VISION	MISSION
"To be the eminent department known for producing globally proficient electrical graduates possessing finest human values, to achieve sustainable socio-economic development"	1. To transform students into academically and technically sound electrically sound engineers. 2. To enhance teaching learning process by dedicated qualified professionals. 3. To promote research and development with current techniques through well developed educational environment.

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	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**

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	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							

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	Theory 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	Innovation and entrepreneurship Development	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	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 trainning/ 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**

Dr.S.R.Vaishnav
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: 2020-21

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.

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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

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY LONERE.

ELECTRICAL ENGINEERING DEPARTMENT

Structure and syllabus

Of

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

With effect from January 2019

Teaching & Evaluation scheme of Third year B. Tech. Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engg .

V Semester

Course Code	Course Name	Teaching Scheme			Evaluation Scheme				
		L	P	T	Int	MSE	ESE	Total	Credits
BTEEC501	Electrical Machine-II	3	0	1	20	20	60	100	4
BTEEC502	Power System-II	3	0	1	20	20	60	100	4
BTEEL503	Microprocessor and micro Controller	3	0	0	20	20	60	100	3
BTHM504	Value Education, Human Rights and Legislative Procedures [MOOC/Swayam/NPTEL]	2	0	0	-	-	-	Audit course	0
BTEEE505	Elective-IV	3	0	0	20	20	60	100	**3**
BTEEOE506	Elective-V	3	0	0	20	20	60	100	**3**
BTEEL507	Electrical Machine-II Lab	0	4	0	**60**	-	**40**	100	**2**
BTEEL508	Power System-II Lab	0	2	0	**30**	-	**20**	50	**1**
BTEEL509	Microprocessor and micro Controller Lab	0	2	0	**30**	-	**20**	50	**1**
BTEEF510	Industrial Training	-	-	-	**50**	-	-	50	**1**
	Total	17	08	02	**270**	**100**	**380**	750	**22**

Elective- IV: 1.Illumination engineering 2. Advances in Renewable Energy Sources. 3. Testing and Maintenance of Electrical equipment.

Elective-V: 1.Electrical Mobility. 2 Power Plant Engineering. 3. Design and Analysis of Algorithms

VI semester

Course Code	Course Name	Teaching Scheme			Evaluation Scheme				
		L	P	T	Int	MSE	ESE	Total	Credits
BTEEC601	Control System	3	0	1	20	20	60	100	4
BTEEC602	Principles of Electrical Machine Design	3	0	0	20	20	60	100	3
BTEEC603	Power Electronics	3	0	1	20	20	60	100	4
BTEEE604	Elective-VI	3	0	0	20	20	60	100	3
BTEEC605	Elective-VII	3	0	0	20	20	60	100	**3**
BTEEOE606	Elective-VIII [MOOC/Swayam/NPTEL]	3	0	0	20	20	60	100	**3**
BTEEL607	Control System- Lab	0	2	0	30	-	20	50	**1**
BTEEL608	Principles of Electrical Machine Design Lab	0	2	0	30	-	20	50	**1**
BTEEL609	Power Electronics Lab	0	4	0	60	-	40	100	**2**
	Total	18	08	02	**240**	**120**	**440**	800	**24**

Elective-VI Industrial automation and Control 2. Design of Experiments 3. Artificial neural network.
Elective-VII 1. Switch Gear and Protection 2. Computer aided analysis and design 3. Mechatronics
Elective- VIII. 1. Rural Technology and Community Development. 2. Project Management 3. Knowledge Management

Semester: V

BTEEC501: ELECTRICAL MACHINE-II

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Electrical machine I	
Course outcome	To study different methods of speed control of AC and DC motor To study importance and procedure of different performance test on AC and DC motor. To determine different operating characteristics of AC and DC machines	
Unit	Contents	Contact Hrs
1	Basic Concepts in A.C. Machines: Classification of A.C. Machines, principle of operation and constructional features of synchronous and induction machines, rotating mmf waves in A.C. Machines	8
2	Armature windings: Introduction, ac machine windings, winding factors, the emf equation, harmonics in generated emf, causes of harmonics and their suppressions.	6
3	Synchronous Machines : Construction, types, armature reaction, circuit model of synchronous machine, determination of synchronous reactance, phasor diagram, power angle characteristics, parallel operation of synchronous generators, synchronizing to infinite bus bars, two axis theory, synchronous motor operation, characteristic curves, synchronous condenser, dynamics.	10
4	Three phase Induction (Asynchronous) Motor: Types of induction motor, flux and mmf waves, development of circuit model, power across air gap, torque and power output, oc and sc tests, circle diagram, starting methods, cogging and crawling, speed control, deep bar/ double cage rotor, induction generator, induction machine dynamics, high efficiency induction motors	10
5	Fractional Kilowatt Motors: Introduction, single phase induction motors, double revolving field theory, circuit model of single phase induction motor, determination of circuit parameters.	5
6	Special A.C. Machines: Single phase synchronous motors, permanent magnet ac motors, ac servomotors	5
	Ref Books: 1.Say M. G., "Design & performance of A.C. Machines", (Book Publications,3rd edition) 2..Bhimra P. S., "Electric Machines", (South Ex Publications, New Delhi) 3. D. P. Kothari, I. J. Nagrath,"Electric Machines ", Tata McGraw Hill Publication, Fourth edition, reprint 2012. 4. A. F. Puchstein, T.C. Lloyd, A.G. Conrad, "Alternating current machines", John Wiley and Sons, New York 1954. 5.• A.E. Fitzgerald, Charles Kingsley Jr., Stephen D. Umans ,"Electric Machinery ", Tata McGraw Hill Publication, sixth edition 2002	

BTEEC502: POWER SYSTEM-II

Teaching scheme:
Theory: 3 hrs
Tutorial: 1hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Power system I	
Course outcome	To study different parameters of power system operation and control To study load flow and Diff. methods of reactive power control. To understand diff. methods of fault analysis and stability study	
Unit	Contents	Contact Hrs.
1	Economic Operation of Power Systems: Distribution of loads between units within a plant, Economic division of load between units in a plant, Transmission loss as a function of plant generation, Calculation of loss co-efficient, Distribution of load between plants, Introduction to unit commitment, Numerical examples	8
2	Load Flow Studies: Network model formulation, (Applications of iterative techniques like Gauss-Siedal method, and Newton-Rap son method, etc.) Numerical. Active Power Control Basic generator control, Load frequency control. Load, prime mover and governor model, Numerical examples	6
3	Reactive Power Control: 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.	6
4	Symmetrical and unsymmetrical fault analysis: Symmetrical Components transformation analysis for, transformers, transmission lines and synchronous machines, Numerical examples. Fault analysis and evaluation of faults on loaded unloaded synchronous generator, Selection of circuit breakers, asymmetrical fault-evaluation of a) Line to ground b) Line to line c) Double line to ground d) single & double conductor open faults, Numerical examples	6
5	Stability: Dynamics of a synchronous machine, Power angle equation, Steady state stability, Equal area criterion, Numerical solution of swing equation, Factors affecting transient stability, Critical clearance angle, Numerical	6
6	Load dispatch center functions, Contingency analysis, preventive, emergency and restorative Control. power quality: def., causes, affects, slandered and mitigation methods	7
	Ref Books: 1. Stevension .W. D– Power System Analysis. (Tata Mcgraw Hill). 2. Ashfaq Hussian - Power System Analysis. (Tata Mcgraw Hill). 3. Nagrath & Kothari – Modern Power System Analysis.(Tata Mcgraw Hill). 4. Hadi Sadat- Power System Analysis (Tata Mcgraw Hill). 5. Prof A M Kulkarni IIT “Bombay Web Course on Power System Operation and Control”	

BTEEC503-.MICROPROCESSOR AND MICRO CONTROLLER

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Digital electronics, electronics devices and circuits	
Course outcome	To know the architecture of 8085 and 8051. To understand interfacing and interrupt features of 8085 and 8051. To develop program for basic applications.	
Unit	Contents	Contact Hrs.
1	Architecture of 8085 Microprocessor and Programming: Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals, Machine cycles and timing diagrams. Instruction formats, Addressing modes, Instruction set, Need for Assembly language, Development of Assembly language programs.	7
2	Interfacing: 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/O Scheme, I/O mapped I/O scheme, Input and Output cycles, Simple I/O ports, Programmable peripheral interface (8255). Data transfer schemes: Programmable data transfer, DMA data transfer, Synchronous, Asynchronous and interrupt driven data transfer schemes, Interfacing, Simple keyboards and LED displays.	5
3	Interrupts and DMA: Interrupt feature, Need for interrupts, Characteristics of Interrupts, Types of Interrupts, Interrupt structure, Methods of servicing interrupts, Development of Interrupt service subroutines, Multiple interrupt request and their handling, need for direct memory access, Devices for Handling DMA, Programmable DMA controller 8237.	5
4	Applications: 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 power factor-Traffic light controller, Stepper motor control	5
5	Intel 8051 Microcontroller : Architecture of 8051, Memory Organization, Addressing modes, Instruction set, Boolean processing, Simple programs	6
6	8051 Peripheral Functions : 8051 interrupt structures, Timer and serial functions, parallel port features : Modes of operation, Power control, features, Interfacing of 8051, Typical applications, MCS 51 family features	6
	Ref 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. 3. Douglas, V.Hall. "Microprocessor and Interfacing Programming and Hardware", 2ndEdition, McGraw Hill Inc., 1992. 4. Kenneth, L.Short., "Microprocessors and Programmed Logic", Prentice Hall of India, 2nd Edition, 1987	

BTHM 504: VALUE EDUCATION, HUMAN RIGHTS AND LEGISLATIVE PROCEDURES

Teaching scheme:
Theory: 2 hrs
Total credit: 0 (Audit course)

Examination Scheme:
Mid-term test: --
Internal Assessment: --
End semester exam:---

Prerequisite	Human Values and engg ethics	
Course outcome	To understand value of education and self-development To develop good values and character To know Human right and legislative procedure	
Unit	Contents	Contact Hrs.
1	Values and Self Development-Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non-moral valuation, Standards and principles, Value judgments.	5
2	Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline.	4
3	Personality and Behavior Development- Soul and scientific attitude, God and scientific attitude, Positive thinking, Integrity and discipline, Punctuality, Love and kindness, Avoiding fault finding, Free from anger, Dignity of labor, Universal brotherhood and religious tolerance, True friendship, Happiness vs. suffering love for truth, Aware of self-destructive habits, Association and cooperation, Doing best, Saving nature.	5
4	Character and Competence- Science vs. God, Holy books vs. blind faith, Self-management and good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of women, All religions and same message, Mind your mind, Self-control, Honesty, Studying effectively.	5
5	Human Rights- Jurisprudence of human rights nature and definition, Universal protection of human rights, Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups.	5
6	Legislative Procedures- Indian constitution, Philosophy, fundamental rights and duties, Legislature, Executive and Judiciary, Constitution and function of parliament, Composition of council of states and house of people, Speaker, Passing of bills, Vigilance, Lokpal and functionaries	4
	Ref Books: 1. Chakraborty, S.K., Values and Ethics for Organizations Theory and Practice, Oxford University Press, New Delhi, 2001. 2. Kapoor, S.K., Human rights under International Law and Indian Law, Prentice Hall of India, New Delhi, 2002. 3. Basu, D.D., Indian Constitution, Oxford University Press, New Delhi, 2002. 4. Frankena, W.K., Ethics, Prentice Hall of India, New Delhi, 1990. 5. Meron Theodor, Human Rights and International Law Legal Policy Issues, Vol. 1 and 2, Oxford University Press, New Delhi, 2000.	

BTEEE 505: ELECTIVE- IV: 1. ILLUMINATION ENGINEERING

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Basic electrical engineering , physics.	
Course outcome	To get the detailed information about modern lamps and their accessories. To get detailed insight of indoor and outdoor illumination system components, its controls and design aspects. To know the requirements of energy efficient lighting. To introduce the modern trends in the lighting	
Unit	Contents	Contact Hrs.
1	**Importance of Lighting in Human Life:**Optical systems of human eye ,Dependence of human activities on light, performance characteristics of human visual system, External factors of vision-visual acuity, contrast, sensitivity, time illuminance, colour, visual perception, optical radiation hazards, Good and bad effects of lighting & perfect level of illumination, Artificial lighting as substitute to natural light, Ability to control natural light, Production of light, physics of generation of light, Properties of light, Quantification & Measurement of Light.	8
2	**Light Sources:** Lamp materials: Filament, glass, ceramics, gases, phosphors and other metals and non-metals. Discharge Lamps: Theory of gas Discharge phenomena, lamp design considerations, characteristics of low and high mercury and Sodium vapour lamps, Low Vapour Pressure discharge lamps – Mercury Vapour lamp, Fluorescent Lamp, Compact Fluorescent Lamp (CFL) High Vapour Pressure discharge lamps - Mercury Vapour lamp, Sodium Vapour lamp, Metal halide Lamps, Solid Sodium Argon Neon lamps, SOX lamps, Electro luminescent lamps, Induction lamps.	6
3	**Electrical Control of Light Sources:** Ballast, igniters and dimmers for different types of lamps, **Photometric Control of Light Sources and their Quantification:** Types of Luminaries, factors to be considered for designing luminaries Types of lighting fixtures. Optical control schemes, design procedure of reflecting and refracting type of luminaries. Lighting Fixture types, use of reflectors and refractors, physical protection of lighting fixtures, types of lighting fixtures according to installation type, types of lighting fixtures according to photometric usages, luminaries standard (IEC-598-Part I).	6
4	Zonal cavity method for general lighting design, determination for zonal cavities and different shaped ceilings using COU (coefficient of utilization), beam angles and polar diagrams. Factors to be considered for design of indoor illumination scheme **Indoor illumination design for following installations:** Residential (Numerical)**,**Educational institute**,** Commercial installation**,** Hospitals**,** Industrial lighting**, Special purpose lighting schemes** Decorative lighting**,** Theatre lighting**,** Aquarium, swimming pool lighting	6
5	Factors to be considered for design of outdoor illumination scheme, **Outdoor Lighting Design:** Road classifications according to BIS, pole arrangement, terminology, lamp and luminaire selection, different design procedures, beam lumen method, point by point method, isolux diagram, problems on point by point method. **Outdoor illumination design for following installations**; Road lighting (Numerical), Flood lighting (Numerical), Stadium and sports complex, Lighting for advertisement/hoardings	6
6	**Modern trends in illumination;** LED luminary designs**,** Intelligent LED fixtures**,** Natural light conduiting**,** Organic lighting system**,** LASERS, characteristics, features and applications, non-lighting lamps**,** Optical fiber, its construction as a light guide, features and applications	7
	Ref Books: 1 H. S. Mamak, “Book on Lighting”, Publisher International lighting Academy 2. Joseph B. Murdoch, “Illumination Engineering from Edison’s Lamp to Lasers” Publisher - York, PA: Visions Communications 3. M. A. Cayless, A. M. Marsden, “Lamps and Lighting”, Publisher-Butterworth-Heinemann(ISBN978-0-415-50308-2) 4. Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002	

BTEEE 505 ELECTIVE- IV: 2. ADVANCES IN RENEWABLE ENERGY SYSTEMS

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Introduction to Non-Conventional energy sources	
Course outcome	To know the principle of energy conversion technique from biomass, geothermal and hybrid energy systems. To understand effects of air pollution and ecosystems	
Unit	Contents	Contact Hrs.
1	Biomass Energy: 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.	8
2	Geothermal Energy : 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	6
3	Hybrid energy systems : 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.	6
4	Air pollution-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.	6
5	Environment impact assessment policies and auditing, conflicting worldviews 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.	6
6	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.	7
	Ref Books: 1. NPTEL courses	

BTEEOE 506: ELECTIVE-V. 1. ELECTRICAL MOBILITY

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Digital electronics, network analysis and synthesis	
Course outcome		
Unit	Contents	Contact Hrs
1	**Electric mobility introduction:** Introduction to electrical mobility, classification, need of electrical mobility, operating principle.	8
2	**Energy sources and storage systems:** Conventional energy sources and non-conventional energy sources, different types of energy storage schemes and energy storage devices	7
3	**Electric machines in electric mobility:** Diff. types of electrical machines used in electric mobility: induction machine , dc machine, synchronous machine,	8
4	**Power converters:** Introduction to power converters, different types of power converters, construction, working, applications, advantages, disadvantages.	7
5	**Applications, Modeling:**	8
6	**Electric vehicles and the environment;**	7
	Ref Books: 1. Nptel 2. Larminie, J.; Lowry, J. Electric vehicle technology explained [on line]. Chichester, West Sussex: J. Wiley, cop. 2003Available 3. on: <http://onlinelibrary.wiley.com/book/10.1002/0470090707>. ISBN 0470851635. 4. Miller, J. M. Propulsion systems for hybrid vehicles. 2nd ed. The Institution of Engineering and Technology, 2010. ISBN 978- 5. 1-84919-147-0. 6. Husain, I. Electric and hybrid vehicles : design fundamentals [on line]. 2nd ed. Boca Raton: CRC Press, cop. 2011 7. [Consultation: 07/03/2012]. Available on: <http://www.sciencedirect.com/science/book/9780444535658>. ISBN 8. 9781439811757. 9. Ehsani, M.; Gao, Y.; Emadi, A. Modern electric, hybrid electric, and fuel cell vehicles : fundamentals, theory and design. 2nd	

BTEEOE 506: ELECTIVE-V 2 POWER PLANT ENGINEERING.

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Power system I, power system II, machine I and II	
Course outcome	To review basic components of power system, energy sources. To understand principle of construction and operation of different conventional power plants.	
Unit	Contents	Contact Hrs
1	Load and Energy survey, load duration curve, plant factor and plant economics, Introduction to conventional energy sources, different sources of non-conventional energy like solar, wind, tidal, geothermal biomass, MHD plants, their applications and site selection, Indian energy scenario	8
2	Thermal Power Station: Introduction, selection of sites, main parts of thermal power station and their working, simple numerical examples. Nuclear Power Plant: Review of atomic physics (atomic number, mass number, isotopes, atomic mass, unit rate of radioactivity, mass equivalent number, binding energy and mass defects), main parts of nuclear power station, types of reactors (pressurized water reactor (PWR), boiling water reactor, gas cooled reactor, liquid metal tank feeder reactor, heavy water reactor, plant layout and working, simple numerical, India's nuclear power program.	6
3	Hydroelectric Power Plant: Advantages and limitations, selection of site, hydrological cycles and hydrographs, storage and pondage, essential elements of hydroelectric plant, classification, different types of turbines and their selection, governing of hydraulic turbines, surge tanks, draft tube, layout of hydro-station, simple numerical.	6
4	Diesel Engine & Gas Power Plant: Advantage and limitations, types of diesel plants, general layout, IC engines and their performance characteristics, layout of diesel engine power plant and applications. Components of gas power plant, gas turbine fuels, turbine fuels, turbine materials, working, improvement of thermal efficiency of gas power plant and applications, simple numerical examples.	6
5	Combined working of power plants: Economics of combined working power plants, base load and peak load stations, pumped storage plants, inter- connections of power stations. Tariff: Fixed cost, running cost and their interrelation for all types of conventional power plants, depreciable cost, different types of tariffs, numerical example based on above, effect of deregulation on pricing.	6
6	Grid interface of different power plants: Concept of parallel operation of various generating sources and load sharing, need of interconnection between different power plants, concept of Grid, importance of grid, requirement of grid, types of grid (in transmission and distribution system), conditions to interface different power plants to grid.	7
	Ref Books: 1.Gupta B. R. " Power Plant Engineering".(Eurasia publications) 2.Nag P. K. " Power Plant Engineering",(Tata McGraw Hill Publications) 3.Deshpande M. V. " Elements of Electrical Power Station Design" (Wheeler publications) 4.Arora and Domkundwar, "A course in Power Plant Engineering" (Dhanpat Rai & co., 5/e) 5.R. K. Rajput, "Power Plant Engineering" 6.V. K. Mehta, "Power System", S. Chand Pub. 7.J. B. Gupta, "A course in Power System Engineering",	

BTEEOE 506: ELECTIVE-V. 3. DESIGN AND ANALYSIS OF ALGORITHMS

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Numerical methods and C programming, control system I,	
Course outcome	To know fundamental characteristic of an algorithm. To understand strategy of algorithm formation, To develop different algorithm.	
Unit	Contents	Contact Hrs
1	Introduction- Fundamental characteristics of an algorithm. Basic algorithm analysis – Asymptotic analysis of complexity bounds – best, average and worst-case behaviour, standard notations for expressing algorithmic complexity. Empirical measurements of performance, time and space trade-offs in algorithms. Using recurrence relations to analyze recursive algorithms – illustrations using recursive algorithms.	8
2	Fundamental Algorithmic Strategies: Brute-Force, Greedy, Branch-and-Bound, Backtracking and Dynamic Programming methodologies as techniques for design of algorithms – Illustrations of these techniques for Problem-Solving. Heuristics – characteristics and their domains of applicability. Design of algorithms for String/ Texmatching problems, Huffman Code and Data compression problems, Subset-sum and Knapsack problems.	6
3	Graph and Tree Algorithms: Depth- and Breadth- First traversals. Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sort, Network Flow problems	6
4	Tractable and Intractable Problems: Computability.The Halting problem. Computability classes – P, NP, NP-complete and NP-hard. Cook‟s theorem. Standard NP-complete problems Reduction techniques.	6
5	Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – PSPACE.	6
6		7
	References: 1. Algorithm Design – Jon Kleinberg and Eva Tardos 2. Introduction to Algorithms – T.H. Corman et. al. 3. Fundamentals of Algorithms – E. Horowitz et al. 4. Combinatorial Optimization: Algorithms and Complexity – C.H. Papadimitriou et al	

BTEEL507. Electrical Machine-II **Lab**

Teaching scheme:
Lab work : 4 hrs
Total credit: 2

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

Pre requisite	Basic electrical engineering, electrical machine I	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Determination of sequence impedances of salient pole synchronous machine	
2	Determination of Xd and Xq of a salient pole synchronous machine from slip test.	
3	V and inverted V curves of a3-phasesynchronous motor	
4	Regulation of alternator by synchronous impedance method and MMF method.	
5	Parallel operation of Synchronous generator	
6	To study different types of starters for three phase Squirrel cage induction motor	
7	Rotor resistance starter for slip ring induction motor.	
8	To conduct no load and blocked rotor test and to determine performance characteristics of three phase induction motor from circle diagram	
9	Load and block rotor tests on squirrel cage induction motor	
10	Brake test on slip ring induction motor	
11	To control speed of wound rotor induction motor by rotor resistance control method	
12	To control speed of induction motor by V/F	
13	To control speed of induction motor by i) star-delta ii) autotransformer	
14		
15		

BTEEL508. Power System-II Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 30 Marks
Pr/oral: 20 Marks

Pre requisite	Basic electrical engineering, Power system I	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Measurement of sequence reactance of salient pole synchronous machine	
2	Measurement of sub transient reactance of salient pole synchronous machine	
3	Steady state stability of synchronous motor	
4	Steady sate power limit of transmission line	
5	Study of AC network analyzer	
6	Load flow study on AC network analyzer	
7	Fault study on AC network analyzer	
8	Use of computers for load flow study	
9	Use of computers for stability study	

BTEEL509. Microprocessor Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 30 Marks
Pr/oral: 20 Marks

Pre requisite	Basic electrical engineering, analog and digital electronics	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
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	Assembly language programmes for rolling/flash display	
5	Assembly language programmes for led flashing	
6	Programming for speed and direction control of dc motor	
7	Programming for speed and direction of stepper motor	
8	Assembly language programming base on lockup table concept	
9	Study of hexadecimal, modulo-9, BCD counter	
10	Assembly language programme for real time clock	
11	Multiplication/division of numbers	

Semester: VI

BTEEC 601. CONTROL SYSTEM

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Control system I	
Course outcome	To understand the behavior of nonlinear control system. To design and analyze PID controller. To understand and analyze state variable technique. To design and analyze suitable control system for engineering application.	
Unit	Contents	Contact Hrs
1	Non-linear Control Systems: Peculiar behavior of non-linear systems such as sub harmonics, jump resonance, limit cycle, Different types of non-linearities, Phase plane method, Singular Points, Methods of isoclines, Limit Lines & dividing lines on phase plane, Construction of phase plane, Obtaining time domain response from phase plane plots, merits & demerits. Describing function (DF) method, definition & assumptions, Derivation for describing function for different non- linearities, Stability analysis using DF method.	8
2	PID controllers: Introduction to Proportional (P), Integral (I) & Derivative (D) controller, individual effect on overall system performance, P-PI & PID control and effect on overall system performance, Numerical examples.	6
3	State Variable Technique: Concept of state & state variable, General form of state equations, formulation of state equations for the physical system, (RLC network, Armature controlled & Field controlled DC servo motor, mechanical systems).	6
4	State Variable Analysis: Different forms of state variable representations (Phase, physical & canonical form), Concept of diagonalization, Obtaining state equations from transfer function representation and vice versa, solution of state equations, State transition matrix (STM), Methods of finding STM, Power series method, Laplace transform method, Calay Hamilton method, Controllability & observability of linear system, Kalman's test.	6
5	Discrete Data Control System: Methods of representation, Z-transform, Inverse Z-transforms, Pulse transfer function of closed loop system, Response between sampling instants, Concept of stability of discrete time systems, Stability by Jury's test.	6
6	Introduction to control system design, Compensation technique-Cascade & Feedback, Compensation network (lag, lead & lag-lead), Design by reshaping of Bode plots & Root locus technique.	7
	References: 1.Ogata K., 'Modem control Engineering', Prentice Hall 2.Kuo B. C., 'Automatic Control System' Prentice Hall 3. Nagarath I. J., Gopal M., 'Control System Engineering' Willey Eastern.	

BTEEC602 PRINCIPLES OF ELECTRICAL MACHINE DESIGN

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Machine I and II,	
Course outcome	To understand principles of electric machine design. To design different components of electric machine. To design Transformer To understand CAD and use it for transformer design	
Unit	Contents	Contact Hrs
1	Principles and design of Electrical machines: Design of Electrical machines along with their parts and special features, rating, Specifications, Standards, Performance and other criteria to be considered, Brief study of magnetic, electric, dielectric and other materials, Introduction to machine design.	6
2	Design of Electrical Apparatus: Detailed design of heating coils, starters and regulators. Design of Electrical Devices Field coils, Chokes and lifting magnets.	6
3	AC and DC Winding: Types of dc windings, Pitches, Choice and design of simple/ duplex lap and wave winding, Concept of multiplex windings and reasons for choosing them, Single and double layer single phase AC winding with integral and fractional slots, Single and double layer integral and fractional slot windings of three phase. AC winding factors, Tests for fault finding in windings, Numerical examples.	6
4	Heating, Cooling and Ventilation: Study of different modes of heat generation, Temperature rise and heat dissipation, Heating and Cooling cycles, heating and cooling time constants, their estimation, dependence and applications, Methods of cooling / ventilation of electrical apparatus, Thermal resistance, radiated heat quantity of cooling medium (Coolant) Numerical.	6
5	Design of Transformer: 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 to counteract them, Testing of transformers as per I.S.S., Numerical examples.	6
6	Computer aided Design of Electrical machine: Introduction, advantages various approaches of Computer Aided Designing, Computer Aided Designing of transformer, Winding of rotating Electrical Machines. Optimization of Design.	6
	References: 1. Siskind – Electrical Machine Design (Mcgraw Hill). 2. Sawhaney. A. K– A Course in Electrical Machine Design (Dhanpat Rai). 3. Deshpande. M. V- A Course in Electrical Machine Design (Prentice Hall Of India).(Design And Testing Of Electrical Machines). 4. Sen .S. K– Computer aided design of Electrical Machines	

BTEEC603 POWER ELECTRONICS

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Electronic Devices And Circuits	
Course outcome	To review principle of construction, operation and characteristics of basic semiconductor devices. To understand and analyze performance of controlled and uncontrolled converters. To understand and analyze performance of DC to DC converters. Dc to AC converters. To understand and analyze performance of AC voltage controllers.	
Unit	Contents	Contact Hrs
1	Power semiconductor devices & their characteristics : Characteristics and operation of power diodes, Thyristors, power transistors (BJTs, MOSFETs, IGBTs, SITs), Ratings of power semiconductor devices, typical applications of power semiconductor devices, Introduction to types of power electronic circuits: diode rectifiers, AC-DC converters, AC-AC converters, DC-DC converters, DC-AC converters	8
2	Turn on and Turn off circuits for power semiconductor devices; BJT base drive requirements and drive circuit, MOSFET & IGBT gate drive circuits, Isolation of gate/base drives: Pulse transformers, optocouplers Thyristor firing schemes, Gate drive ICs	7
3	Diode Rectifiers and AC-DC converters : Diode Rectifiers: Single phase half wave, full wave rectifiers with R and RL load, Three phase bridge rectifier with R and RL load, Effect of source inductance Controlled Rectifiers : Principle of phase controlled rectification, single phase semi and full converter with R and RL load, power factor improvement in controlled rectifiers, three phase semi and full converter with R and RL load.	7
4	AC voltage controllers (AC-AC converters) : 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.	6
5	DC-DC converters : Classification of DC-DC converters, Buck converter, Boost converter, Buck-Boost converter, Cuk converter	6
6	DC-AC converters : Principle of operation and performance parameters, single phase bridge inverter, Three phase inverters: 180 degree and 120 degree conduction modes of operation	7
	References: 1.RashidM. H – Power Electronics circuits, devices and applications-(New Delhi Pearson Education). 2.Murthi.V. R- Power Electonics Devices, circuits and Industrial Applications.(Oxford). 3. Bimbhra.P. S- Power Electronics.(Khanna Publication).	

BTEEE604 : Elective-VI: 1. INDUSTRIAL AUTOMATION AND CONTROL

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Control system I, industrial automation	
Course outcome	To understand construction and working principle of different industrial measurement systems. To understand new trends in industrial process control.	
Unit	Contents	Contact Hrs
1	Introduction to Industrial Automation and Control: Architecture of Industrial Automation Systems. Introduction to sensors and measurement systems.	8
2	measurement: Temperature measurement, Pressure and Force measurements, Displacement and speed measurement, Flow measurement techniques, Measurement of level, humidity, pH etc, Signal Conditioning and Processing, Estimation of errors and Calibration	6
3	Process Control: Introduction to Process Control P I D Control, Controller Tuning. Implementation of PID Controllers. Special Control Structures: Feed forward and Ratio Control. Predictive Control, Control of Systems with Inverse Response, Cascade Control, Overriding Control, Selective Control, Split Range Control.	6
4	Sequence Control: Introduction to Sequence Control PLCs and Relay Ladder Logic Sequence Control, Scan Cycle, RLL Syntax Sequence Control, Structured Design Approach Sequence Control, Advanced RLL Programming Sequence Control : The Hardware environment	6
5	Control of Machine tools: Introduction to CNC Machines Control of Machine Tools, Analysis of a control loop, Introduction to Actuators, Flow Control Valves. Hydraulic Actuator Systems,: Principles, Components and Symbols, Hydraulic Actuator Systems: Pumps and Motors, Proportional and Servo Valves.	6
6	Pneumatic Control Systems: System Components Pneumatic Control Systems, Controllers and Integrated Control Systems. Networking of Sensors, Actuators and Controllers: The Fieldbus, The Fieldbus Communication Protocol, Introduction to Production Control Systems	7
	References NPTEL course	

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BTEEE604 : Elective-VI: 2. DESIGN OF EXPERIMENTS

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite		
Course outcome	To understand experimental design principles. To understand different experimental design used in industry. To deign computer experiments to use with engineering problems.	
Unit	Contents	Contact Hrs
1	Introduction to experimental design principles, simple comparative experiments, introduction to R language and its applications in DOE problems	8
2	Single factor experiments, randomized blocks, Latin square designs and extensions, introduction to R language Introduction to factorial designs, two levels, 2k factorial designs, confounding and blocking in factorial designs, applications to manufacturing problems.	6
3	Fractional factorial designs, two-level, three-level and mixed-level factorials and fractional factorials, applications to quality control problems. Regression models including multiple regression models and its application to transportation scheduling problems	6
4	Response surface methodology, parameter optimization, robust parameter design and its application to control of processes with high variability	6
5	Random and mixed effects models, nested and split plot and strip plot designs and its application to semiconductor manufacturing problem. Repeated measures design, analysis of covariance and its applications in comparing alternatives	6
6	Design of computer experiments and the applications in industrial engineering problems	7
	References NPTEL course	

BTEEE604 : ELECTIVE-VI: 3. ARTIFICIAL NEURAL NETWORK.

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite		
Course outcome	To review basic principles of neuron structure. To understand building blocks artificial neural network. To understand different networks of ANN To develop different algorithm for learning. To study and understand Fuzzy neural networks.	
Unit	Contents	Contact Hrs
1	Introduction and ANN Structure : Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures. Mathematical Foundations and Learning mechanisms : Re-visiting vector and matrix algebra. State-space concepts. Concepts of optimization. Error-correction learning. Memory-based learning. Hebbian learning. Competitive learning.	8
2	Single layer perceptrons : Structure and learning of perceptrons. Pattern classifier - introduction and Bayes' classifiers. Perceptron as a pattern classifier. Perceptron convergence. Limitations of a perceptrons.	6
3	Feedforward ANN : Structures of Multi-layer feedforward networks. Back propagation algorithm. Back propagation - training and convergence. Functional approximation with back propagation. Practical and design issues of back propagation learning.	6
4	Radial Basis Function Networks : Pattern separability and interpolation. Regularization Theory.Regularization and RBF networks.RBF network design and training. Approximation properties of RBF	6
5	Competitive Learning and Self organizing ANN : General clustering procedures. Learning Vector Quantization (LVQ). Competitive learning algorithms and architectures. Self organizing feature maps. Properties of feature maps.	6
6	Fuzzy Neural Networks : Neuro-fuzzy systems. Background of fuzzy sets and logic. Design of fuzzy stems. Design of fuzzy ANNs	7
	References NPTEL course	

BTEEE605 ELECTIVE-VII 1. SWITCH GEAR AND PROTECTION

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Power system I and II, control system I and II, machine I and II	
Course outcome	To understand principles of protective relaying. To understand principle of construction, operation and selection of different type of circuit breaker used in power system. To understand different protection schemes used in power system operation	
Unit	Contents	Contact Hrs
1	Switchgear and protection: Different types of switchgear, modes of classification, ratings and specifications. Protective Relaying: Need of protective relaying in power system, General idea about protective zone, Primary and backup protection, Desirable qualities of protective relaying, Classification of relays, Principle of working and characteristics of attracted armature, balanced beam, induction, disc and cup type relays, induction relays, Setting characteristics of over current; directional, differential, percentage differential and distance (impedance, reactance, mho) relays, introduction to static relays, advantages & disadvantages.	8
2	Circuit interruption: Principles of circuit interruption, arc phenomenon, A.C. and D. C. circuit breaker, Restricting and recovery voltage. Arc quenching methods. Capacitive, inductive current breaking, resistance switching, Auto reclosing Circuit Breakers: Construction, working and application of Air blast, Bulk oil, Minimum oil, SF6 and vacuum circuit breakers, Circuit breaker ratings, Rewritable and H. R. C. fuses, their characteristics and applications..	6
3	Digital And Numerical Protection: Introduction, working principle , Diff. methods of Digital and Numerical protection,	6
4	Bus bar: Feeder and Transmission line protection. Bus bar protection, Frame leakage protection circulating current protection and Transmission line protection using over current relays. Principles of distance relaying, choice between impedance, reactance and mho types, pilot wire and carrier pilot protection.	6
5	Protection of Alternators and Transformers: Alternators – Stator fault, stator inter turn protection. Unbalanced load, protection (Negative phase sequence [NPS] protection) Transformer – Use of Buccholz relay, differential protection, connection of C. T. and calculation of C.T. ratio needed for differential relaying, balanced and unbalanced restricted earth fault protection, frame leakage protection. Generator-Transformer unit protection	6
6	Insulation co-ordination and over current protection: Definitions (Dry flashover voltage FOV), WEF FOV, Impulse FOV, insulation, coordinating insulation and protective devices. Basic impulse insulation (BIL), Determination of line insulation. Insulation levels of substation equipment. Lightning arrester selection and location. Modern surge diverters and Necessity of power system earthing, Method of earthing the neutral, Peterson coil, earthing of transformer.	7
	References: 1. Patara Basu & Chaudhary – Power System Protection.(New Delhi Oxford And IBH). 2. Sunil S. Rao – Switchgear & Protection.(Tata Mcgraw Hill). 3. Madhavrao .T. S– Static relay.	

BTEEE605 ELECTIVE-VII 2. COMPUTER AIDED ANALYSIS AND DESIGN

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Numerical methods and C programming, control system I and II	
Course outcome	To study different computer aided tools in engineering application. To understand the functionality of different engineering software. To apply different software in engineering design.	
Unit	Contents	Contact Hrs
1	Introduction to computer aided tools for analysis and design- software and hardware	8
2	PSPICE /PSIM / MATLAB-SIMULINK/ (description as per choice/ availability)	6
3	MATHEMATICA/ PSIM / LABVIEW / DSPACE(description as per choice/ availability)	6
4	Modelling of Electrical/Electronic components and systems, Time and Frequency domain analysis, parameter variations, response representation storage/import/export.	6
5	Optimization methods: parametric optimization and functional optimization. Design issues of Electrical/Electronic components and systems.	6
6	Applications for control systems, power systems and electrical machines	7
	Text/Reference Books: 1. L.P.Singh, „Advanced Power System Analysis and Dynamics", New Age International. 2. M.Gopal, „Control Systems: Principles and Design", TMH 3. Vlado Ostovic „Computer-Aided Analysis of Electric Machines: A Mathematical Approach", Prentice Hall. 4. Singiresu S. Rao, „ Engineering optimization: theory and practice", John Wiley & Sons. 5. Paul W. Tuinenga, "SPICE: A guide to circuit Simulation and Analysis Using PSPICE", Prentice Hall, 1992. 6. M.H. Rashid, "SPICE for Circuits and Electronics Using PSPICE" Prentice Hall of India, 2000	

BTEEE605 ELECTIVE-VII 3. MECHATRONICS

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Digital electronics, basic mechanical engineering	
Course outcome	To understand concept of mechatronics. To understand sensor and transducer construction and operation. To understand microprocessor architecture and operation. To understand principle of construction and operation of PLC To design a robo for engineering application.	
Unit	Contents	Contact Hrs
1	Introduction to Mechatronics and its Systems; Evolution, Scope, Measurement Systems, Control Systems, open and close loop systems, sequential controllers, microprocessor based controllers, mechatronics approach. Basics of Digital Technology Number System, Boolean algebra, Logic Functions, Karnaugh Maps, Timing Diagrams, Flip-Flops, Applications	8
2	Sensors and transducers -Introduction, performance terminology-Displacement, Position and Proximity, Velocity and motion, force, Fluid Pressure-Temperature sensors Light Sensors-Selection of Sensors-Signal Processing Pneumatic and Hydraulic actuation systems: actuation systems, Pneumatic and hydraulic systems, directional control valves, pressure control valves, cylinders, process control valves, rotary actuators.	6
3	Mechanical actuation systems -Mechanical systems, types of motion, kinematics chains, cams, gear trains, ratchet and pawl, belt and chain drives, bearings, mechanical aspects of motor selection.	6
4	Microprocessors-Introduction, Architecture, Pin Configuration, Instruction set, Programming of Microprocessors using 8085 instructions-Interfacing input and output devices-Interfacing D/A converters and A/D converters, Applications, Temperature control, Stepper motor control, Traffic light controller	6
5	Programmable Logic Controller- Introduction, Basic structure, Input/ Output Processing, Programming, Mnemonics, Timers, Internal relays and counters, Data handling, Analog Input/Output, Selection of a PLC.	6
6	Robotics- Introduction, types of robots, Robotic control, Robot drive systems Robot end effectors, selection parameters of a robot, applications.	7
	Text/Reference Books: 1. Bolton W., “Mechatronics”, Longman, Second Edition, 2004. 2. Histand Michael B.& Alciatore David G., “Introduction to Mechatronics & Measurement Systems”, McGraw Hill, 2003. 3. HMT Ltd., “Mechatronics”, Tata McGraw Hill Publishing Co. Ltd., 1998. 4. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts * Applications”, TMH 2003	

BTEEOE606 ELECTIVE- VIII. 1. RURAL TECHNOLOGY AND COMMUNITY DEVELOPMENT.

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Communication skills	
Course outcome	To analysis data, information and knowledge. To understand concepts of marketing. To identify projects and work for community development To understand and analyze business model.	
Unit	Contents	Contact Hrs
1	Data Analysis and Measures of Central Tendency- Meaning, nature, scope and limitations of statistics, collection of statistical data, classification, tabulation and diagrammatic representation of data, Measures of central tendency : Statistical averages Mean, Median, Mode.	8
2	Data, Information and Knowledge; concept of information, need of information (professional, educational, research), qualities of information, value of information, difference between data and information, properties of the needed information. Information and Management; planning, organizing, co-ordinating and controlling,	6
3	Concepts of marketing; difference between marketing selling and retailing; marketing mix, market-segmentation, marketing planning. Strategy and Approaches; modern concept of marketing.	6
4	Community development; concept, definition, meaning, need, history, principles, objectives and scope. Community Building: Coming of Age, Regenerating Community, Community Model	6
5	Consensus Organizing Model, What's Behind Building Healthy Communities? Participatory Democracy, The Role of various NGOs in Community Development.	6
6	The Role of Business and Government in Community Development Initiatives How to Form a Non-profit Corporation Fund Raising and Grant Writing.	7
	References; NPTEL	

BTEEOE606 ELECTIVE- VIII. 2. PROJECT MANAGEMENT

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Communication skills.	
Course outcome	To understand concepts of project management. To develop a project plan. To understand the project implementation strategy. To analyze post project affects.	
Unit	Contents	Contact Hrs
1	Introduction to Project management: Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization.	8
2	Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management,	6
3	Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks	6
4	Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Levelling and Resource Allocation. Time Cost Trade off: Crashing Heuristic.	6
5	Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management	6
6	Post-Project Analysis	7
	Text/Reference Books: 1. Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, Prentice Hall, India 2. Lock, Gower, Project Management Handbook. 3. Cleland and King, VNR Project Management Handbook. 4. Wiest and Levy, Management guide to PERT/CPM, Prentice Hall. Ibdia 5. Horald Kerzner, Project Management: A Systemic Approach to Planning, Scheduling and Controlling, CBS Publishers, 2002. 6. S. Choudhury, Project Scheduling and Monitoring in Practice. 7. P. K. Joy, Total Project Management: The Indian Context, Macmillan India Ltd.	

BTEEOE606 ELECTIVE- VIII. 3. KNOWLEDGE MANAGEMENT

Teaching scheme:
Theory: 3 hrs
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Communication skills	
Course outcome	To understand different components knowledge management. To conduct knowledge audit and knowledge management practices in organization.	
Unit	Contents	Contact Hrs
1	Introduction: Definition, evolution, need, drivers, scope, approaches in Organizations, strategies in organizations, components and functions, understanding knowledge; Learning organization: five components of learning organization, knowledge sources, and documentation	8
2	Essentials of Knowledge Management; knowledge creation process, knowledge management techniques, systems and tools	6
3	Organizational knowledge management; architecture and implementation strategies, building the knowledge corporation and implementing knowledge management in organization	6
4	Knowledge management system life cycle, managing knowledge workers,	6
5	knowledge audit, and knowledge management practices in organizations, few case studies.	6
6	Futuristic KM: Knowledge Engineering, Theory of Computation, Data Structure	7
	Reference Books : 1. Knowledge Management – a resource book – A Thohothathri Raman, Excel, 2004. 2. Knowledge Management- Elias M. Awad Hasan M. Ghazri, Pearson Education 3. The KM Toolkit – Orchestrating IT, Strategy & Knowledge Platforms, Amrit Tiwana, Pearson, PHI, II Edn. 4. The Fifth Discipline Field Book – Strategies & Tools For Building A learning Organization – PeterSenge et al. Nicholas Brealey 1994 5. Knowledge Management – Sudhir Warier, Vikas publications 6. Leading with Knowledge, Madanmohan Rao, Tata Mc-Graw Hill	

BTEEL607. Control System Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 30 Marks
Pr/oral: 20 Marks

Pre requisite	Basic electrical engineering, control system I	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Study of analog computer components	
2	Simulation of first order differential equation on the analog computer	
3	Simulation of second order differential equations and sine waveform	
4	Simulation of non linear equations	
5	Non linear system analysis by DF method	
6	Non linear system analysis by phase method	
7	Finding transfer function from frequency response plots	
8	Analysis of control system using digital computer matlab and basic command	
9	MATLAB programming	
10	MATLAB simulation program	
11	MATLAB and its basic command	
12	Solution of state space equation using MATLAB	

BTEEL608. Principles of Electrical Machine Design Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 25 Marks
Pr/oral: 25 Marks

Pre requisite	Basic electrical engineering, electrical machine I and II	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	To study General electrical symbol	
2	To study Electrical installation for residential building	
3	To study Design of Dc shunt motor starter	
4	To study Design of simplex lap winding	
5	To study Design of wave winding	
6	To study Design of ac lap winding	
7	To study Design of transformer	

BTEEL609. Power Electronics Lab

Teaching scheme:
Lab work : 4 hrs
Total credit: 2

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

Pre requisite	Basic electrical engineering , basic electronics engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
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	

Dr. Babasaheb Ambedkar Technological University, Lonere.

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(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.