit and energy conservation.
CO2: Classify and Manage electric and thermal energy in the industry.
CO3: Identify various aspects of energy audit such as planning, monitoring and implementation
CO4: Analyze the energy flow diagram of an industry and identify the energy wasted or a waste stream.
CO5: Evaluate the techno economic feasibility of the energy conservation technique adopted.
CO6 : Choose appropriate energy conservation method to reduce the wastage of energy

Unit 1: Basics of Energy Management and Conservation (10 Hrs)

Global and Indian energy scenario. Global environmental concerns, Climate Change, Concept of energy management, energy demand and supply, economic analysis; Carbon Trading & Carbon foot prints. Energy Conservation: Basic concepts, Energy conservation in household, transportation, agricultural, service and industrial sectors; Lighting & HVAC systems in buildings.

Unit 2: Energy Audit (8 Hrs)

Definition, need, and types of energy audit; Energy management (audit) approach: Understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements; Fuel & energy substitution; Energy audit instruments; Energy Conservation Act; Duties and responsibilities of energy managers and auditors.

Unit 3: Material & Energy balance and Waste Heat Recovery (8 Hrs)

Facility as an energy system; Methods for preparing process flow; material and energy balance diagrams. Cogeneration and waste heat recovery;

Unit 4: Energy Action Planning, Monitoring and Targeting: (8 Hrs)

Energy Action Planning : Key elements; Force field analysis; Energy policy purpose, perspective, contents, formulation, ratification; Organizing the management: location of energy

management, top management support, managerial function, roles and responsibilities of energy manager, accountability; Motivation of employees: Information system-designing barriers, strategies; Marketing and communicating: Training and planning.
Monitoring and Targeting : Defining monitoring & targeting; Elements of monitoring & targeting; Data and information analysis; Techniques: energy consumption, production, cumulative sum of differences (CUSUM); Energy Service Companies; Energy management information systems; SCADA systems.

Unit 5: Electrical Energy Management: (8 Hrs)
Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, Demand side management: conservation in motors, pumps and fan systems; energy efficient motors.

Unit 6: Thermal energy Management : (8 Hrs)
Energy conservation in boilers, steam turbines and Furnaces; Application of FBC, Heat exchangers and heat pumps.

Text Books/Reference books :

1) Principles of Energy Conservation, Archie, W Culp, Published by McGraw Hill, 1991.
2) Energy Management, P. O'Callaghan, McGraw - Hill Book Company, 1993.
3) Energy Management Handbook, Wayne C. Turner, Wiley Inter Science Publication

EE6TE04 (B)	Linear Electronic Circuits	3 Credit

COURSE OBJECTIVES:

CO1 To understand characteristics of IC and Op-Amp and identify the internal structure.
CO2 To introduce various manufacturing techniques.
CO3 To study various op-amp parameters and their significance for Op-Amp.
CO4 To learn frequency response, transient response and frequency compensation techniques for Op-Amp.
CO5 To analyze and identify linear and nonlinear applications of Op-Amp.
CO6 To understand functionalities of PLL.

COURSE OUTCOME:

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

CO1 Understand the characteristics of IC and Op-Amp and identify the internal structure.
CO2 Derive and determine various performances based parameters and their significance for Op-Amp.
CO3 Comply and verify parameters after exciting IC by any stated method.
CO4 Analyze and identify the closed loop stability considerations and I/O limitations.
CO5 Analyze and identify linear and nonlinear applications of Op-Amp.
CO6 Understand and verify results (levels of V & I) with hardware implementation
CO7 Implement hardwired circuit to test performance and application for what it is being designed.
CO8 Understand and apply the functionalities of PLL.

Unit I: OP-AMP Basics(7 Hrs)

Block diagram of OP-AMP, Differential Amplifier configurations, Differential amplifieranalysis for dual-input balanced-output configurations, Need and types of level shifter,current mirror circuits. Feedback topologies: Voltage series and voltage shunt feedbackamplifier and its effect on Ri, Ro, bandwidth and voltage gain.

Unit II: Linear Applications of OP-AMP(7 Hrs)

Inverting and non-inverting amplifier configurations, voltage follower, summing, averagingscaling amplifier, difference amplifier, integrator, differentiator, and instrumentationamplifiers.

Unit III: Non-linear Applications of OP-AMP(7 Hrs)
Introduction to comparator, characteristics and applications of comparator, Schmitt trigger,clippers and clampers, voltage limiters, square wave generator, triangular wave generator,Need of precision rectifiers, Half wave and Full wave precision rectifiers.

Unit IV: Converters using OP-AMP(7 Hrs)
V-F, I-V and V-I converter, Digital-to-analog converters (DAC): Weighted resistor, R-2Rladder, resistor string etc. Analog-to-digital converters (ADC): Single slope, dual slope,Successive approximation, flash type.

Unit V: Oscillators(6 Hrs)
Principle of Oscillators, Barkhausen criterion, Oscillator types: RC oscillators (design ofphase shift, Wien bridge etc.), LC oscillators (design of Hartley, Colpitts, Clapp etc.), nonsinusoidaloscillators, and voltage controlled oscillators.

Unit VI: Active filters and PLL(6 Hrs)
Design guidelines of Active filters: Low pass, high pass, band pass and band stop filters, block diagram of PLL and its function.

Text Books

1. Ramakant A. Gaikwad, “Op Amps and Linear Integrated Circuits”, Pearson Education 2000.
2. Salivahanan and KanchanaBhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill, India 2008.
3. George Clayton and Steve Winder, “Operational Amplifiers”, 5th Edition Newnes.
4. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, Tata McGraw Hill.

Reference Book

1. Bali, “Linear Integrated Circuits”, McGraw Hill 2008.
2. Gray, Hurst, Lewise, Meyer, “Analysis & Design of Analog Integrated Circuits”, Wiley Publications on Education.

EE6TE03(C)	Elective III- Introduction to AC and DC Drive	3 Credit

COURSE OBJECTIVES:

1. Understanding the operation of various drives
2. Learning about selection and control of motors.
3. Idea about AC/DC Contactors/Relays, Traction system and PLC programming & its application in electrical drives.

COURSE OUTCOMES

Students are able to

1. Examine factors governing selection of Electric Motors like speed torque characteristics under starting, running, and braking for particular application in a common electric drive system.
2. Select motor rating, Flywheel of common drive motors for continuous and intermittent periodic duties.
3. Analyze control circuit of ac/dc contactors and relays for automatic starting and braking of ac/dc motors.
4. Analyze the performance and suitability of motors used in ac/dc traction, their performance characteristic, and control and braking.
5. Apply digital control of electric motor, plc programming in electrical drives.

Unit I: Introduction to Drives (6 Hrs)

Basics of electrical drives and control ,Factors Governing Selection of Electric Motors, Types of Drives and Types of Load, Starting of electric motors, Speed control of Electric motors. Definition classification and speed torque characteristics of common drive motors and their characteristics under starting, running, Electric Braking. Types of enclosures.

Unit II: Rating (6 Hrs)

Rating & Service Capacity: Selection of Motor, Insulating materials, its classification, Temperature rise in Electrical machines, Power Capacity for Continuous and Intermittent Periodic Duties, Load Equalization: Flywheel Effect, Speed-Time Relations. Brief idea about drives commonly used in industries.

Unit III:AC and DC contactors and relays (6 Hrs)

Control devices for industrial motors, AC and DC contactors and relays: Lock out contactors, magnetic structure, operation, arc interruption, contactor rating, and H.V. contactors. Control circuits for automatic starting and braking of DC motor and three phase induction motor. Control panel design for MCC.

Unit IV: Electrical Traction (6 Hrs)

Electrical Traction: Electric Traction system, Speed time curve. Mechanics of Train movement. Traction motor: Motor Used in AC/DC Traction, Their Performance and Desirable Characteristics, Requirements and Suitability of Motor for Traction Duty. Control of D.C. Traction Motor, Series Parallel Control Starting and Braking of Traction Motor

Unit V:Traction motor control (6 Hrs)

Traction motor control – Starting and speed control traction motors. Series parallel control with numerical. Starting and speed control of 3-phase induction motors. Braking of traction motor.

Unit VI: (6 Hrs)

PLC, its programming and its applications in electrical drives.Digital control of Electric motor, Block diagram arrangement, comparison with other methods of control.

Text Books

1. G. K. Dubey, "Fundamentals of electrical drives", Second edition, (sixth reprint), Narosa Publishing house, 2001.
2. G.K Dubey, "Electrical Drives", Second Edition, 2002, PHI.
3. M.L. Soni, P.V. Gupta, U.S.Bhatnagar, "A course in Electrical Power", 1999, DhanpatRai& Sons.

Reference Books

1. VedamSubrahamanyam, "Electric Drives –Concepts & Applications", 1997, Tata McGraw-Hill.
2. H.Partab, "Art & Science of Utilization of Electrical Energy", 1999, DhanpatRai& Sons.
3. H.Partab, "Modern Electrical Traction", 1973, PritamSurat& Brothers.

EE6TE03 (D) Elective III-Electrical Power Distribution System	Credit 3

COURSE OBJECTIVES:

1.To calculate different distribution factors
2.Understand classification of load, types of load curves.
3.Control of voltage and reactive power in distribution system
4.Understanddistribution automation

COURSE OUTCOME:

CO1. **Remember** basic principles of distribution systems and reliability indices.
CO2. **Understand** the principle of operation of feeder, substation and data acquisition system.
CO3. To **identify** the different factors related to distribution systems.
CO4. **Analyze** the effect of various equipments on voltage control and substation protection requirements.
CO5. **Evaluate** voltage drop, power loss and line drop in distribution system
CO6. **Solve** different problems related to radial networks, reactive power requirements and substation protection

UNIT-1: Distribution systems (6 hrs)
Introduction to Distribution systems, Explanation of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor, Relationship between the load factor and loss factor, Classification of loads , Changes in load curve due to loads, use of captive generation & cogeneration in distribution network, Electricity Act 2003, Energy conservation act-2001, electricity rules-2005

UNIT-2: **Feeders** **(6 hrs)**
Radial and loop types, engineering considerations for voltage levels and loading, causes of unbalance and unequal drops.

System analysis : Voltage drop and power loss calculations, manual methods of solution of radial networks, three-phase & non-three-phase primary lines load flow and symmetrical component applications.

UNIT-3 :**Distribution System Reliability** **(6 hrs)**

Basic definition, appropriate levels of distribution reliability, Series & Parallel System, Markov Processes, Distribution reliability Indices, System and customer based indices, load and energy based indices, usage of reliability indices.

UNIT-4: **Voltage control** **(6 hrs)**

Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop calculations and compensations, Reactive power requirements, economic consideration & best location.

UNIT-5: DistributionAutomation(6 hrs)

Introduction to Distribution Automation, Data acquisition system and decentralized control, data acquisition and protection considerations of control panel, circuit breakers, fuses, relays, earthing.

UNIT-6: Substation **(6 hrs)**

Substation layout, selection criteria, voltage and spacing load, space and location, distribution substation protection needs, distribution substation construction methods, trends in distribution substation, insulation coordination, voltage regulation, theoretical consideration for fault calculations.

Text Books

1. A. S. Pabla,"Electric Power Distribution", Fourth Edition, 1997, Tata McGraw-Hill Publishing Company.

2. Kamaraju ,"Electrical Power Distribution System",Tata-McGraw Hill Publications.

3. TuranGonen, "Electric Power Distribution SystemEngineering", 2nd Edition,2008,CRC Press

Reference Books

1.M. K. Khedkar& G. M. Dhole., "Electric Power Distribution Automation", University Science Press.

EE6TE04(A)	Elective IV- Solar Photovoltaic Devices	3 Credit

COURSE OBJECTIVES:

1. To make the student aware about potential of solar photovoltaic energy source,
2. Introduce modeling of PV cell,
3. Understand the maximum PV power harnessing
4. familiarize with PV power conversion devices.

COURSE OUTCOME:

CO1: Calculate and analyse solar insolation on a collecting surface by locating the sun position at anygiven location and time, interpret sun path diagrams.
CO2. Interpret I-V curves from the circuit model of a PV cell, understand the impact of temperature andsolar insolation on I-V curves.
CO3. Evaluate the algorithms used for the maximum power point tracking of PV array.
CO4. Understand the principle of DC-AC power conversion in Grid connected PV system
CO5. Design standalone PV system by estimating the load, sizing and selecting the batteries, sizing and
selecting the PV modules and other components
CO6. Understand the various issues in PV systems.

Unit I:Introduction : (6 Hrs)

Fossil fuel energy usage and global warming; role of renewable energy in sustainable development; renewable energy sources; global potential for solar electrical energy systems.

Unit II Solar Radiation :(6 Hrs)

Extra-terrestrial and terrestrial solar spectrum; clear sky direct-beam radiation; total clear sky Insolation on a collecting surface; radiation on the collector in tracking systems; calculation of average monthly insolation from measured data.

Unit III: PV Cells and Modules :(6 Hrs)

Photovoltaic cell and its simple model; i-v and p-v characteristics; PV modules and arrays ; effect of shading, use of bypass and blocking diodes; influence of temperature; types of solar cells and their performance; Charge controller, Introduction of maximum power point tracking algorithms

Unit IV: PV Inverters: (7 Hrs)

Principle of DC-AC conversion, Working of Grid-connected PV inverter, schemes and basic control; Introduction to Grid Interfacing standards.

Unit V: PV Systems with Battery Energy Storage: (7 Hrs)

Power processing schemes and control for stand-alone applications; batteries for energy storage – types, charging, battery sizing and turn-around efficiency; other types of energy storage for PV systems; grid connected schemes with standby energy storage.

Unit VI :System Level Issues: (6 Hrs)

Design related issues; grounding, dc arcing and other safety related issues; islanding; harmonics; electro-magnetic interference; energy yield and economics of a PV installation.

Text Books

1. Solar Photovoltaic: Fundamentals, Technologies and Applications: Solanki, PHI Learning Pvt Ltd, 2009

Reference Books

1. Photovoltaic Systems Engineering: Roger A. Messenger & Jerry Ventre, CRC Press, 2004, 2nd edition.
2. Renewable and Efficient Electric Power Systems: Gilbert M. Masters, John Wiley & Sons, 2004

EE6TE04(B)	High Power Semiconductor Devices	3 Credit

COURSE OBJECTIVES:

1. To review principle of construction, operation and characteristics of Power switching devices
2. To understand and analyse performance of Power switching devices.
3.To understand various types of Firing and Protecting Circuits.
4. To understand various types of Thermal Protection.

COURSE OUTCOME:

CO1: To remember the principle of operation of various Power switching devices
CO2: To Understand the characteristics of various types of Power switching devices
CO3: To make use of steady state and dynamic models of Power switching devices
CO4: To analyse various types of Thermal Protection required for protection of Power switching devices
CO5: To compare various Thermal Protections and firing protection Circuits of Power switching devices
CO6: To design the Firing and Protecting Circuits for various Power switching devices.

Unit I: Power switching devices overview(6 Hrs)
Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

Unit II :Current Controlled Devices: (6 Hrs)
BJT's – Construction, static characteristics, switchingcharacteristics; Negative temperature co-efficient and secondary breakdown; Power darlington –Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy– concept of latching; Gate and switching characteristics; converter grade and inverter grade andother types; series and parallel

operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT &Thyristor.

Unit III: Voltage Controlled Devices: (6 Hrs)
Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT, FCT, RCT and GATT.

Unit IV: Firing and Protecting Circuits: (6 Hrs)
Necessity of isolation, pulse transformer, optocopler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers.

Unit V: Thermal Protection: (6 Hrs)
Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design – Mounting types

Unit VI: Phase Controlled Converters: (6 Hrs)
Performance measures of single and three-phase converters with discontinuous load current for R, RL and RLE loads. Effect of source inductance for single and three-phase converters.

Text Books:
1. Rashid M. H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India,Third Edition, New Delhi.
Reference Books:
1. B.W. Williams 'Power Electronics: Devices, Drivers, Applications and Passive Components, Tata McGraw Hill.
2. M. D. Singh and K. B. Khanchandani, "Power Electronics", Tata McGraw Hill.
3. Mohan, Undeland and Robins, "Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore.

EE6TE04(C)	Elective IV -Power Semiconductor Based Drive	3 Credit

COURSE OBJECTIVES:

1.To study the converter and Chopper control of DC drives.
2.To study the semiconductor based control of Induction and Synchronous motors.
3.To learn the basics of Switched reluctance motor and Brushless DC motor.
4.To study the non conventional and renewable energy based drives.

COURSE OUTCOMES:

CO1. **Remember** fundamental principles of power electronics and electric drives.
CO2. **Understand** the basics of construction & principle of operation ofvarious electric drives.
CO3. **Apply** suitable control methods to different motor drives.
CO4. **Analyze** the output of conventional drives and semiconductor based drives.
CO5. **Evaluate** the power factor, harmonics and ripple in motor current.
CO6. **Solve** the problems related starting, braking and speed control of motor drives.

Unit I:Dynamics of Electric Drives (7 Hrs)
Fundamentals of torque equations, speed torque convention and multiquadrant operation, components of load torques, classification of load torques, steady state stability, load equation. Speed control and drive classification, close loop control of drives.

Unit II:D.C. motor drives(7 Hrs)
Controlled rectifier fed d.c. drives, single phase and three phase rectifier control of d.c. separately excited motor. Dual converter control of D.C separately excited motor. Power factor, supply harmonics and ripple in motor current. Chopper controlled dc drives of separately excited dc motor, chopper control of series motor, source current harmonics.

Unit III:Induction motor drives(7 Hrs)
Stator voltage control, variable frequency control usingvoltage source invertors, and current sources invertors. Concept of scalar control of 3-ph Induction Motor, Basic philosophy of vector control of 3-ph I.M. their advantages and list of applications.Basic idea of energy conservation in fan and pump type loads using scalar controlled induction motordrives.(Numericals excluded)

Unit IV:Synchronous Motor Drives(7 Hrs)
Starting Braking of synchronous motor, variable frequency control selfcontrolled synchronous motor drive employing load commutated thyristor inverter or cycloconverter, starting oflarge synchronous motors.

Unit V:Advanced Motor Drives(7 Hrs)
Brushless DC motor, stepper motor drives, Introduction tosolar and battery powered drives.Energy conservation in electric drives.

Unit VI:Traction drives: (7 Hrs)
Conventional dc and ac traction drives, semiconductors converter controlled Drives, 25KV AC traction using semiconductor converter controlled dc motor. DC traction using semiconductor, chopper controlled dc motors, polyphase AC motors for traction drives.

Text Books
1.M. H. Rashid, “Power Electronics Circuits Devices and Applications”, Prentice Hall India
2.G. K. Dubey, “Fundamentals of Electric drives”, CRC Press
3.HPartab, “Modern Electric Traction”, PritamSurat, 1973.
4.Venkataratnam K., Special Electrical Machines, CRC Press, 2009.

Reference Books
1.Ned Mohan, “Power Electronics”, John Wiley and Sons, 3rd Edition
2. VedamSubramanhyam, "Electrical drives concepts and applications ", McGraw Hill 1996

EE6TE04(D)	Elective 4-High Voltage DC transmission(HVDC)	4 Credit

PRE REQUISITES: Electrical Power Systems I & II

COURSE OBJECTIVES:

1. To expose the students to the state of the art HVDC technology.
2. Methods to carry out modelling and analysis of HVDC system for inter-area power flow regulation

COURSE OUTCOME:

CO1. **Remember** basic principles of some HVDC Systems.
CO2. **Understand** the basics of HVDC Systems and their implementation.
CO3. To **identify** the different operational characteristics related to HVDC Systems.
CO4. **Analyze** the performance of HVDC Systems.
CO5. **Evaluate** the operation & characteristics of HVDC Systems.
CO6. **Solve** the different problems related to operation of HVDC Systems.

UNIT-I: DC POWER TRANSMISSION FUNDAMENTALS (07 Hrs)
Introduction, Economics of Dc Power transmission, comparison with AC system, Types of DC links, major components of converter station, planning of HVDC system.

UNIT-II: HVDC CONVERTERS (07 Hrs)
Choice of converter configuration, analysis of Gratz circuit with and without overlap, working of converter as rectifier and inverter, equivalent circuit for HVDC link.

UNIT-III: HVDC SYSTEM CONTROL (06 Hrs)
HVDC System Control: Principles of DC link control, converter control characteristics, firing angle control, current and extinction angle control, Starting and stopping of HVDC link.

UNIT-IV: CONVERTER FAULTS AND PROTECTION (07 Hrs)
Converter Faults and Protection: Types of faults-commutation failure, Arc through, Misfire, short circuit in bridge, Over current and over voltage protection, Detection of line faults, Principle of DC circuit interruption, DC breakers, Types and characteristics of DC breakers, effects of proximity of AC and DC transmission lines.

UNIT-V: Multi -Terminal DC (MTDC) Systems (05 Hrs)
Introduction to MTDC Systems, Importance of Multi-Terminal HVDC Systems, Control of MTDC Systems, Interaction between AC-DC Power Systems.

UNIT-VI: Modelling& Representation of HVDC systems (05 Hrs)
Modeling Of HVDC Systems, Per Unit System, Representation for Power Flow Solution, and Representation for Stability Studies.

Text Books

1. J. Arrillaga,"High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983.
2. K. R. Padiyar, "HVDC Power Transmission Systems", Wiley Eastern Ltd., 1990.

Reference Books

1. E. W. Kimbark, "Direct Current Transmission", Vol.I, Wiley Interscience, 1971.
2. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.

EE6TO01	OpenElective I-Industrial Instrumentation	**4 Credit**

COURSE OBJECTIVES:

The objective of the course is to prepare the students:
1. To equip the students with relevant knowledge to suit the industrial requirements.
2. To provide the knowledge about various techniques used for the measurement of industrial parameters.
3. To have an adequate knowledge about electrical and mechanical transducers for measurements of various physical quantities.

COURSE OUTCOME:

At the completion of this course, students will be able to:
1. Select the instruments for measurement of various physical quantities,
2. Select a transducer based on its operating characteristics for the required application.
3. Check various available techniques and select appropriate to obtain satisfactory task for the parameter to be measured.
4. Know advantages and limitations of selected techniques.

Unit I: Introduction to Industrial Instrumentation: (6 Hrs)
Definitions, Dynamic Characteristics of Instruments, Zero-Order Instrument, First-Order Instrument, Second-Order System.
Pressure Measurement: Introduction, Basic terms, Pressure formulas, Pressure measuring instruments, Application considerations.

Unit II: Temperature and Heat Measurement: (6 Hrs)
Introduction, basic terms, Temperature and heat formulas, Temperature measuring devices, Application considerations.

Unit III: Level Measurement &Flow Measurement: **(6 Hrs)**

Introduction, basic terms, Level formulas, Level sensing devices, Application considerations. Flow formulas, Flow measuring instruments, Application considerations.

Unit IV: Position and motion sensing: **(6 Hrs)**

Basic definitions, measuring devices, application considerations.
Force, Torque and Load cell: Basic definitions, measuring devices, application considerations

Unit V: Transducers:

Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system, Principles and classification of transducers, Electrical transducers, basic requirements of transducers.

Unit VI: Digital Data Acquisition systems & control:

Use of signal conditioners, scanners, signal converters, recorders, display devices, A/D & D/A circuits in digital data acquisition.Instrumentation systems.Types of Instrumentation systems.Components of an analog Instrumentation Data –Acquisition system.Multiplexing systems.Uses of Data Acquisition systems.Use of Recorders in Digital systems.Digital Recording systems.Modern Digital Data Acquisition system. Analog Multiplexed operation, operation of sample Hold circuits.

Text Books

1. Industrial Instrumentation: K Krushnaswamy, New Age International
2. E.O. Doebelin, 'Measurement Systems – Application and Design', Tata McGraw Hill publishing company, 2003.
3. R.K. Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, New Delhi, 1999.

Reference Books

1. Fundamentals of Industrial Instrumentation and Process Control:
   William C. Dunn, TMH Publication, 2nd edition.
2. D. Patranabis, 'Principles of Industrial Instrumentation', Tata McGraw Hill Publishing Company Ltd, 1996.
3. A.K. Sawhney and P. Sawhney, 'A Course on Mechanical Measurements, Instrumentation and Control', DhanpathRai and Co, 2004.
4. B.C. Nakra&K.K.Chaudary, 'Instrumentation Measurement & Analysis', Tata McGraw Hill Publishing Ltd, 2004
5. S.K. Singh, 'Industrial Instrumentation and Control', Tata McGraw Hill, 2003.
6. D.P. Eckman', Industrial Instrumentation', Wiley Eastern Ltd.,

EE6L001	Microprocessor and microcontroller **Lab**	**1 Credit**

List of Practical:-

Sr.No	Title of Experiment
1	Study of architecture of 8085
2	Assembly language programmes for determination of smaller and larger no
3	Assembly language programmes for ascending and descending order
4	Multiplication/division of numbers
5	Assembly language programmes for led flashing (Interfacing of 8051 Microcontroller with various display devices.
6	Programming for speed and direction control of dc motor(Interfacing of 8051 Microcontroller with DC motor.
7	Programming for speed and direction of stepper motor
8	Study of hexadecimal, modulo-9, BCD counter

9	Write a program to move a block of data using 8085 & verify
10	Write a program using 8085 & verify for :A. Addition of Two 8-Bit Numbers,B. Addition of Two 16-Bit Numbers (With Carry).
11	Write a Program Using 8085 & Verify for :a. Subtraction of Two 8-Bit Numbers. (Display Of Borrow),b Subtraction of Two 16-Bit Numbers. (Display Of Borrow)

EE6L003	CAD **Lab**	**1 Credit**

List of Practical:-

Sr.No	Title of Experiment
1	**Introduction to CAD**
2	Study of AutoCAD software basics - GUI, limits and units, drawing tools, editing tools, annotations etc.
3	Study of Coordinate systems- Cartesian and Polar (absolute and relative system of measurement) and practice drawing by using following tools: Grid, span, O-snap, Lines, Erase, Zoom.
4	Create a 2D drawing of a given diagram by using drawing tools: circle, arc, rectangle, polygon, ellipse, and Editing tools: trim, move, copy, rotate, and practice of drawing using these commands.
5	Study and create drawing by using Geometry modifying tools: fillet, chamfer, scale, stretch.
6	Study and create drawing by using copying tools like array, mirror, block and offset.

7	Draw regular solids: Cube, Prism, Pyramid, Cylinder, Cones
8	Study and draw 3D drawing of the given object by using AutoCAD commands and tools.
9	Study and draw 3D drawing of the given object by using AutoCAD commands and tools.
10	Study and draw 3D drawing of the given object by using AutoCAD commands and tools.

EE6P004	**Mini Project (Phase II)**	**2 Credit**

Hardware Mini project should consist of Circuit design, PCB fabrication, & hardware designing of small digital or analog application circuit. Mini Project work should be carried out by a group of maximum three students. Student should use standard software available for drawing circuit schematic, simulating the design and PCB (single/double sided) layout of circuit. Project report should consist of details of work carried out including layouts, circuits, datasheets, list of components, cost .

EE6T003	**Research Methodology**	**2 Credit**

Course Objectives:

Student will be able to

1.Understand the basics of research and the research process.

2.Understand the conducting research work and formulating research synopsis andreport.

Know how to develop data analytics skills and meaningfulinterpretation to the data sets so as to solve the business/Research problem.

Course Outcomes

Student should be able to:

CO1. Remember the basic framework of research process.

CO2. Demonstrate various sources of information for research.

CO3. Develop an understanding of various research design and techniques.

CO4. Compare various sources of information for literature review and data collection.

CO5. Interpret the fundamental functions and working of analytical instruments used in research.

CO6.Discuss different methodologies and techniques used in research work.

Unit-I:

Introduction to Research Methodology Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, and Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process and Criteria of Good Research. Defining the Research Problem: Selecting the Problem, Necessity of Defining the Problem and Technique Involved in Defining a Problem

Unit-II:

Research Design Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs: Exploratory research, Descriptive research, diagnostic research, Basic principles of experimental Design and Important Experimental Designs.

Unit-III:

Sampling Design, Measurement and Scaling Techniques Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample, Random Sample from an Infinite Universe, Complex Random Sampling Designs. Measurement in Research, Measurement Scales, Sources of Error in Measurement, Tests of Sound Measurement, Technique of Developing Measurement Tools, Scaling, Meaning of Scaling, Scale Classification Bases, Important Scaling Techniques

Unit-IV:

Methods of Data Collection Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection and Case Study Method.

Unit-V:

Simulation in Research

Meaning of Simulation, Need of Simulation, Appropriateness of Simulation, Advantages and Disadvantages of Simulation, Areas of Application, Study of any one tool relevant to electrical engineering area is compulsory

Text Books/References:

1. C. R. Kothari, Research Methodology: Methods and Techniques, Second Revised Edition, New Age International Publication, 2004.
2. J. Banks, J. C. Carson II, B. L. Nelson, D. M. Nicol, Discrete Event System Simulation, Fourth Edition, Prentice Hall of India Publication, 2006.
3. K. N. Krishanaswamy, Appa lyer Sivakumar, M. Mathiranjan, Management Research Methodology: Integration of Principles, Methods and Techniques, Pearson Education, New Delhi, 2006.

Dr.S.R.Vaishnav
Chairman
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Dr. Babasaheb Ambedkar Technological University, Lonere.

Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Maharashtra Act No. XXIX of 2014)

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COURSE STRUCTURE AND SYLLABUS

For

Final Year B. Tech. Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering

With effect from the Academic Year 2020-2021(Final Year)

Dr. Babasaheb Ambedkar Technological University, Lonere.

B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Curriculum for Semester VII [Final Year]

Sr. No.	Course Code	Type of Course	Course Title	Hours per week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEEC701	PCC1	Power System Operation & Control	3	0	0	20	20	60	100	3
2	BTEEC702	PCC2	High Voltage Engineering	3	0	0	20	20	60	100	3
3	BTEEC703	PCC3	Electrical Drives	3	0	0	20	20	60	100	3
4	BTEEE704	PEC1	Elective-IX	3	0	0	20	20	60	100	3
5	BTEEE705	PEC2	Elective-X	3	0	0	20	20	60	100	3
6	BTEEL706	Lab	Power System Operation & Control Lab	0	0	2	--	30	20	50	1
7	BTEEL707	Lab	High Voltage Engineering Lab	0	0	2	--	30	20	50	1
8	BTEEL708	Lab	Electrical Drives Lab	0	0	2	--	30	20	50	1
9	BTEES709	Seminar	Seminar	0	0	2	--	30	20	50	1
10	BTEEP710	Project	Project Part-I	0	0	6	--	30	20	50	3
11	BTEEF711	--	Field Training /Internship/Industrial Training III	--	--	--	--	--	50	50	1
			Total	**15**	**0**	**14**	**100**	**250**	**450**	**800**	**23**

Elective-IX	Elective-X
A) Special Purpose Electrical Machines	A) Digital Signal Processing
B) Electrical Traction and Utilization	B) Energy Audit and Conservation
C) Engineering System Design and Optimization	C) Electrical Power Quality
D) Financial Management	D) HVDC Transmission and FACTS

Dr. Babasaheb Ambedkar Technological University, Lonere.

B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Curriculum for Semester VIII [Final Year]

Sr. No.	Course Code	Course Title	Hours per week			Evaluation Scheme			Total Marks	Credits
			L	T	P	MSE	CA	ESE		
	1.Power Management Integrated Circuits 2.DC Power Transmission Systems 3.High Power Multilevel Converters 4.Fuzzy Sets, Logic and Systems & Applications 5.The Joy of Computing using Python 6.Introduction to Industry 4.0 and Industrial Internet of Things 7.Entrepreneurship Essentials **# Student to opt any two subjects from above list**		3	0	0	20*	20*	60*	100	3
			3	0	0	20*	20*	60*	100	3
6	BTEEP803	Project - II	0	0	30	--	100	150	250	15
		Total	**6**	**0**	**30**	**40**	**240**	**270**	**450**	**21**

** Six months of Internship in the industry*

**Students doing project at institute will have to appear for CA/MSE/ESE*

** Student doing project at Industry will give NPTEL examination / Examination conducted byuniversity i.e. CA/MSE/ESE*

 # These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

 # Teacher who work as a facilitator for the course should be allotted 3 hrs/week load.

 # Project Load: 2hrs/week/project.

Mapping of Courses with MOOCs Platform SWYAM / NPTEL

S.N.	Course Name	Duration	Name of Professor	Institute offering Course
1	Power Management Integrated Circuits	12 Weeks	Prof. Qadeer Ahmad Khan	IITM
2	DC Power Transmission Systems	12 Weeks	Prof. Krishna S	IITM
3	High Power Multilevel Converters	12 Weeks	Prof. Anandarup Das	IITD
4	Fuzzy Sets, Logic and Systems & Applications	12 Weeks	Prof. Nishchal Kumar Verma	IITK
5	The Joy of Computing using Python	12 Weeks	Prof. Sudarshan Iyengar Prof. Yayati Gupta	IIT Ropar
6	Introduction to Industry 4.0 and Industrial Internet of Things	12 Weeks	Prof. Sudip Misra	IIT KGP
7	Entrepreneurship Essentials	12 Weeks	Prof. Manoj Kumar Mondal	IIT KGP

BTEEC701: POWER SYSTEM OPERATION AND CONTROL	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Prerequisite:

1. Power System-II

Course Objectives:

1. To understand the fundamental concepts of power system.
2. To obtain mathematical model of Synchronous machine, excitation and speed governing system.
3. To analyze the transient stability of power system.
4. To understand the economic operation of power system.
5. To explain various techniques of reactive power and voltage Control

Course Outcome:

1. Explain the fundamental concept of power system.
2. Design the mathematical model of synchronous machine.
3. Design the mathematical model Excitation system and speed governing system.
4. Analyze the transient stability of power system using swing equation and equal area criteria.
5. Analyze the economic operation of power system.
6. Explain the methods of Voltage control.

UNIT I. FUNDAMENTALS OF POWER SYSTEM: (6hr)

Concepts of real and reactive powers, complex power, per-unit representation of power system, Transmission capacity, load characteristics, real power balance and its effect on system frequency, load frequency mechanism, reactive power, balance and its effect, on-load tap changing transformer and regulating transformer

UNIT II. SYNCHRONOUS MACHINE MODELLING (8hr)

Schematic diagram, Physical description: armature and field structure, machines with multiple pole pairs, MMF waveforms, direct and quadrature axes, Mathematical Description of a Synchronous Machine: Basic equations of a synchronous machine: stator circuit equations, stator self, stator mutual and stator to rotor mutual inductances, dq0 Transformation: flux linkage and voltage equations for stator and rotor in dq0 coordinates, electrical power and torque, physical interpretation of dq0 transformation

UNIT III. MODELLING OF EXCITATION AND SPEED GOVERNING SYSTEM (8hr)

Elements of an Excitation System; Types of Excitation System; Control and protective functions; Functional Block Diagram of Power Generation and Control, Schematic of a hydroelectric plant, classical transfer function of a hydraulic turbine, special characteristic of hydraulic turbine, electrical analogue of hydraulic turbine, Governor for Hydraulic Turbine: Requirement for a transient droop, Block diagram of governor with transient droop compensation, Steam turbine modelling: Single reheat tandem compounded type and cross compound type.

UNIT IV. TRANSIENT STABILITY: (6hr)

Solution of Swing equation using classical model, application of equal area creation on point by point solution

UNIT V. ECONOMIC OPERATION OF POWER SYSTEM: **(6hr)**

Distribution of load between units within a plant, transmission loss as function of plant generation, calculation of loss-coefficient, distribution of loads between plants with special reference to steam and hydro plants, automatic load dispatching, Unit commitment, constraints on unit commitment – spinning reserve, thermal and hydro constraints, methods of unit commitment – priority list and dynamic programming.

UNIT VI. REACTIVE POWER AND VOLTAGE CONTROL: (6hr)

Production and absorption of reactive power- Methods of Voltage Control – Shunt reactors – Shunt Capacitors – Series Capacitors – Synchronous condensers – Static Var systems – Principles of Transmission system compensation – Modeling of reactive compensating devices

Reference Books:

1. P. Kundur, “Power System Stability and Control”, McGraw-Hill, 1993.
2. Gross C. A., ‘Power System Analysis’ McGraw Hill
3. Arrilaga J., ‘Computerised Power system Analysis’ McGraw Hill
4. Foud Anderson, ‘Power system control dynamics’ McGraw Hill
5. Kaushik, ‘Computerised Power system Analysis’ McGraw Hill
6. Padiyar K. R., ‘Power system dynamics, ‘ New Age International

BTEEC702: HIGH VOLTAGE ENGINEERING	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre-requisite: Electrical Engineering Materials,Power systems I, Power Systems II

Course Objectives:

1. To study conduction and breakdown in gases, liquids and solids.
2. To understand the methods and measurement of high voltage generation and measurement
3. To explain the lightening phenomenon and insulation co-ordination.
4. To know different non-destructive testing and standards in HV.

Course Outcomes:

1. Illustrate the concept of electric field stresses, applications of insulating materials and methods for Non-destructive testing of equipment like transformers, insulators, isolators, bushings, lightning arrestors, cables, circuit breakers and surge diverters.
2. Explain the breakdown process in solid, liquid, and gaseous materials
3. Analyze methods for generation and measurement of High Voltages and Currents (both ac and dc)
4. Describe the phenomenon of over-voltage and choose appropriate insulation co-ordination levels based on IS & IEC Standards.

UNIT I: INTRODUCTION TO HIGH VOLTAGE ENGINEERING (2hr)

Electric Field Stresses,Poisson's equation, Estimation and Control of Electric Stress, Surge Voltages, their distribution and control.

UNIT II:CONDUCTION & BREAKDOWN IN GASES: (6hr)

Gases as insulation media, ionization processes, Townsend's current growth equation, current growth in presence of secondary processes, Townsend's criterion for breakdown in electronegative gases, time lags for breakdown, Streamers theory, Paschen's law, breakdown in non-uniform fields and corona discharge, corona under positive & negative polarities, glow & arc discharge, considerations in using gases for insulation purpose.

UNIT III: BREAKDOWN IN DIELECTRIC MATERIALS: (8hr)

Conduction & breakdown in liquid dielectrics: Pure and commercial liquids, breakdown in pure and commercial liquids, theories of breakdown in liquids. Breakdown in solid dielectrics: Intrinsic, electromechanical& thermal breakdown, chemical, electrochemical deterioration, treeing, tracking, internal discharges, breakdown in composite insulation, properties of solid insulators & other materials used in practice. Insulating materials: In power transformers, rotating machines, circuit breakers, cables, power capacitors & other equipment.

UNIT IV: OVER VOLTAGE DUE TO LIGHTENING PHENOMENON: (8hr)

Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, propagation of lightning voltage & current waves on transmission lines, reflection & transmission of traveling wave at junction, system control of over voltage due to switching protection of transmission lines against over voltage. Insulation co-ordination, surge diverters, equipment insulation level & co-ordination of substations.

UNIT V:GENERATION & MEASUREMENT OF HIGH VOLTAGES & CURRENTS: (10hr)

Generation of a) high d. c voltage b) power frequency high alternating voltage c) high frequency a. c. d) impulse voltages Standard impulse waves shapes and it's equation, multistage impulse generator, matrix circuit, generation of switching surges, tripping & control of impulse generators, generation of impulse currents.

Measurement of High Direct Current voltages, Abraham Voltmeter Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements

UNIT VI:NON DESTRUCTIVE TESTING: (6hr)

I.E.C. & IS codes for high voltage tests on electrical appliances & power apparatus &electrical motors, non- destructive testing, testing of insulators, bushings, isolators, circuit breakers, cables, transformers, surge diverter, layout of high voltage laboratories & test facilities.

Reference Books:

1) High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier, 2nd Edition
2) High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.
3) High Voltage Engineering, Theory and Practice by Mazen Abdel Salam, Hussein Anis, Ahdan El-Morshedy, RoshdyRadwan, Marcel Dekker

Text Books:

1. Kamaraju V. & Naidu M. S., 'High Voltage Engineering', Tata-McGraw Hill

2. C. L. Wadhwa, "High Voltage Engineering", New Age International Pvt. Ltd

BTEEC703: ELECTRICAL DRIVES	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre requisite : Electrical machine-II, Power Electronics

Course objective :

Students will be able to understand the dynamics of drive system.
Students will be able to use various methods of speed control of AC and DC Drive.
Students will be have the ability to analyze the drive system
Students will be able to select proficiently and the proper drive system for particular application.
Students will be able to have basic knowledge of recent advancement in Electric Drive.

Course outcomes:

Analyze the dynamics of Electrical Drives system.
Use various control techniques for controlling the speed of AC and DC motors.
Analyze the AC and DC drives.
To Select/recommend the appropriate Drive according to the particular applications.
State the recent technology of AC and DC drive

UNIT I: . INTRODUCTION (8hr)

Advantages of Electrical Drives, Parts of Electrical drive, Choice of Electric drives Dynamics of Electrical drives: fundamental torque equations, multiquadrant operation, nature and classification of load torques, steady state stability, concept of load equalization in drives

UNIT II. .CONTROL OF ELECTRICAL DRIVES (6hr)

Modes of operation: Steady state, Acceleration, Deceleration, Drive classification. Closed loop control of drives : Current limit control, torque control, speed control, position control, Control of multi motor drives, speed sensing, current sensing, Classes of motor duty & criteria for selection of motor.

UNIT III. DC MOTOR DRIVES (7hr)

Review of basic characteristics of DC motors, Single phase drives : Single phase half wave converter drives, semi converter drives, Full converter drives, Dual converter drives. Three phase drives : Three phase half wave drives, semi-converter drives, full converter drives, dual-converter drives,

DC-DC converter drives: Principle of Rheostatic and regenerative braking control, combined control, two and four quadrant DC-DC converter fed drives. Introduction to closed loop control of DC drives.

UNIT IV: INDUCTION MOTOR DRIVES (7hr)

Review of starting, braking and speed control of three phase induction motors, Stator voltage control, Rotor voltage control, frequency control, Voltage and frequency control, Current control, Closed loop control of Induction motors, Principle of Scalar and Vector control of Induction motor, Multiquadrant operation of induction motor drives fed from Voltage Source Inverters. Static rotor resistance control method, static slip power recovery control-Static Scherbius drive and StaticKramer drive.

UNIT V: SYNCHRONOUS MOTOR DRIVES (6hr)

Review of starting, pull in and braking of Synchronous motor,Static variable frequency control for Synchronous motors,Load commutated inverter fed Synchronous motor drive, Introduction to closed loop control of Load commutated inverter fed Synchronous motor drive.

UNIT VI: DRIVES FOR SPECIFIC APPLICATIONS (6hr)

Textile Mill: various stages and drive requirements control of ac motors for controlling torque. Steel Rolling Mill : reversing and continuous hot and cold rolling mills, Drive requirements, motors for mill drive. Cement mill : Stages in cement production, requirements of mill motors, Kiln drives, crusher drives, fan/blower drives, compressor drive. Sugar Mill : Requirements for various drive motors, selection of motors for various processes

Ref Books:

1. Dubey G. K., “Fundamentals of Electrical Drives”, Narosa Publishing house
2. De N. K., Sen P. K., “Electric Drives”, Prentice Hall of India
3. VedamSubramanyam, “Electrical Drives and Control”, TMH Publications

BTEEE704A: SPECIAL PURPOSE ELECTRICAL MACHINES	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Prerequisite:

AC Machines and DC Machines

Course Objectives:

To impart knowledge on Construction, principle of operation and performance of synchronous reluctance motors, stepping motors, switched reluctance motors, Permanent magnet brushless D.C. motors , Permanent magnet synchronous motors.

Course Outcome:

After Completion of this Course, student will be able

1. Demonstrate construction, working principle, and application of various types of special purpose electrical machines
2. Select a special Machine for a particular application
3. Demonstrate behaviour of induction generator and induction machine.

UNIT I. SYNCHRONOUS RELUCTANCE MOTORS (6hr)

Constructional features , Types – Axial and radial air gap motors – Operating principle – Reluctance – Phasor diagram - Characteristics – Vernier motor.

UNIT II. STEPPING MOTORS (6hr)

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Theory of torque predictions – Linear and non-linear analysis – Characteristics – Drive circuits.

UNIT III. SWITCHED RELUCTANCE MOTORS (6hr)

Constructional features – Principle of operation – Torque prediction – Power controllers – Non-linear analysis – Microprocessor based control - Characteristics – Computer control.

UNIT IV. PERMANENT MAGNET BRUSHLESS D.C. MOTORS (8hr)

Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control.

UNIT V. PERMANENT MAGNET SYNCHRONOUS MOTORS (8hr)

Principle of operation – EMF and torque equations – Reactance – Phasor diagram – Power controllers - Converter - Volt-ampere requirements – Torque speed characteristics - Microprocessor based control.

UNIT VI. INDUCTION MACHINES (6hr)

Induction generator–self excitation requirement – voltage regulation – different methods of voltage control –doubly fed induction machine – generation operating mode– linear Induction Motor

Text Books:

1. K.Venkataratnam, Special Electrical Machines, Universities Press (India) Private Limited, 2008.
2. T. Kenjo, Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 1984
3. E.G. Janardanan, Special electrical machines, PHI learning Private Limited, Delhi, 2014.

References:

1. R.Krishnan, Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application, CRC Press, New York, 2001.
2. T. Kenjo and S. Nagamori, Permanent Magnet and Brushless DC Motors, Clarendon Press, London, 1988.
3. T.J.E.Miller,Brushless Permanent-Magnet and Reluctance Motor Drives, Oxford University Press, 1989.
4. R.Srinivasan, Special Electrical Machines, Lakshmi Publications, 2013.

BTEEE704B: ELECTRIC TRACTION & UTILIZATION	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Prerequisite:

- Basics of Electrical Engineering and Electrical Machine-II.

Course Objectives:

1. To possess knowledge of advanced and emerging topics in traction mechanism and illumination engineering and their applications in the field.
2. An ability to design a traction system, a component, to meet desired needs of locomotive industry within realistic constraints and confirms manufacturability, and sustainability.
3. To mold students professionally to possess in-depth and advanced knowledge by course contents along with emerging topics.

Course Outcomes:

After Completion of this Course, student will be able to

1. Identify types of Traction System.
2. Interprete Various Power supply in Electric Traction.
3. Analyze Various Traction Motors.
4. Define methods of Traction motor Control.
5. Elobrate Train movement & Breaking in Traction system.
6. Classify the indoor and outdoor Illumination system.

UNIT I: ELECTRIC TRACTION SYSTEM: (8hr)

Electrical transmission: Electrical transmission system employing D.C. generator D.C. series motor, Electrical transmission system employing 3 phase alternator supplying D.C. traction motors, electrical transmission employing 3 phase alternator supplying induction motors, Choice of traction system-battery drive, hybrid drive, flywheel drive, tramways, trolley bus. Track electrification: D.C. System, single phase low frequency A.C. system, single phase high frequency A.C. system, 3 phase A.C. system and composite system.

UNIT II: POWER SUPPLY FOR ELECTRIC TRACTION: (6hr)

Current collection system, current collectors for Over Head Systems, Overhead construction for Tramways and trolley buses and railways, Sag and Tension calculation for a trolley wire, Traction substations, location of substations, feeding and distributing system, substation

equipment's. Block Diagram of AC Electric locomotive, Signaling interference in tele-communication circuits.

UNIT III: TRACTION MOTORS: (6hr)

Characteristics of traction motors, straight D.C. series motor, suitability of series motor for traction duty, constructional details of D.C. Traction Motors, Series motor using undulating D.C, suitability of shunt motor for traction duty, single phase series motors, Repulsion motor, compensated repulsion motor, Induction motor with variable frequency with SCR, Linear Induction motor.

UNIT IV: TRACTION CONTROL: (6hr)

Traction control: Duty cycle, Methods of traction motor control, series-Parallel and other types of controllers, use of interlocks, run back prevented, multiple unit control, Master controllers, Reverses, Dead man's handle, use of Metaldyne and Megavolt.

UNIT V: TRAIN MOVEMENT AND BRAKING: (8hr)

Speed time curve, its analysis and construction, schedule speed and factors affecting it, train resistance and its components. Tractive effort calculations, average acceleration and speed, energy output and consumption.

Braking: Mechanical versus electric breaking, rheostatic braking, Regenerative braking, method and energy saved in the process, Magnetic track brakes.

UNIT VI: ILLUMINATION: (6hr)

Requirement of good lighting, Classification of light fitting & luminaries, factors to be considered for design of indoor & outdoor lighting scheme, Design Procedure for factory lighting, street lighting.

Reference Books:

1) Utilization of Electrical Power and Electic Traction by J.B. Gupta. (Katson Book publisher)
2) H. Partab: Modern Electric Traction, Dhanpat Rai & sons.
3) Upadhayay J. & Mahindra S.N., Electric Traction, Allied Publishers Ltd., 1st Ed.
4) Rao P.S., Principle of 25 KV Overhead Equipments. R. (Nasik) Printpack Pvt Ltd,, 1st Ed.
5) Electric Traction for Railway Trains, by Edward P. Burch. McGraw Hill Book Co. Inc.
6) C.L.Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age International Publishers.

BTEEE704C: ENGINEERING SYSTEM DESIGN OPTIMIZATION	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre requisite: Linear Algebra, Non-linear Problems

Course Outcome:

1. To understand different level optimization problem formulation.
2. To study novel methods in optimization.
3. To understand and develop genetic algorithm for engineering problems.

UNIT I: INTRODUCTION (8hr)

Introduction to Optimization problem formulation, optimization algorithms, applications and examples, different optimization methods available

UNIT II: SINGLE VARIABLE OPTIMIZATION (6hr)

Optimization criteria, bracketing methods– Exhaustive search method, bound phase method, Region Elimination methods– Fibonacci search method, Golden search method, Gradient based methods– Newton Raphson method, Bisection method, Root finding using optimization technique

UNIT III: MULTI OBJECTIVE OPTIMIZATION (6hr)

Optimization criteria, Different search methods, Unidirectional search, Direct search method – Evolutionary optimization method, Powell's conjugate direction method, Gradient based methods– Newton's method and Variable metric method.

UNIT IV: SPECIALIZED METHODS (6hr)

Integer programming, Geometric programming, simulated annealing, Global optimization using - steep descent method, simulated annealing.

UNIT V: GENETIC ALGORITHMS AND EVOLUTIONARY APPROACHES (6hr)

Differences and similarities between genetic algorithms and traditional techniques, operators of GA's, Computer program for simulated annealing, Newton Raphson method, Evolutionary optimization method.

References

1. Kalyanmoy Deb, "Optimization for Engineering design", Prentice Hall,India, 2005.
2. Kalyanmoy Deb, "Multi objective optimization using Evolutionaryalgorithms", John Wiley,2001

BTEEE704D: FINANCIAL MANAGEMENT	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Course Objectives:

• To help the students to develop cognizance of the importance of Financial Management in corporate valuation

• To enable students to describe how people analyze the corporate leverage under different conditions and understand why people valuate different corporates in different manner.

• To provide the students to analyze specific characteristics of Supply Chain Industry and their future action for cash flow

• To enable students to synthesize related information and evaluate options for most logical and optimal solution such that they would be able to predict and control Debt Equity incurrence and improve results.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. The students would be able to understand and define basic terminology used in finance and accounts
2. The students would be able to prepare& appraise Financial Statements and evaluate a company in the light of different measurement systems.
3. The students would be able to analyze the risk and return of alternative sources of financing.
4. Estimate cash flows from a project, including operating, net working capital, and capital spending.
5. To estimate the required return on projects of differing risk ,to estimate the cash flows from an investment project, calculate the appropriate discount rate, determine the value added from the project, and make a recommendation to accept or reject the project
6. To describe and illustrate the important elements in project finance Using financial calculator and Excel in a variety of problems.

UNIT I: INTRODUCTION

Introduction to Financial Accounting, Book keeping & Recording: Meaning, Scope and importance of Financial Accounting. Financial Accounting - concepts and conventions, classification of accounts, Rules and principles governing Double Entry Book-keeping system, Meaning, Preparation of Journal, Ledger , Cash book & Trial balance.

UNIT II: FINANCIAL STATEMENT PREPARATION, ANALYSIS & INTERPRETATION

Preparation of financial statement and Profit & Loss Account, Balance Sheet. , Ratio Analysis - classification of various ratios.

UNIT III: INTRODUCTION TO FINANCIAL MANAGEMENT

Concept of business finance, Goals & objectives of financial management, Sources of financing, Long Term financing- shares, debentures, term loans, lease & hire purchase, retained earnings, public deposits, bonds (Types, features & utility). Short Term Financing- bank finance, commercial paper, trade credit

UNIT IV: WORKING CAPITAL MANAGEMENT

Concept of working Capital, significance, types. Adequacy of working capital, Factors affecting working capital needs, financing approaches for working capital, Methods of forecasting working capital requirements, Methods of Forecasting.

UNIT V: TIME VALUE OF MONEY & CAPITAL BUDGETING

Concept of time value of money, Compounding & discounting; Future value of single amount & annuity, present value of single amount & annuity; Practical application of time value technique. Capital budgeting - Nature and significance, techniques of capital budgeting –Pay Back Method, Accounting rate of return, Internal Rate of Return, DCF, Net Present Value and profitability index.

UNIT VI: PROJECT FINANCING

Details of the company, its promoters and project finances required, profitability etc., Loan documentation-Appraisal of terms loans by financial institutions. Basic components of project finance.

TEXT & REFERENCE BOOKS:

1. Financial Management by Khan & Jain, Text, Problem & Cases, Tata McGraw Hill Publication 5th Edition.
2. Tulsian Financial Management by Dr. P.C.Tulsian, S Chand Publication 5th Edition.
3. Taxman’s Financial Management by Ravi M. Kishore, Taxmann 2017 Edition.
4. A Textbook of Financial , Cost & Management Accounting by Dr.P.Pariasamy, Himalaya Publishing House
5. Fundamentals of financial Management by Bhabhtosh Banerjee, PHI publication, 2nd Edition.

BTEEE705A: DIGITAL SIGNAL PROCESSING	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Prerequisite:

Digital Systems, Interfacing, Z-Transform, Fourier Transform

Course Objectives:

To understand the design and implementation of digital Signal processing systems

Course Outcomes:

After Completion of this Course, student will be able to

1. Represent signals, systems and digital processing of analog signals.
2. Represent discrete time signals, systems and analysis of Discrete-Time Linear Time-Invariant Systems.
3. Apply digital signal processing techniques to analyze discrete time signals in time domain.
4. Apply digital signal processing techniques to analyze discrete time signals in frequency domain.
5. Design different filter structure
6. Validate system functionality and evaluate results.

UNIT I: INTRODUCTION TO DIGITAL SIGNAL PROCESSING (8 hr)

Signals, Systems and Signal Processing: Basic Elements of a Digital Signal Processing System, Advantages of Digital over Analog Signal Processing.

Classification of Signals: Multichannel and Multidimensional Signals, Continuous-Time versus Discrete-Time Signals, Continuous-Valued Versus Discrete-Valued Signals, Deterministic Versus Random Signals.

The Concept of Frequency in Continuous-Time and Discrete-Time Signals: Continuous-Time Sinusoidal Signals, Discrete-Time Sinusoidal Signals, Harmonically Related Complex Exponentials.

Analog-to-Digital and Digital-to-Analog Conversion: Sampling of Analog Signals, the Sampling Theorem, Quantization of Continuous-Amplitude Signals, Quantization of Sinusoidal Signals, Coding of Quantized Samples, Digital-to-Analog Conversion, Analysis of Digital Signals and Systems versus Discrete-Time Signals and Systems.

UNIT II: DISCRETE-TIME SIGNALS AND SYSTEMS (8 hr)

Discrete-Time Signals: Some Elementary Discrete-Time Signals, Classification of Discrete-Time Signals, Simple Manipulations of Discrete-Time Signals.

Discrete-Time Systems: Input-Output Description of Systems, Block Diagram Representation of Discrete-Time Systems, Classification of Discrete-Time Systems, Interconnection of Discrete-Time Systems.

Analysis of Discrete-Time Linear Time-Invariant Systems: Techniques for the Analysis of Linear Systems, Resolution of a Discrete-Time Signal into Impulses, Response of LTI Systems to Arbitrary Inputs: The Convolution Sum, Properties of Convolution and the Interconnection of LTI Systems, Causal Linear Time-Invariant Systems, Stability of Linear Time-Invariant Systems, Systems with Finite-Duration and infinite-Duration Impulse Response.

Discrete-Time Systems Described by Difference Equations: Recursive and Nonrecursive Discrete-Time Systems, Linear Time-Invariant Systems Characterized by Constant-Coefficient Difference Equations, Solution of Linear Constant-Coefficient Difference Equations, The Impulse Response of a Linear Time-Invariant Recursive System

UNIT III: Z-TRANSFORM AND ITS APPLICATION TO THE ANALYSIS OF LTI SYSTEMS (6 hr)

Z-Transform: Direct z-Transform, Inverse z-Transform. Properties of z-transform. Rational z-Transforms: Poles and Zeros. Pole Location and Time-Domain Behavior for Causal Signals, System Function of a Linear Time-Invariant System. Inversion of the z-Transform: Inverse z-Transform by Contour Integration, Inverse z-Transform by Power Series Expansion, Inverse z-Transform by Partial-Fraction Expansion, Decomposition of Rational z-Transforms, One-sided z-Transform: Definition and Properties, Solution of Difference Equations.

UNIT IV: FREQUENCY ANALYSIS OF SIGNALS AND SYSTEMS (4 hr)

Properties of the Fourier Transform for Discrete-Time Signals: Symmetry Properties of the Fourier Transform, Fourier Transform Theorems and Properties.

UNITV:DISCRETE FOURIER TRANSFORM: PROPERTIES AND APPLICATIONS (8 hr)

Frequency Domain Sampling: The Discrete Fourier Transform: Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, Discrete Fourier Transform (DFT), DFT as a Linear Transformation, Relationship of the DFT to Other Transforms. Properties of the DlT: Periodicity. Linearity and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties.

UNIT VI: IMPLEMENTATION OF DISCRETE- TIME SYSTEMS (6 hr)

Structures for the Realization of Discrete-Time Systems. Structures for FIR Systems: Direct-Form Structure, Cascade-Form Structures, Frequency-Sampling Structures, Lattice Structure.

Structures for IIR Systems: Direct-Form Structures, Signal Flow Graphs and Transposed Structures, Cascade-Form Structures, Parallel-Form Structures, Latticc and Lattice-Ladder Structures for IIR Systems.

Reference Book:

1) John G. Proakis, Dimitris G.Manolakis, “Digital Signal Processing”.
2) Shalivahanan, Vallavaraj and Gnanapriya, “Digital Signal Processing”

Text Book:

1) N.G.Palan, “Digital Signal Processing”
2) Ramesh Babu, “Digital Signal Processing”
3) Alon V. Oppenhelm, “Digitsl Signal Processing”, PHI Pub.
4) S.K.Mitra, “Digital Signal Processing”, TMH Pub.

BTEEE705B: ENERGY AUDIT AND CONSERVATION	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Pre Requisite:

Basics of Electrical Machines, Power Plant Engineering

Course Objectives:

1. To understand the basic process involved in the energy audit and the terminologies associated in the process.
2. To be able to develop audit reports of any firm including large and small scale industries, residential and commercial establishments.
3. To select and comment on the appropriate method for the planning and monitoring of any energy conservation project.

Course Outcomes:

After Completion of this Course, student will be able

1. To recognize Global Environmental Issues and Role of Renewable & non-conventional energy sources
2. To estimate Energy efficiency opportunities in Thermal- Mechanical Systems and Electrical System.
3. To analyze Energy Conservation Proposals economically and prepare audit reports.

UNIT I: SOURCES OF ENERGY: (6hr)

Energy resources, Stored & running resources, Environmental Concerns – Global Warning , Depletion of Ozone layer, Kyoto Protocol, UNFCCC, CDM, Carbon Emissions, Role of Renewable Energy Sources

UNIT II: (7hr)

Energy Conservation Act 2001, Designated Consumers, Energy Policy, BEE and its role in Energy Conservation, Energy Audit – Need, Types , Methodology, Steps involved in Energy Audit, Energy Costs and Benchmarking , Measurements for Energy Audit, Energy Management Duties and Responsibilities.

UNIT III: THERMAL MECHANICAL SYSTEMS (8hr)

Boiler Efficiency by direct and indirect methods, Energy efficiency opportunities in boilers, HVAC, and refrigeration systems, compressed air systems, pumps, cooling towers, fans and blowers, Cogeneration – Need and Principle , Prime movers for cogeneration, Waste heat recovery systems – Recuperators, economizer heat recovery boilers.

UNIT IV: ELECTRICAL SYSTEMS (7hr)

Utilities: Energy conservation in generation, transmission,distribution & utilization, Electrical billing , load management ,maximum demand control, APFC Panel , PF improvement and benefits , Energy Efficient motors and starter, lightning systems, Electronic Ballast

UNIT V: (6hr)

Planning, Implementation & monitoring of energy conservation project, Time Value of money, Financial Investment – Simple payback period, ROI (Return on Investment), Net Present value, Internal rate of return, profitability index. All calculations and numerical interpretation.

UNIT VI: (6hr)

Case studies on various industrial sectors like Steel Plant, Thermal Plant, Industries Building and Commercial Establishments and preparing audit reports

Text Books:

1. "Industrial Energy Conservation" Charles M Gottschalk ,John Willey and Sons
2. "Energy Management" Paul O Callagham, Tata Mc Grawhill
3. "Energy Technology" – S Rao and B Parulekar , Khanna Publisher

References:

1. "Energy Management Handbook" – Wayne C Turner

BTEEE705C: ELECTRICAL POWER QUALITY	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Prerequisite:

1. Basic Electrical concepts
2. Power Electronics concepts
3. Power system concepts

Course Objectives:

1. To study the various power quality issues, their production, monitoring and mitigation.
2. To study the various power quality standards.
3. To study various power quality monitoring methods.
4. To apply appropriate solution techniques for power quality Problems.

Course Outcome:

After Completion of this Course….

1. Student will be able to get the in-depth understanding of power quality issues & standards.
2. Students will be able to understand working of power quality improving Equipment's.

UNIT I: INTRODUCTION (7hr)

Understanding Power quality, definitions, growing concerns to Power Quality, Evaluation Procedure,General Classes of Power Qualitydisturbances, causes and effects of Power Quality disturbances

UNIT II: TRANSIENT OVER VOLTAGES (7hr)

Sources, causes and effects, Principle of Overvoltage protection and solutions. VoltageSag and Interruptions: causes and effects, estimation of voltage sag performance, principle ofprotection and solutions.

UNIT III: LONG-DURATION VOLTAGE VARIATIONS (7hr)

Long Duration Voltage variations, principles of regulating voltage Devices for voltage regulation, flickers, flicker sources and mitigation, quantifying flicker.

UNIT IV: FUNDAMENTALS OF HARMONICS (7hr)

Harmonic distortion, sources of harmonics, effects of harmonic distortion, Voltage Vs Current Harmonics,Active, Reactive, Volt-Amp power under non sinusoidal conditions, Harmonic Indices (THD and TDD),principles of harmonic control, mitigating devices, interharmonics, IEEE standard 519.

UNIT V: WIRING AND GROUNDING (4hr)

Reasons for Grounding, wiring and grounding problems and solutions

UNIT VI: POWER QUALITY MONITORING (7hr)

Monitoring Considerations, site survey, Monitoring Quality, monitoring location, PQ measuringinstruments, assessment of power quality measurement data, IEEE 1159 Standard. Impact of poor power quality on Reliability Indices.

References/Books:

1.Chattopadhyay, Surajit, Mitra, Electric Power Quality, Springer.
2.Haytt G. T., ―Electric Power Quality‖, Stars In Circle Publication.
3. NPTEL courses
a) NOC:Power Quality Improvement Technique, IIT Roorkee by Avik Bhattacharyya.
b) Power Quality in Power Distribution Systems, IIT Madras by Dr. Mahesh Kumar.

BTEEE705D: HVDC TRANSMISSION AND FACTS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre requisite: Power System-II, Power Electronics

Course Outcome:

1. To understand importance, configuration and types of HVDC transmission.
2. To analyst the operation of HVDC converter, system control and protection.
3. To understand the concept of FACTS, their role, type and functionality.
4. To analyze the operation of static series and shunt compensator.

UNIT I: DC POWER TRANSMISSION FUNDAMENTALS (8hr)

Introduction, Economics of Dc Power transmission, comparison with AC system, Types of DC links, major components of converter station, planning of HVDC system.

UNIT II: HVDC CONVERTER (6hr)

Choice of converter configuration, analysis of Gratz circuit with and without overlap, working of converter as rectifier and inverter, equivalent circuit for HVDC link

UNIT III: HVDC SYSTEM CONTROL (6hr)

HVDC System Control: Principles of DC link control, converter control characteristics, firing angle control, current and extinction angle control, Starting and stopping of HVDC link

UNIT IV: CONVERTER FAULTS AND PROTECTION (6hr)

Converter Faults and Protection: Types of faults-commutation failure, Arc through, Misfire, short circuit in bridge, Over current and over voltage protection, Detection of line faults, Principle of DC circuit interruption, DC breakers, Types and characteristics of DC breakers, effects of proximity of AC and DC transmission lines.

UNIT V: FACTS CONCEPT AND GENERAL SYSTEM CONSIDERATIONS (6hr)

Transmission Interconnections, Flow of Power in an AC System, Loading Capability limits, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, Relative Importance of Controllable Parameters, Basic types of FACTS Controllers, Description and Definitions of FACTS Controllers, Benefits from FACTS Technology, Comparison between HVDC & FACTS.

UNIT VI: STATIC SHUNT COMPENSATORS (6hr)

Static Shunt Compensators: Objective of shunt compensation, Methods of Controllable VAR Generation, Static VAR Compensators: SVC and STATCOM, Comparison of SVC and

STATCOM, Static VAR Systems (SVS)Static Series Compensation: Objective of series compensation, Variable Impedance Type Series Compensators, Switching Converter Type Series Compensators

References

1. Padiyar K. R., “HVDC Power Transmission Systems”, New Age International.
2. Kimbark, “ HVDC Transmission”, John Willey AndSons.
3. Hingorani N. G., “ Understanding FACTS”, IEEE Press2001
4. Yong Hua Song, ‘ Flexible AC transmission systems(FACTS)’IEEE

BTEEL706: POWER SYSTEM OPERATION AND CONTROL LAB	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Sr. No.	List of the Experiment
1	Write a program for economic dispatch in power systems using
2	Simulation of Automatic voltage regulator using MATLAB.
3	Write a program to compute the voltage and power factor for a given system using MATLAB.
4	Write a program to solve Swing Equation by Classical Method.
5	Write a program to plot power angle curve of synchronous machine using MATLAB.
6	Write a program to solve the given Equal Area Criteria problem using MATLAB.
7	To demonstrate the Excitation System for Synchronous machine using MATLAB
8	Simulation of single area load frequency control using MATLAB.

BTEEL707: HIGH VOLTAGE ENGINEERING LAB	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Sr. No.	List of Experiment
1	Study of Faraday Cage for HV labs.
2	Study of Standard HV Laboratory layouts.
3	One min. (1-min.) DC high voltage withstand test on Equipment. (Max. up to 10 KV).
4	Effect of gap length on liquid insulating material.
5	Breakdown Strength of composite dielectric material.
6	Study of impulse generator.
7	High voltage withstand test on cables/safety gloves/shoes, as per IS. (Max. 2.25 KV DC)
8	Horn gap arrangement as surge diverter.
9	Measurement audible and visible corona inception and extinction voltage
10	Development of tracks and trees on polymeric insulation.
11	Study of Effect of EHV field on Human, Animals & Plants.

BTEEL708: ELECTRICAL DRIVES LAB	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Pre requisite	Basic electronics engineering, basic electronics engineering Course
Course Outcome	• Efficiently use various AC and DC drive. • Simulate various drive system
Sr.No	List of Experiments
1	Study the ramp comparator firing circuit.
2	Study of single phase half wave converter and semi converter DC Drive .
3	Study of single phase full controlled converter (Bridge converter) DC Drive.
4	Speed control of DC motor using chopper.
5	Simulation of single phase half wave and semiconductor controlled DC drive.
6	Simulation of chopper fed DC Drive .
7	Study of AC Drive .
8	Study of V/f control of AC drive
9	Study the inverter fed induction motor drive.
10	Simulation of AC drive .

BTEES709: SEMINAR	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Student shall choose a topic of his/her interest in consultation with faculty in the department. The topic for seminar may be related to Recent Developments in Instrumentation Engineering area and/or interdisciplinary area. Student shall attempt to collect necessary information and present a summary indicating comprehension of the topic and acquired depth of knowledge. A brief report on topic of seminar shall be submitted. Evaluation shall be based on report and power point presentation.

BTEEP710: PROJECT PART-I	
Teaching Scheme:	Examination Scheme:
Practical: 6hr	Continuous Assessment: 30 Marks
Total Credits: 3	End Term Exam: 20 Marks

Term work shall consist of detailed report for chosen topic and output of final working proposed. Report shall summarize the literature survey, spell out the scope of work, methodology and results. Viva-voce Examination shall be based on work carried out by the student. In case of students opting for Internship in the eighth semester, the Project may be industry-based.

BTEEF711: FIELD TRAINING/INTERNSHIP/INDUSTRIAL TRAINING III	
Teaching Scheme:	Examination Scheme:
Practical: --	Continuous Assessment: --
Total Credits: 1	End Term Exam: 50 Marks

Students are expected to undergo industrial training for at least four weeks at factory / design offices or in combination of these after VI semester. Training session shall be guided and certified by qualified engineer / industry expert. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester VI and appear at examination in Semester VII. A brief report of industrial training shall be submitted. Evaluation shall be based on report and power point presentation.

POWER MANAGEMENT INTEGRATED CIRCUITS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
Total Credits: 3	Internal Assessment: 20* Marks
	End Term Exam: 60* Marks

Prof. Qadeer Ahmad Khan | IIT Madras

Course Duration: 12 weeks

CourseOutline:

This course is intended to develop understanding of why power management circuits are needed in a VLSI system, what are the different components of a power management system with focus on voltage regulators. By the end of this course, students should be able to understand the concept behind power management circuits and design a linear (LDO) and switching regulator (dc-dc converter) for a given specifications using behavioral and circuit level simulators.

Course Plan:

Week 1 : Introduction to Power Management - Application, Need, Discrete vs. Integrated PMIC; DC-DC Converters, Types of DC-DC Converters, Linear versus Switching Regulator, Choosing between Linear and Switching Regulators, Choosing the Type of Regulator in a Multi-Chip System; Performance Parameters - Efficiency, Accuracy, Line and Load Regulation, Line and Load Transient, PSRR; Remote versus Local Feedback, Point-of-Load Regulator, Kelvin Sensing, Droop Compensation; Current Regulators and their Applications; Bandgap Voltage Reference - Designing a Bandgap Reference using PTAT and CTAT Voltage References, Brokaw Bandgap Circuit.

Week 2: Sub-1-volt Bandgap Reference; Introduction to Linear Regulator, Applications of Linear Regulator; Review of Feedback Systems and Bode Plots, Loop Gain AC Analysis, Stability Criterion and Phase Margin, Review of First-Order and Second-Order Systems, Relationship between Damping Factor and Phase Margin; Parasitic Capacitances in a MOS transistor, Finding the Poles of the Error Amplifier; Stabilising a Linear Regulator - Frequency Compensation Techniques, Dominant Pole Compensation.

Week 3 : Miller Compensation, R.H.P. zero due to Miller Compensation, Intuitive Methods of Determining Poles and Zeros after Miller Compensation, Pole Splitting due to Miller Compensation, Reducing the Effect of R.H.P. zero; LDO with NMOS Pass Element; Load Regulation and Output Impedance of LDO; Line Regulation and PSRR of LDO; Sources of Error in a Regulator, Static Offset Correction, Dynamic Offset Cancellation.

Week 4 : Digital LDO, Avoidance of Limit-Cycle Oscillations in a Digital LDO, Hybrid LDO; Short-Circuit Protection and Foldback Current Limit in an LDO; Basic Concept of a Switching Regulator, Inductor volt-second Balance, Power Stage of a Buck Converter and Calculation of Duty Cycle; Transformer Model of a Buck Converter, Resistive Losses, Efficiency of a Switching Regulator, Efficiency considering only Conduction Losses; Synchronous and Non-Synchronous Switching Converters; PWM Control Techniques (Voltage-Mode and Current-

Mode Control); Losses in Switching DC-DC Converter- Conduction Loss, Gate-Driver Switching Loss, Segmented Power FETs, Dead-Time Switching Loss.

Week 5 : Hard Switching Loss, Magnetic Loss, Relative Significance of Losses as a Function of the Load Current; Inductor Current Ripple and Output Voltage Ripple in a DC-DC Converter, Ripple Voltage versus Duty Cycle, Ripple Voltage versus Input Supply Voltage; Choosing the Inductor and Capacitor of a Buck Converter; Continuous and Discontinuous Conduction Modes - Boundary Condition, Voltage Conversion Ratio in DCM; Concept of Pulse Frequency Modulation (PFM); Classification of Pulse Width Modulators -- Trailing, Leading and Dual-Edge PW Modulators; Control Techniques for DC-DC Converters; Voltage Mode Control, Small-Signal Modeling of a DC-DC Converter, Loop Gain and Stability Analysis using Continuous-Time Model.

Week 6 : Compensating a Voltage-Mode-Controlled Buck Converter; Designing Type-I (Integral), Type-II (PI) and Type-III (PID) Compensators; Implementation of Compensators using Op Amp-RC and Gm-C Architectures, Finding Compensation Parameters; Design Examples with Simulation Demonstrations.

Week 7 : Designing Type-III Compensator using Gm-C Architecture and Design Example; Ramp Generator with Feed-Forward Line Compensation, Loop Gain Compensation via Gm-modulation; Designing a Buck Converter - Power Loss Budgeting, Sizing of Power FETs, Estimation of Switching Losses and Choice of Switching Frequency, Choosing the External Passive Components (L and C); Choice of C in Relation to Factors that Limit the Load Transient Response; Inductor and Capacitor Characteristics, Reducing the Effect of Capacitor ESL.

Week 8 : Designing the Gate-Driver (Gate Buffer and Non-Overlap Clock Generator), Designing the Ramp Generator in a Pulse-Width Modulator, Design Considerations of the Error Amplifier; Delays Associated with Pulse-Width Modulators; PFM/PSM for Light Load, Using PSM in CCM to Avoid Duty Cycle Saturation; DCM Operation using an NFET; Designing a Zero-Cross Detector/Comparator; Introduction to Current Mode Control; Peak, Valley and Average CMC; Sub-Harmonic Oscillations, Avoiding Current Loop Instability via Slope Compensation in a Current-Mode-Controlled Buck Converter.

Week 9 : Non-Linear Control Techniques for DC-DC Converters; Hysteretic Control - Stability Issues due to Phase Shift between Inductor Current and Capacitor Voltage; Voltage-Mode versus Current-Mode Hysteretic Control, Stabilising a Voltage-Mode-Controlled Hysteretic Converter using R_esr, Relation between Hysteresis Window and Switching Frequency, Using R-C Circuit as Ripple Generator in a Current-Mode-Controlled Hysteretic Converter, Hybrid Voltage-Mode and Current-Mode Hysteretic Control, Fixed-Frequency Hysteretic Control, Effect of Loop Delay, Frequency-Regulation and Voltage-Regulation Loops in a Fixed-Frequency Hysteretic Converter; Constant ON/OFF-Time Control; Basic Concept of a Boost Converter, RHP zero in a Boost Converter.

Week 10 : Introduction to the Buck-Boost Converter, Tri-Mode Buck-Boost Converter, Boundary Conditions for Mode Transition in a Tri-Mode Buck-Boost Converter, Generation of Buck and Boost Duty Cycles; Introduction to Switched-Capacitor DC-DC Converters,

Applications of SC DC-DC Converters in Open-Loop, Output Regulation in SC DC-DC Converters using Feedback Control, H-Bridge SC DC-DC Converter, Multiple Gain Settings in SC DC-DC Converters; Current-Sensing Techniques in DC-DC converters.

Week 11 : Selecting the Process Node for a PMIC, Chip-Level Layout and Placement Guidelines, Board-Level Layout Guidelines, EMI Considerations; Introduction to Advanced Topics in Power Management --- Digitally-Controlled DC-DC Converters, Adaptive Compensation Techniques, Limitations of Analogue and Digital Controllers, Time-Based Control Techniques and their Drawbacks, Multi-Phase DC-DC Converters; Dynamic Voltage and Frequency Scaling (DVFS); Single-Inductor Multiple-Output (SIMO) DC-DC Converters.

Week 12 : Introduction to Advanced Topics in Power Management (continued) - DC-DC Converters for LED Lighting, LCD/AMOLED Display Drivers, LED Drivers for Camera Flash, Lithium-ion Battery and its Charging Phases, Battery Charger ICs.

DC POWER TRANSMISSION SYSTEM	
Teaching Scheme:	Examination Scheme:
Theory: 03	Mid-term Test: 20* Marks
Tutorial: 00	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Krishna S, IIT Madras

Course Duration: 12 weeks

CourseOutline:

This course gives an introduction to the DC power transmission system using the conventional line commutated converters. The topics covered include a detailed analysis of the 6 pulse line commutated converter (LCC), 12 pulse LCC, capacitor commutated converter, DC link control, and design of single tuned filter.

Course Plan:

Week 1: Introduction, choice of converter configuration
Week 2: Converter configuration for pulse number equal to 6, analysis of 6 pulse LCC neglecting overlap
Week 3: Fourier series, analysis of 6 pulse LCC neglecting overlap
Week 4: 2 and 3 valve conduction mode of 6 pulse LCC
Week 5: Extinction angle, 3 and 4 valve conduction mode and 3 valve conduction mode of 6 pulse LCC
Week 6: Commutation margin angle, normalization, characteristics of 6 pulse LCC, steady state analysis of a general LCC
Week 7: 6 pulse LCC with other circuits on the AC and DC sides
Week 8: Capacitor commutated converter, 12 pulse LCC
Week 9: Mode of operation of 12 pulse LCC, purposes of transformer, applications of DC transmission, types of DC link, DC link control
Week 10: Converter control characteristics, MTDC systems, non-characteristic harmonics
Week 11: Design of single tuned filter
Week 12: Double tuned and damped filters, reactive power requirement, comparison of AC and DC transmission

HIGH POWER MULTILEVEL CONVERTERS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial:	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Anandarup Das, IIT Delhi

Course Duration: 12 weeks

CourseOutline:

The course covers different types of high power converters used in the industry for applications in HVDC, FACTS, Motor Drives, Power quality improvement. Traditional converters like NPC and emerging converters like modular multilevel converters will be covered. Operational issues and design considerations for these medium/high voltage high power converters will be covered. The course will discuss many practical issues faced in the industry while designing and operation of these converters.

Course Plan:

Week 1 : (a) Half bridge, Full bridge and three phase converters, sinusoidal PWM

Week 2 : (a) 3rd harmonic addition, space vector PWM

Week 3 : (a) Different types of multilevel converters
(b) Cascaded H-Bridge converter – Basic operation

Week 4 : (a)PWM Techniques for CHB converter
(b) Fault tolerant operation of CHB converter

Week 5 : (a) Modular Multilevel converter- Topology, operation and PWM

Week 6 : (a) Capacitor voltage balancing in MMC
(b) Design of components of MMC

Week 7 : (a) NPC converter – Basic operation
(b) NPC (3 level) Space vector diagram

Week 8 : NPC - PWM technique and midpoint balancing

Week 9 : (a) Case study of High Power converters for Motor drive and HVDC application

Week 10 : (a) Multi –pulse transformers

Week 11 : (a) Gate Drive circuit designing, protection and condition monitoring in high power converters

Week 12 : (a) Other topologies : conclusion

FUZZY SETS, LOGIC AND SYSTEMS & APPLICATIONS	
Teaching Scheme:	**Examination Scheme:**
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial:	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Nishchal Kumar Verma, IIT Kanpur

Course Duration: 12 weeks

CourseOutline:

The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get these concepts.

Course Plan:

Week 1 : Introduction and Fuzzy Sets Theory

Week 2: Membership Functions

Week 3: Set Theoretic Operations

Week 4: Fuzzy Arithmetic

Week 5: Fuzzy Relations

Week 6: Fuzzy Inference Systems I

Week 7: Fuzzy Inference Systems II

Week 8: Wang and Mendel Model

Week 9: TSK Model

Week 10: Fuzzifiers and Defuzzifiers

Week 11: ANFIS Architecture

Week 12: Fuzzy Systems and Machine Learning

THE JOY OF COMPUTING USING PYTHON	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial: 1hr	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof.Sudarshan Iyengar, Department of Computer Science and Engineering, IIT Ropar

Course Duration: 12 weeks

CourseOutline:

ThisisamostfundamentalDigitalCircuitDesigncourseforpursingamajorinVLSI. We do not deal with any Verilog coding during this course and instead discuss transistor level circuit design concepts in greatdetail.

Learning objectives of this course are:

- Characterize the key delay quantities of a standardcell
- Evaluate power dissipated in a circuit (dynamic andleakage)
- Design a circuit to perform a certain functionality with specifiedspeed
- Identify the critical path of a combinationalcircuit
- Convert the combinational block to pipelinedcircuit
- Calculate the maximum (worst case) operating frequency of the designedcircuit

Course Plan:

Motivation for Computing
Variables and Expressions: Design your own calculator
Loops and Conditionals: Hopscotch once again
Lists, Tuples and Conditionals: Let’s go on a trip
Abstraction Everywhere: Apps in your phone
Counting Candies: Crowd to the rescue
Birthday Paradox: Find your twin
Google Translate: Speak in any Language
Currency Converter: Count your foreign trip expenses
Monte Hall: 3 doors and a twist
Sorting: Arrange the books
Searching: Find in seconds
Substitution Cipher: What’s the secret !!
Sentiment Analysis: Analyse your Facebook data
20 questions game: I can read your mind
Permutations: Jumbled Words
Spot the similarities: Dobble game
Count the words: Hundreds, Thousands or Millions.
Rock, Paper and Scissor: Cheating not allowed !!
Lie detector: No lies, only TRUTH

Calculation of the Area: Don’t measure.
Six degrees of separation: Meet your favourites
Image Processing: Fun with images
Tic tac toe: Let’s play
Snakes and Ladders: Down the memory lane.
Recursion: Tower of Hanoi
Page Rank: How Google Works !!

INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS	
Teaching Scheme:	**Examination Scheme:**
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial:	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. SudipMisra, IIT Kharagpur

Course Duration: 12 weeks

CourseOutline:

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

Course Plan:

Week 1 : Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II

Week 2 : Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Week 3 : Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis

Week 4 : Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Week 5 :IIoT-Introduction, Industrial IoT: Business Model and RefereceArchiterture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

Week 6 : Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

Week 7 : Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Week 8 : Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

Week 9 : Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.

Week 10 : Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Week 11 : Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory

Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Week 12 : Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :

Case study - I : Milk Processing and Packaging Industries
Case study - II: Manufacturing Industries - Part I
Case study - III : Manufacturing Industries - Part II
Case study - IV : Student Projects - Part I
Case study - V : Student Projects - Part II
Case study - VI : Virtual Reality Lab
Case study - VII : Steel Technology Lab

ENTREPRENEURSHIP ESSENTIALS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Manoj Kumar Mondal, IITKharagpur

Course Duration: 12 weeks

CourseOutline:

The course provides foundational knowledge on various aspects of entrepreneurial venture creation and management during its life-cycle. It has been designed to address multidisciplinary audiences. The objective of the course is to teach key issues faced by entrepreneurs and managers at different stages of the life-cycle of an enterprise and is relevant both for aspiring entrepreneurs and for decision makers in established enterprises. Topics can be classified in some major themes such as : Making a choice to create an entrepreneurial venture, current trend of technology entrepreneurship, how to start a start-up, identifying opportunities, factors driving competitive advantages, organizational structure, basic knowledge of financial statements and project report,introductory knowledge on marketing management, human resource management, & strategic management, risk analysis, legal aspect of business, how to raise fund during life-cycle of a new ventures.

Course Plan:

Week 1 : Introduction
DhirubhaiAmbani& Sofia
Myths & Realities about entrepreneurship
entrepreneurial qualities
Why start-ups fail?

Week 2: Mission, vision, entrepreneurial qualities – I
Mission, vision, entrepreneurial qualities – II
Value proposition
Business Model canvas
Business model generation

Week 3: Competitive advantage
Lean start-up – 1
Lean start-up – 2
Team and early recruit
Legal forms of business

Week 4: Marketing management 1
Marketing management 2
Market research –I
Market research –II
Market research –Example

Week 5: Introduction to financial statements
Profit & Loss statement
Balance sheet

Cash flow
Example – 1
Example – 2
Cost-volume-profit & Bread-Even analysis
Capital budgeting

Week 6: Business plan-I
Business plan-II
Pitching
Go-to-market strategies
Does & Don'ts

Week 7: How to innovate
Design Thinking
Design-Driven Innovation, Systems thinking
Open innovation, TRIZ
How to start a start-up?

Week 8: Government incentives for entrepreneurship (1 lecture)
Incubation, acceleration
Funding new ventures – bootstrapping, crowd sourcing, angel investors, VCs, debt financing (3), due diligence
Legal aspects of business (IPR, GST, Labour law)

Week 9: Cost, volume, profit and break-even analysis
Margin of safety and degree of operating leverage
Capital budgeting for comparing projects or opportunities
Product costing
Product pricing

Week 10: Funding new ventures – bootstrapping, crowd sourcing,
Angel investors, VCs, debt financing (3), and due diligence
Incubation and acceleration
Government incentives for entrepreneurship
Project cost and Financial Closure

Week 11: Dos &Donts in entrepreneurship
Growth Hacking
Growth Strategy
Legal aspects of business (IPR, GST, Labor law)
Negotiation skill

Week 12: Human Resource management in startups
Pivoting
Entrepreneurial cases
Risk assessment and analysis
Strategy management for entrepreneurial ventures
Factors driving success and failure of ventures
Concluding remarks

BTEEP803: PROJECT-II	
Teaching Scheme:	Examination Scheme:
Practical: 30hr	Continuous Assessment: 100 Marks
Total Credits: 15	End Term Exam: 150 Marks

Since Project Stage II is in continuation to Project Stage I, the students are expected to complete the total project by the end of semester VIII. After completion of project work, they are expected to submit the consolidated report including the work done in stage I and stage II.

The report shall be comprehensive and presented typed on A4 size sheets and bound. The number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.