Teaching and Evaluation Scheme

B. Tech in Electrical Engineering

Abbreviations

L: Lecture

T: Tutorial

P: Practical

CA1: Continuous Assessment 1

CA2: Continuous Assessment 2

MSE: Mid Semester Exam

ESE: End Semester Exam

BSC -Basic Science Courses

ESC: Engineering Science Courses

OEC: Open Elective Course

PCC: Program Core Course

PEC: Program Elective Course

HSMC: Humanities, Social Sciences, and Management Course

CC: Co-curricular Courses

Teaching and Evaluation Scheme for FY B. Tech

Department of Electrical Engineering

Semester: I & II

Group- A

Department: Electrical Engineering **Rev:** Course Structure/00/2020-21
Class: F.Y. B.Tech. **Semester:** I

Course Code	Type of Course	Name of the course	Teaching Scheme				Evaluation scheme					Credit
			L	T	P	Total Hrs	CA1	CA2	MSE	ESE	Total	
BSH11	BSC1	Engineering Mathematics- I	3	1	0	4	10	10	30	50	100	4
BSHA12	BSC2	Engineering Physics	3	0	0	3	10	10	30	50	100	3
BSHA13	HSMC1	Communication Skills	3	0	0	3	10	10	30	50	100	3
BSHA14	ESC1	Engineering Graphics	2	0	0	2	10	10	30	50	100	2
BSHA15	ESC2	Basic Civil Engineering	1	0	0	1	5	5	15	25	50	1
BSHA16	ESC3	Basic Mechanical Engineering	1	0	0	1	5	5	15	25	50	1
BSHA12L	BSC2	Engineering Physics Laboratory	0	0	2	2	15	15	0	20	50	1
BSHA13L	HSMC1	Communication Skills Laboratory	0	0	2	2	15	15	0	20	50	1
BSHA14L	ESC1	Engineering Graphics Laboratory	0	0	2	2	15	15	0	20	50	1
BSHA17	ESC4	Workshop Practices	0	0	4	4	15	15	0	20	50	2
Total			**13**	**1**	**10**	**24**	**110**	**110**	**150**	**330**	**700**	**19**

Group- A

Department: Electrical Engineering **Rev:** Course Structure/00/2020-21
Class: F.Y. B.Tech. **Semester:** II

Course Code	Type of Course	Name of the course	Teaching Scheme				Evaluation Scheme					Credit
			L	T	P	Total Hrs	CA1	CA2	MSE	ESE	Total	
BSH21	BSC3	Engineering Mathematics-II	3	1	0	3	10	10	30	50	100	4
BSHA22	BSC4	Engineering Chemistry	3	0	0	3	10	10	30	50	100	3
BSHA23	ESC5	Engineering Mechanics	3	0	0	3	10	10	30	50	100	3
BSHA24	ESC6	Computer Programming in C	3	0	0	3	10	10	30	50	100	3
BSHA25	ESC7	Basic Electrical Engineering	1	0	0	1	5	5	15	25	50	1
BSHA26	ESC8	Basic Electronics Engineering	1	0	0	1	5	5	15	25	50	1
BSHA22L	BSC4	Engineering Chemistry Laboratory	0	0	2	2	15	15	0	20	50	1
BSHA23L	ESC5	Engineering Mechanics Laboratory	0	0	2	2	15	15	0	20	50	1
BSHA24L	ESC6	Computer Programming in C Laboratory	0	0	2	2	15	15	0	20	50	1
BSHA25L	ESC7	Basic Electrical Engineering Laboratory	0	0	2	2	15	15	0	20	50	1
BSHA26L	ESC8	Basic Electronics Engineering Laboratory	0	0	2	2	15	15	0	20	50	1
BSHMP	PRJ01	Mini Project-I	0	0	2	2	25	25	0	0	50	Audit
Total			**14**	**1**	**12**	**27**	**150**	**150**	**150**	**350**	**800**	**20**

Group- B

Department: Electrical Engineering **Rev:** Course Structure/00/2020-21
Class: F.Y. B.Tech. **Semester:** I

Course Code	Type of Course	Name of the course	Teaching Scheme				Evaluation scheme					Credit
			L	T	P	Total Hrs	CA1	CA2	MSE	ESE	Total	
BSH11	BSC1	Engineering Mathematics-I	3	1	0	4	10	10	30	50	100	4
BSHB12	BSC2	Engineering Chemistry	3	0	0	3	10	10	30	50	100	3
BSHB13	ESC1	Engineering Mechanics	3	0	0	3	10	10	30	50	100	3
BSHB14	ESC2	Computer Programming in C	3	0	0	3	10	10	30	50	100	3
BSHB15	ESC3	Basic Electrical Engineering	1	0	0	1	5	5	15	25	50	1
BSHB16	ESC4	Basic Electronics Engineering	1	0	0	1	5	5	15	25	50	1
BSHB12L	BSC2	Engineering Chemistry Laboratory	0	0	2	2	15	15	0	20	50	1
BSHB13L	ESC1	Engineering Mechanics Laboratory	0	0	2	2	15	15	0	20	50	1
BSHB14L	ESC2	Computer Programming in C Laboratory	0	0	2	2	15	15	0	20	50	1
BSHB15L	ESC3	Basic Electrical Engineering Laboratory	0	0	2	2	15	15	0	20	50	1
BSHB16L	ESC4	Basic Electronics Engineering Laboratory	0	0	2	2	15	15	0	20	50	1
Total			**14**	**1**	**10**	**25**	**125**	**125**	**150**	**350**	**750**	**20**

Group- B

Department: Electrical Engineering **Rev:** Course Structure/00/2020-21
Class: F.Y. B.Tech. **Semester:** II

Course Code	Type of Course	Name of the course	Teaching Scheme				Evaluation Scheme					Credit
			L	T	P	Total Hrs	CA1	CA2	MSE	ESE	Total	
BSH21	BSC3	Engineering Mathematics- II	3	1	0	4	10	10	30	50	100	4
BSHB22	BSC4	Engineering Physics	3	0	0	3	10	10	30	50	100	3
BSHB23	HSMC1	Communication Skills	3	0	0	3	10	10	30	50	100	3
BSHB24	ESC5	Engineering Graphics	2	0	0	2	10	10	30	50	100	2
BSHB25	ESC6	Basic Civil Engineering	1	0	0	1	5	5	15	25	50	1
BSHB26	ESC7	Basic Mechanical Engineering	1	0	0	1	5	5	15	25	50	1
BSHB22L	BSC4	Engineering Physics Laboratory	0	0	2	2	15	15	0	20	50	1
BSHB23L	HSMC1	Communication Skills Laboratory	0	0	2	2	15	15	0	20	50	1
BSHB24L	ESC5	Engineering Graphics Laboratory	0	0	2	2	15	15	0	20	50	1
BSHB27	ESC8	Workshop Practices	0	0	4	4	15	15	0	20	50	2
BSHMP	PRJ01	Mini Project-I	0	0	2	2	25	25	0	0	50	Audit
Total			**13**	**1**	**12**	**26**	**135**	**135**	**150**	**330**	**750**	**19**

Engineering Mathematics-I

BSH11	BSC1	Engineering Mathematics-I	3-1-0	4 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: 1hr/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: HSC Mathematics

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

CO1	Apply the concept of linear transformation to solve the linear equations, find the Eigen values and Eigen vectors and use Cayley-Hamilton theorem to find inverse of the matrix.
CO2	Make use of characteristics of complex numbers in problems pertaining to electric circuit, Mechanical system etc.
CO3	Apply the concept basic laws of derivatives in partial differentiation to solve first & Higher order derivative.
CO4	Apply the concept of partial derivative, to find Jacobin, series expansion and maxima
CO5	Apply the reduction formula to evaluate definite integral and develop the ability to trace the curve for a given equation of curve and its nature.
CO6	Apply the concept of change of variable and change of order of integration to evaluate multiple integral and their usage in computing area and volumes.

Course Contents:

Unit 1: Linear Algebra Matrices: Elementary row and column transformations on a matrix; Rank of a matrix-normal form & Echelon form; Consistency and solutions of systems of linear equations using elementary transformations; Eigen values and Eigen vectors; Properties of Eigen values and Eigen vectors; Cayley Hamilton's theorem (without proof) and its applications.	[7]
Unit 2: Complex Numbers De-Moivre's theorem(without proof); Roots of complex numbers by using De-Moivre's theorem; Expansion of $sinn\theta$&$cos\ n\theta$ in powers of $\boldsymbol{\sin\theta}$&$\boldsymbol{\cos\theta}$; 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.	[8]

Unit 3: Partial Differentiation Partial derivatives of first and higher orders; Homogeneous functions – Euler's Theorem; Total derivative; Change of variables; Differentiation of implicit function.	[6]
Unit 4: Application of Partial derivatives Jacobians - properties; Taylor's & Maclaurin's theorem for functions of one & two variables; Errors and approximations; Maxima and minima of functions of two variables.	[6]
Unit 5: Reduction Formulae and Curve Tracing Reduction formulae for $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, $\int_0^{\frac{\pi}{2}} cos^n x\ dx$ & $\int_0^{\frac{\pi}{2}} sin^m x cos^n x dx$; Tracing of the curves given in Cartesian & polar forms; Rectification of plane curves (Cartesian and Polar form).	[7]
Unit 6: Multiple Integrals & its application 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; Area enclosed by plane curves; Mass of a plane lamina.	[8]

Textbooks:

1. P. N. Wartikar & J. N. Wartikar: A Text Book of Applied Mathematics. (Vol-I & II), Pune Vidyarthi Griha Prakashan, Pune
2. N. P. Bali: A Text Book of Engineering Mathematics, Laxmi Publications, New Delhi.
3. Peter O" Neil: A Text Book of Engineering Mathematics, Thomson Asia Pvt. Ltd., Singapore

Reference Books:

1. B. S. Grewal: Higher Engineering Mathematics, Khanna Publishers.
2. Erwin Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons.
3. B. V. Ramana: Higher Engineering Mathematics, McGraw-Hill Publications, New Delhi
4. C. R. Wylie & L. C. Barrett: advanced Engineering Mathematics, McGraw Hill Publishing Company Ltd.

Engineering Physics

BSHA12/B22	BSC2/4	Engineering Physics	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic concepts of optics, solid state physics and modern physics.

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

CO1	Apply the basic of interference, diffraction, polarization for their engineering applications.
CO2	Make use of laser technology and optical fibre in various disciplines.
CO3	Explain the basic concepts of quantum mechanics.
CO4	Apply the knowledge of crystallography to study various engineering materials
CO5	Solve the problems by applying the basics of semiconductors and dielectrics.
CO6	Summarize the basic knowledge of nanotechnology and Nano-materials.

Course Contents:

Unit 1: Interference, diffraction and polarization Introduction, Interference of light in thin film, Newton's rings, Diffraction grating construction theory, Derivation of measurement of wavelength using diffraction grating, Polarization of light, Methods of production of polarized light, Huygens theory of double refraction, Lorentz half shade polarimeter.	[6]
Unit 2: LASER and Fibre optics Introduction, Principle of laser, Characteristics of laser, Einstein's coefficient, Types of laser (Ruby & He-Ne), Population inversion and pumping, Applications of laser, Introduction of optical fibre, Structure of optical fibre, Propagation mechanism of light through optical fibre, Types of optical fibre and its applications.	[7]
Unit 3: Quantum Mechanics Introduction, Wave particle dualism, De-Broglie hypothesis, Phase velocity, Group velocity, Relation between phase velocity and group velocity, Physical significance of	[6]

wave function, Schrodinger's time dependent and time independent wave equation, Heisenberg's uncertainty principle.	
Unit 4: Crystallography Introduction, Space Lattice and Crystal Structure, Unit Cell, Bravais Space Lattices, Seven Crystal System, Properties of Cubic Unit Cell, Relation Between Lattice Constant and Density, Lattice Planes and Miller Indices, Interplanner Spacing For Cubic System, X-ray Diffraction, Bragg's Law, X-Ray Spectrum.	[6]
Unit 5: Semiconductor and dielectrics Introduction**,** Band theory of solids, Intrinsic and extrinsic semiconductor, Conductivity of semiconductor, Hall Effect, Application of semiconductor, Introduction of dielectrics, Dielectric parameters, Types of polarization, Dielectric materials, Frequency and temperature dependence of dielectric materials.	[6]
Unit 6: Nanophysics Introduction, Top down and bottom up approach for synthesis of nanomaterials, Scanning electron microscopy and High-resolution transmission electron microscopy, Properties and applications of nanomaterials, Carbon nanotubes (CNTs)- structure and types, Properties and applications of CNTs.	[5]

Textbooks:

1. M. N. Avadhanulu and P.G. Kshirsagar, A Textbook of Engineering Physics, S Chand Publication 2007.
2. B. K. Pandey and S. Chaturvedi, Engineering Physics: – Cengage Publications.

Reference Books:

1. Geometrical & Physical optics by D. S. Mathur
2. Laser and Non-liner optics by B.B. Laud
3. S. O. Pillai, Solid State Physics
4. L. J. Schiff – Quantum Mechanics - Tata Mc. Graw Hills
5. R. K. Gaur and S. L. Gupta, Engineering Physics, Dhanpat Rai Publications.
6. C.M. Srivastava and C. Srinivasan, Science of Engineering Materials, Wiley publication.
7. Nanotechnology, Dr. Sulbha K Kulkarni, Capital Publishing Co, 2011, Second Edition.

Engineering Physics Laboratory

BSHA12L/B22L	BSC2/4	Engineering Physics Laboratory	0-0-2	1 Credits

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester examination: 20 Marks

Pre-Requisites: Basic concepts of optics, solid state physics and modern physics.

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

CO1	Understand the I-V characteristic and band gap energy of semiconductor.
CO2	Understand the basic concept of LASER and Fibre optics.
CO3	Demonstrate the knowledge of half shade polarimeter, plane diffraction grating and crystal structure.
CO4	Develop the basic knowledge of Hall effect, Ultrasonic Interferometer and Newton's ring.

List of Experiments: Minimum 8 practicals should be performed from the following list.

1. **Newton's rings:** To determine the wavelength of monochromatic light using Newton's rings.
2. **Resolving power of grating**: To determine resolving power of grating.
3. **Polarimeter:** To calculate specific rotation of sugar solution.
4. **LASER:** To determine the divergence and wavelength of He-Ne LASER beam.
5. **Numerical aperture of optical fibre**: To calculate numerical aperture of optical fibre by laser diode.
6. **Crystal plane:** To analyze crystal structure and miller indices of various planes.
7. **Hall Effect:** To determine the Hall coefficient of a given current carrying conductor.
8. **Band gap energy:** To determine band gap energy of given semiconductor.
9. **P-N Junction diode**: To study I-V characteristics of P-N junction diode.
10. **Ultrasonic interferometer**: To determine the velocity of ultrasonic waves through liquid.

Communication Skills

BSHA13/B23	HSMC1	Communication Skills	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic knowledge of English language with grammar.

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

CO1	Illustrate concept of communication and its process
CO2	Apply the knowledge of reading & listening skills
CO3	Develop the knowledge of phonetics through oral drilling.
CO4	Apply the knowledge of oral communication & presentation skills
CO5	Make use of grammar correctly.
CO6	Utilize the knowledge of written communication skills

Course Contents:

Unit 1: Fundamentals of Communication Introduction to communication skills (LSRW), nature and importance of communication, process of communication, verbal and non-verbal communication, types and functions of communication, barriers to communication, types and solutions to overcome it.	[5]
Unit 2: Effective Comprehension skills **Listening:** Importance of listening, Types of listening, Barriers to listening & techniques for effective listening. **Reading:** Introduction to reading, Types of reading, Barriers to reading, Strategies for reading comprehension**.**	[4]
Unit 3: Introduction to Phonetics Phonology of English, articulation of sounds in English, phonemic symbols (IPA), study of phonetic/phonemic transcription, pronunciation, stress and intonation.	[8]

Unit 4: Oral Communication Skills Features of effective oral communication, appropriate use of non-verbal communication, Group discussion, Debate, Public speaking, Presentations, job interview, Telephonic etiquettes.	[6]
Unit 5: Basic English Grammar Parts of speech, Synonyms and Antonyms, Articles, Prepositions, Sentence formation and sentence structures, Aspects of tenses, Subject-Verb agreement, Use of auxiliaries and modal auxiliaries, Common errors.	[7]
Unit 6: Effective Writing Skills Seven Cs of effective written communication, Writing emails, Essay writing, (Technical, Social, and Cultural Topics), Reports writing: Format, Structure and types, Writing memorandum, Circulars, Notices, Agenda and minutes. Research Papers- Introduction, Structure and documentation **Business Correspondence**: Letters- Layouts, Elements, Types, Job application and résumé writing.	[12]

Reference Books:

1. Sanjay Kumar, PushpLata, Communication Skills, Oxford University Press, 2016
2. Meenakshi Raman, Sangeeta Sharma, Technical Communication: Principles and Practice, Oxford University Press, 2017
3. Bovee Courtland,L and Thrill, John V. Business Communication, Today McGraw Hill, New York, Taxman Publication, 1989.
4. Dr.G.S. Kushwaha, English Phonetics and Pronunciation for Indian Learners, Notion Press, 2017
5. Murphy Raymond, English Grammar in Use: A Self Study Reference and Practice Book Intermediate Learners Book Cambridge, 2013.

Communication Skills Laboratory

BSHA13L/B23L	HSMC2	Communication Skills Laboratory	0-0-1	1 Credits

Teaching Scheme	Evaluation Scheme:
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester examination: 20 Marks

Pre-Requisites: Basic knowledge of English language with grammar.

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

CO1	Develop Received Pronunciation with stress and intonation
CO2	Take part in group discussion, elocution and debate
CO3	Utilize grammar in writing skills
CO4	Make use of presentation and interview techniques effectively

List of Practicals:

Minimum 10 practicals should be performed from the following list.

1. Ice breaking: Problems I face while communicating (LSRW) (LO3)
2. Vocabulary Building: Activities & Games (CO2)
3. Grammar activities (CO3)
4. Introduction to phonetic symbols (Consonants, Vowels & Diphthongs) (CO1)
5. Practicing correct articulation of sounds (CO1)
6. Pronunciation/transcription from the dictionary (CO1)
7. Stress and intonation (CO1)
8. Elocution & Extempore (CO2)
9. Group discussion & debate (CO2)
10. Interview techniques (CO4)
11. Effective telephonic skills (CO4)
12. Technical report writing (CO3)
13. Letter writing (CO3)
14. Case Study: preparation & presentation (CO4)
15. Presentation techniques (CO4)

Engineering Graphics

BSHA14/B24	ESC1/5	Engineering Graphics	2-0-0	2 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 2 hrs/week	CA1:10 CA2: 10 Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Geometry & Mensuration

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

CO1	Interpret projection of points, lines and plane planes with reference to principal.
CO2	Interpret projection of solids with reference to principal
CO3	Interpret section of solids and its development of lateral surfaces
CO4	Interpret the orthographic views of an object
CO5	Interpret the isometric views of an object
CO6	List basic commands of AUTOCAD

Course Contents:

Unit 1: Projection of points and lines and plane (1st Angle Projection only) Introduction to drawing instruments and their uses. Layout of drawing sheets, Lettering, Different types of lines used in drawing practice, Dimensioning system as per BIS conventions (Theoretical treatment only) a) Orthographic projection system, First and third angle projection methods, Projection of points on regular reference planes (HRP, FRP, PRP) b) Projection of lines –Horizontal, Frontal, Profile and oblique lines; Rotation method for determining true length and angles of a line c) Projection of planes (regular polygons and circle) inclined to both reference planes.	[6]
Unit 2: Computer Aided Drafting a) Introduction to Computer Aided Drafting (CAD), Basic command to draw 2- D objects like line, point, circle, arc, ellipse, polygon, polyline, spline etc. b) CAD Edit /Modify Commands Erase, Trim, Extend, Scale, Break, Fillet, Chamfer, Offset, Copy, Move, Mirror, Array, Hatch etc.	[4]

c) CAD Viewing Commands Zoom, Pan, Rotate etc., Other Commands: Line type, Text, Text style, Dimensioning, Dimension style, Leader, Layers etc.	
Unit 3: Projections of Solids Projection of Solids such as Prisms, pyramids, cylinder and cone with their axis inclined to one the reference planes.	[4]
Unit 4: Sections of solids & Development of surfaces a) Sections of solids: obtaining true shape of cut sections of Prisms, Pyramids, Cylinders and Cones (Simple positions only) b) Development of plane and curved lateral surfaces: Prisms, Pyramids, Cylinders and Cones (cutting planes specified).	[4]
Unit 5: Orthographic Projections Lines used, Selection of views, spacing of views, dimensioning and sections. Conversion of pictorial view into orthographic views including sectional orthographic view.	[5]
Unit 6: Isometric projections Introduction to isometric, Isometric scale, Isometric projections and Isometric views/drawings, Circles in isometric view. Isometric views of simple solids and objects.	[5]
Textbooks: 1. R. K. Dhawan, "A text book of Engineering Drawing", S. Chand and Co.	
Reference Books: 1. N. D. Bhatt, "Engineering Drawing", Charotor Publication House, Bombay 2. N. D. Bhatt, "Machine Drawing", Charotor Publication House, Bombay 3. K. Venugopal, "Engineering Drawing and Graphics", New Age Publication 4. N. B. Shaha and B. C. Rana, "Engineering Drawing", Pearson Education.	

Engineering Graphics Laboratory

BSHA14L/B24L	ESC1/5	Engineering Graphics	0-0-2	1 Credits

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester examination: 20 Marks

Pre-Requisites: Geometry & Mensuration

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

CO1	Solve projection of points, lines and plane planes with reference to principal.
CO2	Solve projection of solids with reference to principal
CO3	Adopt basic knowledge of imagination & construction of sectioning effect of various kinds of solids & to develop its lateral surfaces.
CO4	Develop orthographic views of an object
CO5	Construct isometric views of an object
CO6	Make use of different basic commands of AUTOCAD to produce drawing in CAD

Course Contents:

Term work:

Students are supposed to draw/construct and submit all the sheets based on syllabus contents in the semester. (Sheet size- A2).

List of Experiments:

1. Lettering, Types of lines and Methods of dimensioning and geometrical constructions.
2. Projection of Points and lines.
3. Projection of Planes.
4. Projection of Solids.
5. Section of Solids and Development of Lateral Surfaces.
6. Orthographic Projections.
7. Isometric Projections.
8. Orthographic Projections on CAD software

Textbooks:

1. R. K. Dhawan, "A text book of Engineering Drawing", S. Chand and Co.

Reference Books:

1. N. D. Bhatt, "Engineering Drawing", Charotor Publication House, Bombay
2. N. D. Bhatt, "Machine Drawing", Charotor Publication House, Bombay
3. K. Venugopal, "Engineering Drawing and Graphics", New Age Publication
4. N. B. Shaha and B. C. Rana, "Engineering Drawing", Pearson Education.

Basic Civil Engineering

BSHA15/B25	ESC2/6	Basic Civil Engineering	1-0-0	1 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 1 hrs/week	CA1: 05 Marks CA2: 05 Marks Mid Semester Exam: 15 Marks End Semester Exam: 25 Marks

Pre-Requisites: Nil

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

CO1	Classify the branches of civil engineering & building construction materials.
CO2	Explain the components of building and concept of building planning.
CO3	Summarize different building services.
CO4	Describe the advance techniques in civil & modern equipments in surveying.

Course Contents:

Unit 1: Introduction to Civil Engineering Introduction to civil engineering, Branches of civil engineering, Role of Civil Engineer Building materials –River sand or Natural sand, Bitumen, cement, structural and reinforced steel, RMC, fly ash.	[3]
Unit 2: Basic building components and building planning Types of building as per NBC, Components of a residential building, Sub structure components their functions and types, Super structure components their functions and types, Definition and concept of plan of a simple residential building, Principles of planning.	[4]
Unit 3: Building Services Introduction to types of building services like water supply design criteria, building finishes, rain water harvesting.	[4]
Unit 4: Advancements in Civil Engineering Smart city and its features, Green building, nZEB (Nearly zero energy building). Surveying Modern equipment: Electronic distance meter, GPS, Total Station.	[4]

Textbooks:

1. Sundar Narayan, "Basic Concepts of Civil Engineering", ATLANTIC Publications, 2nd edition.
2. S. K. Duggal "Building Materials", New Age International Publisher, New Delhi, 3rd edition 2009.

Reference Books:

1. S.S. Bhavikatti, "Elements of Civil Engineering", New Age International Publisher, New Delhi, 3rd edition 2009.
2. M.N. Shesha Prakash and Ganesh. B. Mogaveer, "Elements of Civil Engineering and Engineering Mechanics", PHI Learning, 3rd Revised edition (2014)
3. Rangawala SC And Dalal K B, "Engineering Materials" charotar publications
4. Dalal K R, "Essentials of Civil Engineering", Charotar publications
5. G. K. Hiraskar, "Basic Civil Engineering", Dhanpat Rai Publication.

Basic Mechanical Engineering

BSHA16/A26	ESC3/7	Basic Mechanical Engineering	1-0-0	1 Credits

Teaching Scheme	Evaluation Scheme:
Lecture: 1 hrs/week	CA1: 05 Marks CA2: 05 Marks Mid Semester Exam: 15 Marks End Semester Exam: 25 Marks

Pre-Requisites: Engineering Mathematics, Engineering Physics, Chemistry

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

CO1	Describe various thermodynamic systems and state laws of thermodynamics
CO2	Explain different types of links, mechanisms and machines in mechanical engineering
CO3	List different types of manufacturing processes and different engineering materials
CO4	Explain metal joining processes and additive manufacturing

Course Contents:

Unit 1: Introduction to thermodynamics Thermodynamic state, Process, cycle, Thermodynamic system, Heat, work, Internal energy. Zeroth Law, First Law of Thermodynamics and its application to various mechanical elements. Limitations of First Law of Thermodynamics, Statements of Second Law of Thermodynamics Thermodynamic Processes-Ideal gas equations, Isobaric, Isochoric, Isothermal, Isentropic, Adiabatic processes.	[3]
Unit 2: Introduction to machine and mechanism Difference between Machine and Structure, Definition of Link**,** Pair, Kinematic Chain, Study of Various Mechanisms such as Steering Mechanism, Different motions involved in Mechanisms, Introduction to Machine, Study of different machines such as differential, Drilling, Lathe, Milling etc.	[3]
Unit 3: Introduction to manufacturing processes Introduction to manufacturing processes-Casting Process, Steps involved in Sand casting processes, **Metal removing processes** –Turning, Drilling, Milling, Boring, Grinding, Super finishing operations. (Applications of each metal removing process), **Materials used in engineering and their applications** Metals- Ferrous and Non-	[3]

Ferrous Nonmetallic materials, Material selection criteria.	
Unit 4: Introduction to metal joining processes and additive manufacturing **Metal joining processes-** Introduction to Welding, Classification of Welding Processes, Soldering Process, Brazing Process (Applications of each metal joining process), Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM, Additive Manufacturing Process chain: Introduction, the eight steps in additive manufacture, variations from one AM machine to another, metal systems.	[3]
Term Work: Four assignments based on topics of syllabus of Basic Mechanical Engineering	
Textbooks: 1. Thermal Engineering by R.K. Rajput, Laxmi Publication, Delhi. 2. Engineering Thermodynamics by Achultan, Prentice Hall of India 3. Elements of Workshop Technology, Vol.I and II by Hajara Choudhari, Media Promoters 4. Theory of Machines by S.S. Ratan 5. Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing Gibson D.W. Rosen B. Stucker Springer New York Heidelberg Dordrecht, London	
Reference Books: 1. Manufacturing Technology Volume I and II by P. N. Rao, Tata Mc-Graw Hill Publication. 2. Basic Mechanical Engineering by Basant Agrawal& C. M. Agrwal, Wiley India Pvt. Ltd 3. S. Hall, A. R. Holowenko, H. G .Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982.	

Workshop Practices

BSHA17/B27	ESC4/8	Workshop Practices	0-0-4	2 Credits

Teaching Scheme	**Evaluation Scheme:**
Practical: 4 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Nil

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

CO1	To make use of different tools for carpentry, fitting and plumbing operations with safety measures.
CO2	To develop skills in sheet metal, welding, smithy and machine shop operations with safety measures.

Course Contents:

Evaluation:

The evaluation consists of continuous assessment of each job and performance of work based on Workshop Practice syllabus. The term work also based on workshop diary and attendance of student.

Instructions to the student:

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

Unit 1: 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, carpentry tools like- Marking tools, cutting tools, planes, striking tools, holding tools, Carpentry operations- marking, sawing, chiseling, grooving etc. safety precautions.

Unit 2: 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, safety precautions.

Unit 3: Welding

Arc welding- welding joints, edge preparation, welding tools and equipment, electrode

classification and coding. Resistance welding - Spot welding, safety precautions.

Unit 4: Sheet metal work

Specifications of metal sheets, working tools, Simple development and sheet metal operations like-cutting, bending, folding, punching, revetting and joining by brazing and soldering., Sheet metal machines - Bending Machine, Guillotine shear, Sheet metal joints, safety precautions.

Unit 5: Smithy

Introduction to smithy operations like- bending, forming, upsetting, drawing. Smithy tools - hammer, hot & cold chisel flatters, tongs, anvil etc. safety precautions.

Unit 6: Plumbing

Different types of pipes, joints, taps, fixtures and accessories used in plumbing, safety precautions.

Unit 7.Machine shop:

Lathe machine, types of lathes, major parts, cutting tool, turning operations, safety precautions.

List of Practical:

1. Wood sizing exercises in planning, marking, sawing, chiseling and grooving to make different types of 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 to make a joint.
4. Exercise in Resistance (Spot) welding to make a lap joint.
5. Making a small parts using GI sheet involving development, marking, cutting, bending, brazing and soldering operations - i)Tray ii) Dust bin iii) funnel, etc. and similar articles
6. A job on smithy involving upsetting, Drawing, bending such as- Hook, peg, chisel, square headed bolt or similar articles.
7. A job on use of plumbing tools and preparation of plumbing line involving fixing of water tap and use of elbow, tee, union and coupling, etc.
8. A job on turning of a Mild Steel cylindrical job using center lathe.

Reference Books:

1. A Course in Workshop Technology, Vol – I by B. S. Raghuvanshi, DhanapatRai and Sons.
2. Elements of Workshop Technology, Vol – I by HajaraChaudhari, Media Promoters.
3. Workshop Technology, Vol – I by Gupta and Kaushik, New Heights.
4. Workshop Technology, Vol – I by Chapman, The English Language Book Society.
5. Workshop Technology, Vol.-I by H.S. Bawa, TMH Publications, New Delhi.
6. K. C. John, Mechanical Workshop Practice, Prentice Hall Publication, New Delhi, 2010.

Engineering Mathematics-II

BSH21	BSC3	Engineering Mathematics-II	3-1-0	4 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: 1 hr/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: HSC Mathematics

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

1	Solve first order linear and exact differential equations and apply them to the problems related to electric circuit, mechanical system etc.
2	Solve the first order and first degree differential equations numerically.
3	Solve higher order linear differential equations with constant coefficients.
4	Apply the Vector differential operator on scalar and vector point functions.
5	Define and discuss the concept of vector Integration. & apply to solve Physics and Engineering problems.
6	Demonstrate the ability to integrate knowledge and ideas of complex differentiation and complex integration in a coherent and meaningful manner.

Course Contents:

Unit 1: Ordinary differential equation of first order and first degree Introductory remarks - Order, degree and formation of differential equations; Linear differential equations; Reducible to Linear differential equations; Exact differential equations ;Reducible to Exact differential equations; Applications to electric circuit, orthogonal trajectories and Newton's law of cooling.	[8]
Unit 2: Numerical solution of ordinary differential equations of first order and first degree Numerical Solution by Picard's method, Taylor's series method, Euler's method, Modified Euler's method & Runge-Kutta fourth order formula	[7]
Unit 3: Linear differential equations with constant coefficients Introductory remarks -Complementary function, particular integral; Rules for finding complementary function and Particular integral; Method of variation of parameters; Cauchy's homogeneous and Legendre's linear equations.	[7]

Unit 4: Vector differential calculus Differentiation of vectors, Gradient of scalar point function, Directional derivative, Divergence of vector point function, Curl of a vector point function. Irrotational and solenoidal vector field.	[6]
Unit 5: Vector integration Line integrals, Surface integrals and volume integrals. Theorems of Green, Gauss and Stokes (without proof).	[6]
Unit 6: Calculus of complex functions: Functions of complex variable, Analytic function, necessary and sufficient conditions for f(z) to be analytic (without proof), Cauchy-Riemann equations in Cartesian & polar coordinates; Milne- Thomson method to determine analytic function f (z); Harmonic functions. Complex integration, Cauchy's theorem and Cauchy's integral formula (without proof).	[8]

Textbooks:

1. P. N. Wartikar& J. N. Wartikar: A Text Book of Applied Mathematics. (Vol I & II), Pune Vidyarthi Griha Prakashan, Pune
2. N. P. Bali: A Text Book of Engineering Mathematics, Laxmi Publications, New Delhi.
3. Peter O" Neil: A Text Book of Engineering Mathematics, Thomson Asia Pvt. Ltd., Singapore.

Reference Books:

1. B. S. Grewal: Higher Engineering Mathematics, Khanna Publishers.
2. Erwin Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons.
3. B. V. Ramana: Higher Engineering Mathematics, McGraw-Hill Publications, New Delhi
4. C. R. Wylie & L. C. Barrett: advanced Engineering Mathematics, McGraw Hill Publishing Company Ltd

Engineering Chemistry

BSHB12/A22	BSC2/4	Engineering Chemistry	3-0-0	3 Credits

Teaching Scheme	**Evaluation Scheme:**
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: 11th and 12th Science Chemistry,

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

CO1	Explain and determine various characteristics of water to develop water treatment methods to solve environmental problems.
CO2	Illustrate and demonstrate different rapid and reliable analytical instrumental methods for Chemical analysis.
CO3	Summarize proper advanced materials for engineering applications
CO4	Analyze the quality of fuel and select proper fuel for industrial purpose.
CO5	Outline the knowledge of corrosion for prevention of materials from corrosion
CO6	Make use of metallic materials & green chemistry approach in the industrial point of view

Course Contents:

Unit 1: Water Treatment Introduction, impurities in natural water, Water Characteristics –Hardness and its determination by EDTA method, Dissolve oxygen (DO) and its determination by Winkler's method, BOD, COD. ill effects of hard water in steam generation in boilers, Numerical on hardness of Water, Treatment of hard water- Hot Lime –Soda process, Zeolite process, Ion exchange process	**[8]**
Unit 2: Instrumental methods of chemical analysis Introduction, advantages and disadvantages of instrumental methods, A) pH-metry: Introduction, pH measurement using glass electrode, Applications of pH-metry, B) Spectrometry: Introduction, Laws of spectrometry (Lamberts and Beer-Lamberts law), Single beam spectrophotometer (Principle, schematic, working and applications), C) Conductometry: Conductometric Titrations, D) Chromatography: Introduction, types, Gas-liquid chromatography (GLC), basic principle, Instrumentation and applications	**[7]**
Unit 3: Advanced Materials A) Polymers: Introduction, plastics, thermo softening and thermosetting plastic, industrially important plastics like phenol formaldehyde, urea formaldehyde and epoxy resins, conducting polymers and biopolymers (Introduction, examples and applications.),	**[7]**

B) Nanomaterials: Introduction, Synthesis –Top down and Bottom up approach, Applications of Nanomaterials, C) Composite materials: Introduction, Composition, properties and uses of fiber reinforced plastics (FRP) and glass reinforced plastic (GRP).	
Unit 4: Fuels Introduction, classification, calorific value, types of calorific value (higher and lower), characteristics of good fuels, comparison between solid, liquid and gaseous fuels, Determination of Calorific value of fuel by Bomb calorimeter, and by Boy's calorimeter, Numericals on Bomb and Boy's calorimeter, Fuel cells: Introduction, Classification, advantages, Limitations and applications	**[7]**
Unit 5: Corrosion Introduction, causes, classification, atmospheric corrosion (oxidation corrosion), electrochemical corrosion (hydrogen evolution and oxygen absorption mechanism), factors affecting rate of corrosion, Prevention of corrosion by proper design and material selection, Protective coatings hot-dipping (galvanizing and tinning), Metal Spraying, cathodic protection, and electroplating.	**[7]**
Unit 6: Metallic materials & Green Chemistry A) Metallc materials: Introduction, alloy definition and classification, purposes of making Alloys,Ferrous alloys: Plain carbon steels (mild, medium and high), stainless steels, Nonferrous alloys: Copper alloy (Brass), Nickel alloy (Nichrome), Aluminum alloy (Duralumin and Alnico), Tin alloy (Solder metal), B) Green Chemistry: Definition, goals of green chemistry, significance, basic principle of green chemistry research, industrial applications.	**[6]**

Textbooks:

1. Engineering Chemistry by Jain and Jain, Dhanpat Rai Publishing Company Ltd., New Delhi.
2. A Textbook of Engineering Chemistry by S. S. Dara and S. S. Umare, S. Chand & Company Ltd., New Delhi.
3. A Textbook of Engineering Chemistry by C. P. Murthy, C. V. Agarwal and A. Naidu, BS Publications, Hyderabad.
4. Engineering Chemistry by Dr. A. K. Pahari and Dr. B. S. Chauhan, Laxmi Publications (P) Ltd, New Delhi.
5. A text Book of Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Co. (Pvt.) Ltd, Delhi.
6. Engineering Chemistry by RenuBapna and Renu Gupta, MacMillan Publishers (India) Ltd, Delhi

Reference books:

1. D. A. Skoog, D. M. West, Fundamentals of Analytical Chemistry, Cengage Learning.

2. A. I. Vogel, Quantitative Chemical Analysis, Longmann Publication
3. Chatwal and Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House, New Delhi.
4. S. K. Kulkarni, Nanotechnology: Principals and Practices, Capital Publishing Company.
5. B. K. Sharma, Environment Chemistry, Goel Publication, Meerut.
6. K. J. Sundars, Organic Polymer Chemistry, Springer Publication.
7. B. K. Sharma, Instrumental Methods of Chemical Analysis, Goel Publication, Meerut

Engineering Chemistry Laboratory

BSHB12L/A22L	BSC2/4	Engineering Chemistry Laboratory	0-0-2	1 Credits

Teaching Scheme	Evaluation Scheme:
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: 11th and 12th Science Chemistry,

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

CO1	Experiment with given water sample to determine different parameters such as DO, alkalinity, chloride content, hardness of water sample.
CO2	Experiment with different organic compound such as urea/phenol, formaldehyde to synthesis resins.
CO3	Experiment with different industrial compounds such coal, brass & Aluminum material for the determination its contents.
CO4	Demonstrate the different instrumental methods such as pH meter and photo-colorimeter conductivity meter, chromatography to analyze the given sample.

List of Experiments:

Minimum 10 experiments should be performed from the following list out of which two experiments should be demonstrative on instrumental methods.

1. Determination of alkalinity of water.
2. Determination of chloride content of water by Mohr's method.
3. Determination of total hardness of water by EDTA method.
4. Determination of Dissolve Oxygen of water by Winkler's method.
5. Preparation of urea-formaldehyde resin.
6. Preparation of phenol-formaldehyde resin.
7. Determination of moisture, volatile and ash content in a given coal sample by proximate analysis.

8. Determination of percentage of copper in brass.

9. Estimation of zinc in brass solution.

10. Determination of rate of corrosion of aluminium in acidic and basic medium.

11. pH metric Titration (Acid Base titration)

12. Demonstration of photo-colorimeter / spectrophotometer.

13. Conductometric Titration (Acid Base titration)

14. Demonstration of paper chromatography.

15. Demonstration of electroplating

Engineering Mechanics

BSHB13/A23	ESC1/5	Engineering Mechanics	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme:
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic concepts of physics and mathematics.

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

CO1	Apply the knowledge of basic laws, resolution-composition of forces.
CO2	Apply concept of equilibrium for rigid bodies.
CO3	Apply the knowledge of dynamics for rigid bodies.
CO4	Solve the problems related to work, power & energy of the bodies.

Course Contents:

Unit 1: Fundamentals of Statics Basic Concepts and Fundamental Law's and principles,, Force, Moment and Couple, System of Forces, Resultant, Resolution and Composition of Forces, Varignon's Theorem, Law of Moments. Basis of assumptions.	[7]
Unit 2: Equilibrium Static equilibrium, analytical and graphical conditions of equilibrium, equilibrium of coplanar concurrent forces, coplanar non concurrent forces, parallel forces, free body diagram, Lami's theorem, Beam, Types of beams, types of supports, types of load, beams reactions, Principle of virtual work, virtual displacements for particle and rigid bodies, **Friction**: Coulomb law, friction angles, wedge friction, sliding friction and rolling resistance.	[9]
Unit 3: Analysis of Truss Types of Trusses, Assumptions, Methods of Analysis:- method of joints for plane trusses, method of sections for plane trusses	[5]

Unit 4: Kinematics Types of motions, kinematics of particles, rectilinear motion, constant and variable acceleration, motion under gravity, study of motion diagrams, angular motion, tangential and radial acceleration, kinematics of rigid bodies, concept of instantaneous center of rotation, concept of relative velocity	[9]
Unit 5: Kinetics Introduction to Kinematics of Linear motion, Kinetics of linear motion, Newton's Laws, D'Alembert's Principle, Work- Energy Principle, Impulse Momentum Principal.	[6]
Unit 6: Work, Power, Energy Impact, Types of impact, Law of conservation of momentum, Coefficient of restitution, Numerical on direct central Impact. work done by a force, potential energy, kinetic energy of linear motion and rotation, conservation of energy, power.	[6]

Textbooks

1. S. Timoshenko, D. H. Young, "Engineering Mechanics", McGraw Hill, 1995.
2. Tayal A. K., "Engineering Mechanics, Umesh Publications, 2010.
3. Bhavikatti S. S., Rajashekarappa K. G., "Engineering Mechanics", New Age international Publications,2nd Edition.
4. Beer, Johnston, "Vector Mechanics for Engineers", Vol. 1: Statics and Vol. 2: Dynamics, McGraw Hill Company Publication, 7th edition, 1995.
5. Irving H. Shames, "Engineering Mechanics - Statics and Dynamics", Pearson Educations, Fourth edition, 2003.
6. McLean, Nelson, "Engineering Mechanics", Schaum's outline series, McGraw Hill Book Company, N. Delhi, Publication.
7. Singer F. L., "Engineering Mechanics - Statics & Dynamics", Harper and Row Pub. York.
8. Khurmi R. S., "Engineering Mechanics", S. Chand Publications, N. Delhi

Engineering Mechanics Laboratory

BSHB13L/A23L	ESC1/5	Engineering Mechanics Laboratory	0-0-2	1 Credits

Teaching Scheme	Evaluation Scheme:
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic concepts of optics, solid state physics and modern physics.

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

CO1	Make use of concept of equilibrium.
CO2	Solve the problem on equilibrium by graphical method.
CO3	Identify coefficient of friction for various pairs of contacting surfaces.
CO4	Show centroid of irregular shaped different laminas.

Students are expected to satisfactorily complete any eight experiments listed below

A. List of Practical's/Experiments/Assignments

1. Polygon law of coplanar forces.
2. Lamis' theorem.
3. Jib crane apparatus.
4. Centroid of irregular shaped bodies.
5. Bell crank lever.
6. Support reaction for beam.
7. To determine coefficient of friction.
8. Verification of law of Machine using Screw jack.

B. Graphics Statics (To be solved on A3 Sheets.)

9. To find resultant – 3 problems.
10. To find support reactions – 3 problems.

Computer Programming in C

BSHB14/A24	ESC2/6	Computer Programming in C	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme:
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites:

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

CO1	Design algorithm and flowchart by summarizing the basic terminologies used in C Programming.
CO2	Make use of different data types, operations and expressions and apply the fundamentals of C programming by choosing the loops and decision making statements to solve the problems
CO3	Apply the concept of arrays and string handling functions
CO4	Apply concepts of functions and pointers to building C application
CO5	Apply concepts of structures
CO6	Make use of file handling concepts

Course Contents:

Unit 1: Basics of C History and Features of C, Importance of C, About Procedural Language, Role of Compiler, Role of Interpreter, The Structure of a C Program, Writing C Programs, Algorithm, Flowchart, Building an Executable Version of a C Program, Debugging a C Program, Examining and Running a C Application program	[4]
Unit 2: An Overview of C and Buzzwords Data Type, Variable, Operators, Control Statement ,Preprocessor Directives Input and Output Operators, Reading/Writing Characters ,Formatted input/output Function, The IF.....ELSE Statement, IF ELSE ladder, Nesting of IF ELSE Statements, the Switching statements, The do-while Statement, the while statement, FOR Statements.	[6]
Unit 3: Arrays in C Array: What and Why? One Dimensions Arrays, Two Dimensions Arrays, Multi Dimensions Arrays, Reading String from Terminal, Writing String to Screen, String Handling Functions	[6]

Unit 4: Functions in C Function Basics, Advantage of Function, Recursion, Variable Storage Classes, Variable arguments Function, Understanding Pointers, Pointer expressions, Pointer and Arrays, Pointers and Character String, Pointers to Functions, Pointers and Structures	[6]
Unit 5: Structures in C Defining a Structure, Advantage of Structure, Size of Structure, Arrays of Structures, Structures and Functions, Defining Unions.	[4]
Unit 6: File handling in C Introduction to dynamic memory allocation- Malloc, Calloc, Realloc, Introduction to file management, Opening/Closing a file, Input/ Output operations on Files, Error handling during I/O Operations, Command Line Arguments	[4]
Reference Books: 1. "Let us C" by Yashwant Kanetkar 2. The C Programming Language is a computer programming by Brian Kernighan and Dennis Ritchie. 3. Computing Fundamentals and C Programming | 2nd Edition, by E Balagurusamy	

Computer Programming in C Laboratory

BSHB14L/A24L	ESC2/6	Computer Programming in C	0-0-2	1 Credits

Teaching Scheme	Evaluation Scheme:
Practical: 2 hrs/week	CA1: 15Marks CA2: 15Marks End Semester Exam: 20 Marks

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

CO1	Develop the programs on the basic programming concepts.
CO2	Understand the syntax and develop programs based on control structures.
CO3	Demonstrate the knowledge of Derived data types and develop programs.
CO4	Develop the programs on user defined functions.
CO5	Develop the basic knowledge of file handling concepts.

Course Contents:

List of Practical:

1. Assignment on Flowchart.
2. A simple program to display a message.
3. Basic program on operators.
4. Program using if else
4. Basic programs demonstrating different loops.
5. Programs demonstrating use of array.
6. Programs using strings handling functions.
7. Programs demonstrating use of functions.
8. Programs demonstrating use of structures.
9. Programs demonstrating use of pointers to integers, float, char, strings.
10. Programs demonstrating file handling and dynamic memory allocation.

Basic Electrical Engineering

BSHB15/A25	ESC3/7	Basic Electrical Engineering	1-0-0	1 Credits

Teaching Scheme	Evaluation Scheme:
Lecture: 1 hrs/week	CA1: 05 Marks CA2: 05 Marks Mid Semester Exam: 15 Marks End Semester Exam: 25 Marks

Pre-Requisites: Applied Physics.

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

CO1	To Define Elementary concepts of electrical engineering.
CO2	To Explain construction and working principle of Single Phase Transformer.
CO3	To Explain construction and working principle of AC Motors.
CO4	To Explain construction and working principle of DC Motors.

Course Contents:

Unit 1: Elementary Electrical Concepts Elementary electrical concepts definition of EMF, current, resistance, Work, power, energy, Ohm's law, Series parallel circuits, Kirchhoff's law-KVL, KCL, Introduction to electrical energy generation from different resources, transmission, distribution and utilization, Energy conversion	
Unit 2: Single Phase Transformer Operating principle, construction, types of transformer, EMF equation, transformation ratio working of transformer at no load and at load, loses in transformer efficiency and regulation	
Unit 3: AC Motors Working principle of AC motor, construction, types, circuit diagram, speed and torque equations, characteristics and applications	
Unit 4: DC Motors Working principle of DC motor, construction, types, circuit diagram, speed and torque equations, characteristics and applications.	

Textbooks:

1. A Textbook of Electrical Technology in SI Units. Volume I: Basic Electrical Engineering by B. L. Theraja and A. K. Theraja.
2. V. N. Mittal and Arvind Mittal, Basic Electrical Engineering, McGraw-Hill Publication.
3. Vincent Del Toro, Electrical engineering Fundamentals, PHI Publication, 2nd Edition, 2011

Reference Books:

1. Basic Electrical Engineering by C L Wadhwa.
2. Basic Electrical Engineering by Mehta V K and Mehta Rohit.
3. Basic Electrical Engineering by Nagrath, I and Kothari.
4. Basic Electrical Engineering by Mittle, V and Arvind Mittle.

Basic Electrical Engineering Laboratory

BSHB15L/A25L	BSC 3/7	Basic Electrical Engineering Laboratory	0-0-2	1 Credits

Teaching Scheme	Evaluation Scheme:
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Applied physics.

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

CO1	Choose different wiring components and make use of them to prepare wiring connections.
CO2	Explain basic circuit theorems, and study different meters and instruments for measurement of electrical quantities.
CO3	Basic methods of Earthing and study how to Measure earth resistance and insulation resistance by using Megger.
CO4	Classify application of different types of lamps and list different component in electrical power system.
CO5	Test for performance parameters of AC machines DC machines.

List of Experiments: Minimum 8 practicals should be performed from the following list.

1. To study of electric symbols & study of wiring components.
2. To prepare wiring connection of control of two lamps from two switches & stair case wiring
3. Use of megger for insulation testing and continuity
4. To study the different types of lamps.
5. Study of electric shocks & precautions against electric shocks; Basic methods of earthing.
6. Study of single line diagram of power system
7. To Verify KCL and KVL.
8. Measurement of power in a three phase system by two wattmeter method.
9. To perform open circuit & short circuit test on a single phase transformer to calculate different losses in transformer.
10. To perform speed reversal of single phase Induction Motor
11. To perform speed control of DC shunt motor

Basic Electronics Engineering

BSHB16/A26	ESC4/8	Basic Electronics Engineering	1-0-0	1 Credits

Teaching Scheme	Evaluation Scheme:
Lecture: 1 hr/week	CA1: 05 Marks CA2: 05 Marks Mid Semester Exam: 15 Marks End Semester Exam: 25 Marks

Pre-Requisites: Nil

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

CO1	To demonstrate the function of Electronics instruments and diode applications
CO2	To illustrate different parameters of transistor
CO3	To compare applications of op-amp
CO4	To Classify logic Gates and Boolean algebra laws; various Electronic appliances

Course Contents:

Unit 1: Basics of Electronics and Diode applications Evolution of electronics, Introduction of active and passive components-symbol and units, Types and color coding, Semiconductor Theory, Diode-construction and working, VI Characteristics of diode, Types of Diodes: Zener diode- reverse bias characteristics, Diode applications: half wave and full wave rectifiers (centre tapped and bridge) circuits and operation	[4]
Unit 2: Bipolar junction transistor (BJT) Transistor construction and working principle, configurations: CE, CB, CC, junction biasing condition for active, saturation and cut-off modes, DC analysis for transistor circuits, biasing circuits - fixed bias; voltage divider bias; collector to base bias BJT as an amplifier and as a switch	[4]
Unit 3: Introduction to Operational Amplifiers OPAMP– definition, block diagram, operation, characteristics, applications, µA 741 pin diagram. Definitions of virtual ground, CMRR and slew rate. OPAMP applications– inverting, integrator, differentiator, summer, voltage follower, and comparator Filters-definition, Working- low pass, high pass passive and active filters	[4]
Unit 4: Digital Electronics Basic logic gates, Universal logic gates, Boolean algebra, Introduction to number system,	[4]

Half Adder, Full Adder, Multiplexer, Demultiplexer, Flip-Flop, Microwave oven, solar panel. Telephone, Radio, Television, Radar, Satellite communication: Block diagram and Operation	

Textbooks:

1. D. Chattopadhyay, P. C. Rakshit, Electronics Fundamentals and Applications, New Age International
2. Millman & Halkias, Integrated Electronics, Tata McGraw Hill.
3. Boylestead and Nashelsky, Electronic Devices and Circuits Theory, 9/e, PHI, 2006.
4. Digital Circuits, Anandkumar

Reference Books:

1. Sedra& Smith, Microelectronics Engineering.
2. John D. Ryder, Electronic Fundamentals and Applications, PHI
3. J.B.Gupta, Basic Electronics, S.K. Kataria.
4. Malvino: Electronic Principle.
5. Schilling & Belove: Electronics Circuits
6. Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Learning Pvt. Ltd., Fourth Edition.

Basic Electronics Engineering Laboratory

BSHB16L/A26L	ESC4/8	Basic Electronics Engineering Laboratory	0-0-2	1 Credits

Teaching Scheme	Evaluation Scheme:
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic concepts of semiconductor theory.

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

CO1	To demonstrate the function of Electronics instruments and diode applications.
CO2	To illustrate different parameters of transistor.
CO3	To compare applications of op amp.
CO4	To Classify logic Gates and Boolean algebra laws; various Electronic appliances.

List of Experiments: Minimum 8 practicals should be performed from the following list.

1. Identification of Circuit Components, Breadboard and its connections
2. Study of CRO and measurement of voltage amplitude and frequency
3. To study the VI characteristics of P-N junction diode
4. To study the VI characteristics of Zener diode
5. To study Half wave Rectifier with and without filter
6. To study Full wave Rectifier with and without filter
7. To perform single stage amplifier using transistor
8. To study the Inverting and Non-inverting Amplifier
9. To study the digital logic Gates
10. To perform De-Morgan's theorem

Mini Project-I

BSHMP	PRJ01	Mini Project-I	0-0-2	Audit

Teaching Scheme	Evaluation Scheme
Practical: 2 hr/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Basic fundamental knowledge of various engineering streams.

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

CO1	Identify the problems related to engineering.
CO2	Associate the problem with real life situation.
CO3	Develop leadership and team building skill.
CO4	Employ managerial skills while working in team.

Course Content:

First year engineering students can choose their area of interest among the latest technologies and use their hands-on skills to develop mini projects. The mini-project should be undertaken preferably by a group of 4-5 students who will jointly work and implement the mini-project. The group will select a project with the approval of the project guide. Mini project topics and the work for these groups in the batch will be guided by a teacher for the batch, preferably on one of the topics from energy engineering, mechanical engineering, Civil Engineering, Computer Engineering., Electrical Engineering., Electronics and Telecommunication Engineering., etc. The teacher will periodically assess the performance of students in the mini project. Project group will submit hardcopy project report along with project demonstration at the term end.

Teaching and Evaluation Scheme for SY B. Tech

Department of Electrical Engineering

Semester: III

Department: Electrical Engineering **Rev:** Course Structure/00/2021-22

Class: S.Y. B.Tech **Semester:** III

Course Code	Type of Course	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs.	CA1	CA2	MSE	ESE	Total	
EE301	BSC	Engineering Mathematics-III	3	1	-	4	10	10	30	50	100	4
EE302	ESC	Network Analysis	4	-	-	4	10	10	30	50	100	4
EE303	PCC	Measurement & Instrumentation	3	-	-	3	10	10	30	50	100	3
EE304	PCC	Renewable Energy Sources	4	-	-	4	10	10	30	50	100	4
EE305	PCC	Analog & Digital Electronics	3	-	-	3	10	10	30	50	100	3
EE306	ESC	Network Analysis Laboratory	-	-	2	2	15	15	-	20	50	1
EE307	PCC	Measurement & Instrumentation Laboratory	-	-	2	2	15	15	-	20	50	1
MDC01	MC	Constitution of India	1	-	-	1	25	25	-	-	50	Audit
HSM01	HSMC	Aptitude Skills-I	1	-	-	1	25	25	-	-	50	1
HSM02	HSMC	Language Skills-I	-	-	2	2	25	25	-	-	50	Audit
PRJ02	PROJ	Mini Project	-	-	2	2	25	25	-	-	50	Audit
			19	**1**	**8**	**28**	**185**	**185**	**150**	**290**	**800**	**21**

Engineering Mathematics-III

EE301	BSC	Engineering Mathematics-III	3-1-0	4 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: 1hr/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Mathematics-I & II

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

CO1	Apply the definition & properties of Laplace Transform to evaluate the integral & to find Laplace transform of elementary functions and special functions like periodic function, Dirac-delta function & unit step function.
CO2	Apply the knowledge of Laplace transformation to find solution of linear differentiation equations with constant coefficient.
CO3	Solve partial differential equations & use of separation of variable method to solve heat and Laplace equations.
CO4	Develop the concept of Fourier series expansion of different periodic functions so as to use them in harmonic analysis.
CO5	Solve problems related to Fourier transform and inverse Fourier transform.
CO6	Solve finite difference equation using Z- transform.

Course Contents:

Unit 1: Laplace Transform Definition – conditions for existence ; Transforms of elementary functions; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of derivatives ; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.	[8]
Unit 2: Inverse Laplace Transform **I**ntroductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find the solutions of linear differential	[7]

equations and simultaneous linear differential equations with constant coefficients.	
Unit 3: Partial Differential Equations and Their Applications Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation ($\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$), and two dimensional heat flow equation (i.e., Laplace equation: $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$).	[8]
Unit 4: Fourier Series Definition, Euler's formulae, Conditions for a Fourier expansion, Functions having points of discontinuity, change of interval, expansions of odd and even periodic functions and half range series.	[7]
Unit 5: Fourier Transforms Fourier Transforms, Fourier Sine and Cosine Transforms, Complex form of Fourier Integral, Finite Fourier Sine and Cosine Transform.	[6]
Unit 6: Z Transform Definition, properties of z transform, Z Transform of basic sequences, Z transform of some standard discrete function inverse Z transform.	[6]
Textbooks: 1. P. N. Wartikar & J. N. Wartikar, A Text Book of Applied Mathematics (Vol I & II), Vidyarthi Griha Prakashan, Pune. 2. N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publications, New Delhi.	
Reference Books: 1. C. R. Wylie & L. C. Barrett, Advanced Engineering Mathematics, McGraw Hill Publishing Company Ltd. 2. B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publications, New Delhi. 3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers. 4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.	

Network Analysis

EE302	ESC	Network Analysis	4-0-0	4 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 4 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electrical Engineering, Engineering Mathematics-I, II.

Course Outcomes:

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

CO1	Solve network equation with various techniques to find electrical parameters.
CO2	Apply various theorems to electrical networks for finding electrical parameters.
CO3	Solve the transient responses by using different conditions for DC and AC excitations.
CO4	Apply concepts of electric network topology to solve problems in circuits.
CO5	Solve electrical networks using Basic Laws to find two port network parameters (Z, Y, ABCD, h).
CO6	Solve Selectivity, Bandwidth & Q-factor of the circuit in series & parallel resonance of circuit and show the effect of resonance.

Course Contents:

Unit 1: Basic Concepts Introduction, Sources, Circuit Elements, Mutual inductance and dot convention, Source transformations, Network reduction using Star – Delta transformation, Loop and nodal analysis with linearly dependent and independent sources for DC and AC networks.	[8]
Unit 2: Network Theorems Superposition, Thevinin's and Norton's theorems, Maximum Power transfer theorem, Millman's theorems, Reciprocity Theorem, Compensation Theorem, Tellegen's theorem.	[7]
Unit 3: Transient Analysis Behavior of circuit elements under switching condition and their Representation, Evaluation	[8]

of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations.	
Unit 4: Network Topology Basic Terminology: Graph, Types of Graphs, Tree, Co-tree, Matrices Associated with Network Graphs: Incidence Matrix, Fundamental Loop Matrix, Fundamental Cutset Matrix with examples.	[5]
Unit-5: Two Port Network Parameters Concept of complex frequency, Transform impedance & transform admittance Definition and classification of Two port network parameters: Z, Y, h and Transmission parameters, relationship between parameters sets, Interconnections of Two-Port Network, condition for symmetry and reciprocity, numerical problems.	[8]
Unit 6: Resonance Introduction, Series Resonance: Variation of Current and Voltage with Frequency, Selectivity, Bandwidth, Circuit Magnification Factor**.** Parallel Resonance: Selectivity and Bandwidth, Circuit Magnification Factor, Maximum Impedance Conditions with C, L and f Variable, Current in Anti-Resonant Circuit, The General Case-Resistance Present in both Branches.	[6]

Textbooks:

1. M.E. Van Valkenberg, "Network Analysis", Prentice Hall of India, 3rd Edition, 2000.
2. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", TMH, 3rd Edition, 2009.

Reference Books:

1. Hayt, Kemmerly and Durbin, "Engineering Circuit Analysis", TMH, 7th Edition, 2010.
2. J. David Irwin and R. Mark Nelms, "Basic Engineering Circuit Analysis", John Wiley, 8th Edition, 2006.
3. Roy Choudhury, "Networks and Systems", 2nd Edition, New Age International Publications, 2006.
4. Joseph A. Edminister, Mahmood Maqvi, "Theory and Problems of Electric Circuits", Schaum's Outline Series.
5. Robert L Boylestad, "Introductory Circuit Analysis", Pearson Publications.

Measurement & Instrumentation

EE303	PCC	Measurement & Instrumentation	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electrical Engineering

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

CO1	Explain Construction, Working & characteristics of measuring instruments.
CO2	Illustrate the different methods of power & energy measurement.
CO3	Illustrate the Measurement of resistance, inductance & capacitance.
CO4	Demonstrate construction & working principle of transducers.
CO5	Explain the digital meters.
CO6	Estimate electrical parameters with help of electrical devices

Unit 1: Characteristics of measuring instruments Static & dynamic characteristics of measuring instruments, Errors & its types, Classification of instruments, Standards, torque in measuring instruments, Construction & working principle advantages and disadvantages of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) and Dynamometer type instruments, shunt and multipliers for range extension of MI Instruments	[6]
Unit 2: Measurement of Power and Energy Measurement of active & reactive power in electrical circuit, Construction, working principle, torque equation of single phase conventional (induction type) energy meter, Calibration of energy meter, digital Energy Meter, block diagram and operation of electronic energy meter.	[6]
Unit 3: Measurement of Resistance, Inductance and Capacitance Measurement of low, medium and high resistance, Wheatstone Bridge, Kelvin's Double	[8]

Bridge, Ammeter-Voltmeter method, Megger, Earth tester for earth resistance measurement, inductance measurement: Maxwell's inductance Bridge, Maxwell's inductance capacitance bridge, Hay's Bridge, Anderson's Bridge, Schering Bridge and Wien's Bridge.	
Unit 4: Transducers Transducers: Definition - Classification of transducers general characteristics— Selection of transducers — Resistive, capacitive & inductive Transducers — Piezoelectric, Hall effect, optical and digital transducers — Elements of data acquisition system — Smart Sensors-Thermal Imagers.	[6]
Unit 5: Digital Meters Digital instruments - pros and cons, working of digital voltmeters. Automatization in digital meters-mechanism of automatic zeroing, polarity indication and auto ranging. Digital frequency meter, time interval measurement, digital LCR meter, digital multimeters, Digital Tachometer, microprocessor-based instruments.	[6]
Unit 6: Storage & Display Devices DSO, CRO, Power Analyzer, Wave Analyzer & Harmonic Distortion, Spectrum Analyzer, Instrument Transformers: Construction, connection of CT & PT in the circuit, advantages of CT / PT, LED, LCD & Dot matrix display — Data Loggers.	[6]
Textbooks: 1. Electrical & Electronic Measurement by R K Rajput. 2. Measurement & Instrumentation by S Chand	
Reference Books: 1. Electrical and Electronic Measurements and Instrumentation, by A. K. Sawhney and Puneet Sawhney 2. Electrical and Electronic Measurements and Instrumentation by V.K.Mehta 3. Electronic Instrumentation by H.S Kalsi 4. Electrical Measurement by U. A. Bakshi, A.V. Bakshi, K. A. Bakshi	

Renewable Energy Sources

EE304	PCC	Renewable Energy Sources	4-0-0	4 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 4hrs./week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Physics, Basic Electrical Engineering

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

CO1	Explain the overview of renewable energy resources and its key factors
CO2	Explain the field applications of solar energy
CO3	Explain the concepts of solar photovoltaic
CO4	Explain the concepts of wind energy
CO5	Explain the wind machines and generating systems
CO6	Explain the concepts of hybrid power systems

Course Contents:

Unit 1: Renewable Energy Overview: Introduction, Global Scenario for Renewable Energy, Indian Scenario for Renewable Energy, Reserves of Energy Resources, Environmental Aspects of Energy Utilization, Future Prospects for Renewable Energy, Types of Renewable Energy Sources, Potential of Renewable Energy Sources, Renewable Electricity.	[6]
Unit 2: Solar Energy: Introduction, Solar Constant, Solar Radiation at Earth's Surface, Solar Radiation Geometry - Numerical, Solar Radiation Measurements, Solar Radiation Data, Estimation of Average Solar Radiation - Numerical, Solar Radiation on Tilted Surfaces, Solar Flat Plate Collectors, Concentrating Collectors, Applications of Solar Energy – Solar Air Heaters,	[7]

Solar Dryers, Storage of Solar Energy, Solar Water Heaters, Solar Water Distillation, Solar Still, Solar Cooker, Solar Green House.	
Unit 3: Solar Photovoltaic: Introduction, Solar Cell Characteristics, Losses in Solar Cells, Modeling of Solar Cell, Solar PV Modules, Mismatch in PV Module, Hotspot in PV Module, Bypass Diode in PV Module, Design of PV Module, PV Module Power Output, IV Curve for PV Module, BOS of PV Module, Batteries for Solar PV, Battery Charge Controllers, DC to DC Converters, DC to AC Converters, Supporting Structures for Mounting the PV Panels, MPPT, Different Algorithms for MPPT, Types of PV Systems, Performance Analysis of Solar Cell, Working of Solar Cell Power Plant.	[8]
Unit 4: Wind Energy: Introduction, Principle of wind energy conversion – Nature of wind, Power in the wind, Forces on the Blade, Wind Energy Conversion & Numerical, Site Selection Considerations, Basic Components of WECS (Wind Energy Conversion System), Classification of WEC Systems, Advantages & Disadvantages of WECS,	[7]
Unit 5: Wind Machines: Introduction, Types of Wind Machines- Horizontal Axial Machines, Design Considerations of Horizontal Axis Machines, Vertical Axial Machines, Analysis of Aerodynamic Forces acting on the Blade, Performance of Wind Machines, Generating Systems- Schemes for Electric Generation, Generator Control, Load Control, Energy Storage, Applications of Wind Energy, Interconnected System, Safety Systems, Environmental Aspects.	[8]
Unit 6: Hybrid Power Systems: Introduction, Need for Hybrid Systems, Range of Hybrid Systems, Types of Hybrid Systems, Diesel-PV Systems, Wind-PV Systems, Micro Hydel-PV Systems, Biomass-Diesel Systems, Electric Vehicles, Hybrid Electric Vehicles.	[6]
Textbooks: 1. S. S. Thipse: Non-Conventional and Renewable Energy Sources, Narosa Publishers 2. N. Mathur: Non-Conventional Resources of Energy. 2010 3. V. V. N. Kishore: Renewable Energy Engineering and Technology, TERI. 2006	
Reference Book: 1. G. D. Rai: Non-Conventional Energy Sources, Khanna Publishers	

Analog and Digital Electronics

EE305	PCC	Analog and Digital Electronics	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3hrs./week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Mathematics-I, II, III, Basic Electronics Engineering

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

CO1	Analyze various applications of diode
CO2	Understand the types of biasing circuits for BJT
CO3	Analyze he working of amplifier and oscillator
CO4	Apply Boolean Algebra to simplify logic circuits
CO5	Analyze various types Registers and Flip-Flops
CO6	Design counters using Flip-Flops

Course Contents:

Unit 1: Semiconductor Diodes and Applications P-N junction diode, V-I characteristics, Half wave rectifier, two diode full wave rectifier and bridge rectifier with capacitor filter, Zener diode voltage regulator, Positive clipper, negative clipper, double sided clipper, numerical.	[6]
Unit 2: BJT Biasing Circuits BJT operation, Transistor biasing, operating point, Analysis of Fixed bias circuit, load line analysis, numerical, advantages and disadvantages, analysis of emitter stabilized bias circuit, numerical, advantages and disadvantages, Analysis of voltage divider bias circuit, numerical collector to base bias circuit, Transistor switching circuit and switching characteristics.	[6]
Unit 3: Power Amplifiers and Oscillators Classification of amplifiers, comparison of amplifier classes series fed class A amplifier, maximum efficiency, analysis of class B amplifier, harmonic distortion, principle of operation of oscillator, classification of oscillator, RC phase shift oscillator, Wein bridge	[7]

oscillator, Hartley oscillator, Colpit's oscillator.	
Unit 4: Boolean Algebra Basic gates and universal gates, Boolean algebra, Boolean functions, truth tables, canonical forms, Standard forms vs. non-standard forms, Logic networks, Simplification of Boolean Functions using Karnaugh's map for 3 variables, numerical don't care condition, simplification of max term equations.	[6]
Unit 5: Latches and Flip-Flops Basic Bistable Element, Latches, SR Latch, Application of SR Latch, A Switch Debouncer, The S R Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip- Flop.	[6]
Unit 6: Registers and Counters Characteristic Equations, Registers, Counters - Binary Ripple Counters, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters, Design of a Synchronous Mod-6 Counter using clocked JK Flip-Flops Design of a Synchronous Mod-6 Counter using clocked D, T, or SR Flip-Flops.	[7]
Textbooks: 1. Basic Analog Electronics by J B Gupta, S K Kataria publications. 2. Analog Electronic Circuits by Salivahanan, TMH. 3. Electronic Circuits and Devices by Robert L Boylestad and Louis Nashelsky, Pearson Education. **Reference Books:** 1. Integrated Electronics by Jacob Millman and Christos C Halkias	

Network Analysis Laboratory

EE306	ESC	Network Analysis Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2hr/week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic Electrical Engineering, Engineering Mathematics-I, II.

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

CO1	Apply various theorems to electrical networks for finding electrical parameters and verify them through experiments.
CO2	Solve the transient responses by using different conditions for DC and AC excitations.
CO3	Solve electrical networks using Basic Laws to find two port network parameters (Z, Y, ABCD, h).
CO4	Solve Selectivity, Bandwidth & Q-factor of the circuit in series & parallel resonance of circuit and show the effect of resonance.

List of Experiments:

At least minimum 8 experiments should be performed from the following list.

1. Verification of Superposition theorem
2. Verification of Thevinin's theorem
3. Verification of Reciprocity theorem
4. Verification of maximum power transfer theorem
5. Transient analysis of RL circuit supplied by DC Voltage source
6. Transient analysis of RC circuit supplied by DC Voltage source
7. Determination of z and y parameters of the two port networks
8. Determination of ABCD and h parameters of the two port networks
9. Study of Series Resonant Circuit
10. Study of Parallel Resonant Circuit
11. Simulation of AC Circuits.
12. Simulation of DC Circuits.

Textbooks:

1. M.E. Van Valkenberg, "Network Analysis", Prentice Hall of India, 3rd Edition, 2000.
2. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", TMH, 3rd Edition, 2009.

Reference Books:

1. Hayt, Kemmerly and Durbin, "Engineering Circuit Analysis", TMH, 7th Edition, 2010.
2. Roy Choudhury, "Networks and Systems", 2nd Edition, New Age International Publications, 2006.
3. Joseph A. Edminister, Mahmood Maqvi, "Theory and Problems of Electric Circuits", Schaum's Outline Series.
4. Robert L Boylestad, "Introductory Circuit Analysis", Pearson Publications.

Measurement & Instrumentation Laboratory

EE307	PCC	Measurement & Instrumentation Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2hr/week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic Electrical Engineering

List of Experiments:

Minimum 8 experiments should be performed from the following list.

1. Measurement of active power in three phase's circuit using two wattmeter methods.
2. Measurement of reactive power in three phase circuit
3. Calibration of dynamometer type of wattmeter
4. Calibration of single phase energy meter.
5. Measurement of low resistance using Kelvin double bridge.
6. Measurement of medium resistance using Wheatstone bridge.
7. Measurement of inductance by using ac bridges / by using virtual lab
8. Measurement of capacitance by using Schering Bridge / by using virtual lab
9. Measurement of displacement.
10. Measurement of Strain.
11. Measurement of speed.
12. Study of piezo electric transducer.
13. Measurement of Current, Voltage, pf, Active power, Reactive power by using power analyzer.

Textbooks:

1. Electrical & Electronic Measurement by R K Rajput.
2. Measurement & Instrumentation by S Chand

Reference Books:

1. Electrical and Electronic Measurements and Instrumentation, by A. K. Sawhney and Puneet Sawhney
2. Electrical and Electronic Measurements and Instrumentation by V.K.Mehta
3. Electronic Instrumentation by H.S Kalsi.
4. Electrical Measurement by U. A. Bakshi, A.V. Bakshi, K. A. Bakshi.

Constitution of India

MDC01	MC	Constitution of India	1-0-0	Audit

Teaching Scheme	Evaluation Scheme
Lecture: 1hr/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Nil

At the end of the course students will be able to

CO1	Define the meaning and features of Indian constitution.
CO2	Interpret right to life and fundamental rights to certain freedom under article 19 and 21.
CO3	Outline the federal structure of power and directive principles of state policy.

Course Contents:

Unit 1: Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India	[2]
Unit 2: Salient features and characteristics of the Constitution of India, Scheme of the fundamental rights , The scheme of the Fundamental Duties and its legal status	[2]
Unit 3: 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 , Parliamentary Form of Government in India – The constitution powers and status of the President of India	[2]
Unit 4: Amendment of the Constitutional Powers and Procedure , The historical perspectives of	[2]

the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency	
Unit 5: Local Self Government – Constitutional Scheme in India , Scheme of the Fundamental Right to Equality	[2]
Unit 6: Scheme of the Fundamental Right to certain Freedom under Article 19 , Scope of the Right to Life and Personal Liberty under Article 21.	[2]
Textbooks/Reference Books: 1. Constitution of India Published by Government of India Ministry of Law and Justice (Legislative Department), 2020 2. Textbook on The Constitution of India by S R Bhansali 3. Constitution of India by Bakshi P M, January 2014	

Aptitude Skills-I

HMS01	HSMC	Aptitude Skills-I	1-0-0	1 Credit

Teaching Scheme	Evaluation Scheme
Lecture: 1 hrs/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Communication Skills

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

CO1	Understand speed math techniques to solve aptitude problems
CO2	Summarize number systems in detail.
CO3	Explain basic aptitude techniques related to Percentage, Average, Ratio Proportion and Fraction
CO4	Understand speed, time and distance concepts
CO5	Summarize the concepts of Business aptitude using basic aptitude
CO6	Solve the aptitude problems on Geometry and Venn Diagram

Course Contents:

Unit 1: Speed Math Techniques Multiplication, Squares, Square roots, Cubes, Cube roots	[1]
Unit 2: Number System Types of Number System, Last Digit Method, BODMAS Calculation, HCF and LCM, Progressions	[2]
Unit 3: Basic Aptitude Percentage, Average, Ratio and Proportion, Fraction, Partnership	[3]
Unit 4: Speed- Time- Distance Speed, Time, and Distance, Trains, Boats, Streams, Races	[2]
Unit 5: Business Aptitude Profit & Loss, Simple Interest, Compound Interest	[2]
Unit 6: Geometry and Venn Diagram 2D and 3D Mensuration, Venn diagram	[2]

Textbooks:

1. Arun Shrama - Quantitative aptitude for CAT.
2. RS Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publisher; 2016 edition
3. RS Aggarwal, Quantitative Aptitude for Competitive Evaluations, S. Chand Publisher; 2016 edition

Reference Books:

1. Fast Track Objective Arithmetic Paperback, by Rajesh Verma – 2018
2. Teach Yourself Quantitative Aptitude, Arun Sharma
3. The Pearson Guide to Quantitative Aptitude for Competitive Evaluation by Dinesh Khattar

Language Skills - I

HMS02	HSMC	Language Skills- I	0-0-2	Audit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Communication Skills

Languages (Any One)

C Programming (Technical Language) (24Hrs)

Syllabus for C Programming

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

CO1	Explain fundamentals & essentials of C programming.
CO2	Illustrate Types, Operators and Expressions.
CO3	Make use of Decision Making and Looping Statements
CO4	Make use of Arrays in C programming.

Course Contents:

Unit 1: Basics of C Editing, Compiling, Error Checking, executing, testing and debugging of Programs, Flowcharts, Algorithms, Structure of C Program.	**[6]**
Unit 2: Types, Operators and Expressions 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	**[6]**
Unit 3: Decision Making and Looping Statements Statements and Blocks. If-else, else-if switch Loops while and for, do-while break and	**[6]**

continue go to and Labels.	
Unit 4: Arrays Initializing arrays, Initializing character arrays ,two dimensional and multidimensional arrays.	**[6]**
Textbooks 1. C Programming Absolute Beginner's Guide, Que Publishing; 3rd Edition 2. C Programming Language 2nd Edition, Peasrson Publication	
Reference Books 1. C: The Complete Reference, McGraw Hill Education; 4th edition 2. C Programming in easy steps, 5th Edition, In Easy Steps Limited	

Japanese Language Course I (24Hrs)

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

CO1	Explain the history and scripts used in Japanese
CO2	Translate simple English words into Japanese
CO3	Express themselves by using simple sentences and responses to questions.
CO4	Demonstrate Japanese scripts through oral and written communication.

Unit 1: Introduction Brief history of Japan, Japanese Language, Introduction of three scripts in Japanese, viz. Hiragana, Katakana, and Kanji**,** Days of the week, Basic Numerals, and months of the year,	**[6]**
Unit 2: Simple Word forming Demonstratives in Japanese, Writing simple words in Hiragana, Writing all types of words, and simple sentences in Hiragana, Verbs in Japanese,	**[6]**
Unit 3: Simple sentence forming Introduction of Katakana, Formation of simple sentences involving asking and answering questions, Basic Conversational skills. Asking and answering questions based on the topics studied, Introduction of few simple Kanji, and their use in sentences based on the pattern "---ni--- gaarimasu".	**[6]**
Unit 4: Simple interactions Translations from, and into Japanese, Reading an unseen paragraph, and answering questions based thereon, General revision	**[6]**
Text Book: 1. Nihongo Shoho I (Japan Foundation Publ.) 2. GENKI I: An Integrated Course in Elementary Japanese (English & Japanese Ed.) Japanese for Busy People I: Kana Version (Japanese for Busy People Series) 3rd Ed.	
Reference Book: 1. Minna No Nihongo I (3A Corporation, Japan) 2. Japanese from Zero! 1: Proven Techniques to Learn Japanese for Students and Professionals 6th Edition by George Trombl	

Foreign Languages (Any One)

German Language Course I (24Hrs)

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

CO1	Summarize the simple German words used for daily used words
CO2	Translate simple English words into German
CO3	Express themselves by using simple sentences and responses to questions.
CO4	Demonstrate German scripts through oral and written communication.

Course Contents:

Unit 1: Introduction Introduction of the language, Greetings, Introduce oneself, speaking about yourself and others, numbers, E-mail address, Alphabets, speaking about countries and languages, Speaking about Hobbies, to have an informal appointment, learning weekdays, months and seasons	**[6]**
Unit 2: Simple Word forming Speaking about professions, work and wartimes, learning to fill up a profile in German, Learning to name the famous places, buildings in a city, learning definite/ indefinite and negative articles in German, to name the modes of transportation, To learn to describe the way, to understand the texts with international words.	**[6]**
Unit 3: Simple sentence forming To speak about food, to plan a shopping, conversation with the shopkeeper, Conversation about the food, about likes and dislikes, to understand the "w" questions, To understand the watch timings , giving information about time, speaking about the families, to plan a date	**[6]**
Unit 4: Simple interactions Learning about punctuality in Germany and how to excuse for delay, telephonic conversation about the appointments, to plan something together, speaking about birthday, to understand invitation and to write an invitation, to order and to pay in restaurant, to speak about own experiences, to understand particular information from the texts, to understand about different events and events related information in Radio	**[6]**

Textbooks

1. Netzwerk Arbetisbuch A1 Goyal Publisher.
2. "The Everything Learning German Book: Speak, Write and Understand Basic German in No Time" by Ed Swick

3. "German Made Simple: Learn to Speak and Understand German Quickly and Easily" by Eugene Jackson and Adolph Geiger

Reference Books

1. "Hammer's German Grammar and Usage" (Fifth Edition) by Professor Martin Durrell
2. "Learn German with Stories: Café in Berlin" by André Klein

Mini Project-II

PRJ02	PROJ	Mini Project-II	0-0-2	Audit

Teaching Scheme	Evaluation Scheme
Practical: 2hr/week	CA1: 25 Marks CA2: 25 Marks

Course Outcomes at the end of the course students will be able to

CO1	Develop software and Hardware skills.
CO2	Improve technical knowledge, Team Building, communication and management.

Instructions:

Students have to submit a report to the respective guide and demonstrate the mini project for the evaluation. Students have to carry out one mini project in a group of maximum four students.

Teaching and Evaluation Scheme for SY B. Tech

Department of Electrical Engineering

Semester: IV

Department: Electrical Engineering **Rev:** Course Structure/00/2021-22

Class: S.Y. B.Tech. **Semester:** IV

Course Code	Type of Course	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs.	CA1	CA2	MSE	ESE	Total	
EE401	PCC	DC Machines & Transformer	4	-	-	4	10	10	30	50	100	4
EE402	PCC	Control Systems	3		-	3	10	10	30	50	100	3
EE403	PCC	Signals & Systems	4	-	-	4	10	10	30	50	100	4
EE404	PCC	Power System	3	-	-	3	10	10	30	50	100	3
EE405	PEC	Elective-I	3	-	-	3	10	10	30	50	100	3
EE406	PCC	DC Machines & Transformers Laboratory	-	-	2	2	15	15	-	20	50	1
EE407	PCC	Control Systems Laboratory	-	-	2	2	15	15	-	20	50	1
EE408	PCC	Power System Laboratory	-	-	2	2	15	15	-	20	50	1
MDC02	MC	Environmental Sciences	2	-	-	2	25	25	-	-	50	Audit
HMS03	HSMC	Aptitude Skills-II	1	-	-	1	25	25	-	-	50	Audit
HMS04	HSMC	Language Skills-II			2	2	25	25	-	-	50	1
PRJ03	PROJ	Mini Project-III	--	--	2	2	25	25	-	-	50	1
IFT01	PROJ	Industrial Training/ Field Training-I	-	-	-	-	-	-	-	50	50	Audit
			19	**1**	**10**	**30**	**220**	**220**	**150**	**310**	**900**	**22**

Elective-I: A. Electrical Engineering Materials

B. Industrial Safety

C. Electrical Estimation and Costing

DC Machines & Transformers

EE401	PCC	DC Machines & Transformers	3-1-0	4 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week Tutorial: 1 hr/week	CA1:10 Marks CA2:10 Marks Mid Semester Exam: 30Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electrical Engineering

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

CO1	Explain single phase transformer.
CO2	Explain three phase transformer.
CO3	Design various parts of transformers.
CO4	Determine performance characteristics & breaking of DC Motor.
CO5	Design various parts of DC Motor.
CO6	Classify special purpose machines for different applications.

Contents:

Unit 1: Single Phase Transformer: Transformer construction, Ideal and practical transformer, exact and approximate equivalent circuits, no load and on load operation, phasor diagrams, power and energy efficiency, voltage regulation, parallel operation, effect of load on power factor, excitation phenomenon in transformers, switching transients, Auto transformers, Variable frequency transformer, voltage and current transformers, welding transformers, Pulse transformer and applications.	**[6]**
Unit 2: Three Phase Transformers: Constructional features of three phase transformers, cooling methodology, Standard and special transformer connections, Phase conversion, Parallel operation of three phase	**[7]**

transformers, three winding transformers and its equivalent circuit, on load tap changing of transformers, Modern trends in transformers.	
Unit 3: Design of Transformers: Output equation of transformer, Relation between Core Area & Weight of iron & copper, Design for minimum cost, Design for minimum loss or maximum efficiency, variation of Output & losses in transformer with linear Dimensions, Design of Core (rectangular core, Square & stepped Cores), Variation of Core Diameter, Selection of core areas & type of core, Choice of Flux Density, design of winding, Windows Space Factor, Windows Dimensions, Overall Dimensions, Simplified Steps for transformer Design. Resistance of Winding, Mechanical Forces, No load currents, No load current of 1ph transformer, No load current of 3ph transformer, Design of Tank with Tubes, Core Design, Winding Design, Window Area.	**[6]**
Unit 4: D.C. Machine: Principles of working, Significance of back emf, Torque Equation, Types, Characteristics and Selection of DC Motors, Starting of DC Motors, Speed Control, Losses and Efficiency, Condition for Maximum Efficiency, Braking of DC Motors, Effect of saturation and armature reaction on losses; Applications, Construction, working principle & applications of D.C. Machine	**[6]**
Unit 5: Design of DC Machines: Introduction & Applications, classification, Constructional Details, Stator, Armature, Commutator, Brush Gear, Design output Equation, Interdependence of specific & Electric loadings, Selection of no of poles, Core Length, Armature diameter, Length of air gap, No of Armature coils, No of Armature Slots, Cross Section of Armature Conductors, Insulation of armature winding, Slots Dimensions, Poles Design (Area of poles, Height of Poles), length of Inter poles, Losses & Efficiency (Rotational Losses, Losses Stray load losses, Efficiency). Design of commutator and brush gear.	**[6]**
Unit 6: Special Machines: Construction, working principle & applications of stepper motors, Brushless DC motors, variable-reluctance machines, Permanent Magnet DC Motors, Servo motor.	**[5]**

Textbooks:

1. Bhattacharya S. K, "Electrical Machines",(Tata McGraw Hill Publications)
2. Kothari Nagrath, "Electrical Machines", (Tata McGraw Hill Publications)
3. M. N. Bandopadhyay, "Electrical Machines", (Tata McGraw Hill Publications)

Reference Books:

1. Fitzerland, "Electrical Machines", (Tata McGraw Hill Publications)
2. A Course in Electrical Machine Design, A.K.Sawhney, Dhanpat Rai & sons New Delhi
3. Principles of Electrical Machine Design, R. K. Agarwal, S. K. Katariya and sons.
4. A Text Book of Electrical Engineering Drawings, K.L. Narang, Satya Prakashan, New Delhi.
5. Electrical Machine Design Data Book, A Shanmugasundaram, G. Gangadharan, R. Palani, 3rd Edition, Wiely Eastern Ltd., New Delhi.

Control Systems

EE402	PCC	Control Systems	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Network Analysis, Mathematics

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

CO1	Evaluate the transfer function of the system using block diagram reduction techniques and signal flow graph method
CO2	Determine the system response in time-domain.
CO3	Determine stability by applying Routh-Hurwitz criteria and Root Locus method
CO4	Determine the stability and response by constructing Polar, Nyquist& Bode plot
CO5	Evaluate the effect of P, PI, PD and PID controllers on system.
CO6	Explain control system models using state space models

Contents:

Unit 1: Introduction to Control System Importance of Control Systems, Classification of control systems, Open loop system, closed loop system, Applications, Mathematical representation and Transfer function of mechanical, electrical systems, Block diagram representation and reduction, Signal flow graph, Mason's gain formula	**[8]**
Unit 2: Time Domain Analysis Time Response, Steady state analysis, Transient response analysis, Transient response Specifications, Feedback characteristics of Control System	**[7]**
Unit 3: Stability Analysis Concept of stability, Routh-Hurwitz stability criteria, Special cases of Routh's criteria, Root Locus method, Effect of pole-zero addition on root locus	**[6]**

Unit 4: Frequency Domain Analysis Correlation between time domain and frequency domain specification, Polar plot, Nyquist plot, Bode plot	**[8]**
Unit 5: PID Controller Introduction to P, I & D controller, Individual effect on overall system performance, PI, PID controller and effect on overall system performance	**[5]**
Unit 6: State Space Analysis Representation of system in state space, converting transfer function model in to state space model, Non uniqueness of state space model, State space representation, Solution of state equations, State Transition Matrix, Controllability and Observability Test.	**[7]**

Textbooks:

1. I.J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2008
2. M. Gopal, Control System: Principles and Design, Tata Mc Graw-Hill Publication
3. K. Ogata, Modern Control Engineering, Eastern Economy, 5th Edition 2011.

Reference Books:

1. Katsuhiko Ogata," Modern Control Engineering", Prentice Hall, 2010
2. B. C. Kuo, Automatic Control System, Wiley Publication 8th Edition.
3. Norman S. Nise, Control System Engineering, John Wiley and Sons, 6th Edition, 2014.
4. M.Gopal, Digital Control and State Variable Methods, Tata Mc Graw Hill, 3rd Edition.

Signals and Systems

EE403	PCC	Signals and Systems	4-0-0	4 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 4 hrs/week	CA1:10 Marks CA2:10 Marks Mid Semester Exam: 30Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Mathematics-I, II, and III

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

CO1	Analyze different signals.
CO2	Determine the properties of CT and DT systems.
CO3	Determine Impulse response of CT and DT system using convolution principle
CO4	Analyze systems using Fourier Series and Fourier Transform.
CO5	Analyze DT systems using Z-Transforms.

Unit 1: Introduction to signals Definition of signals, classification of signals: continuous time signals & discrete time signals, even & odd signals, periodic & non-periodic, deterministic & non-deterministic, energy & power, elementary signals: unit impulse, unit step, unit ramp, exponential & sinusoidal, basic operations on signals.	**[6]**
Unit 2: Classification of Systems Definition of System, example of communication system classification of system such as Linear-nonlinear, Time variant-invariant, causal-noncausal, static-dynamic, stable-unstable, invertible, Block diagram representation of systems 1^{st} and 2^{nd} order representation.	**[6]**
Unit 3: Time domain representation of LTI System: Impulse response, convolution sum, convolution integral. Computation of convolution sum and convolution integral using graphical method for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular.	**[7]**

Unit 4: Fourier analysis of Periodic Signals Orthogonality of signals, synthesis and analysis equations of a Discrete time periodic signal, review of properties of DTFS, Numerical to obtain magnitude and phase spectra. Numerical to determine time-domain signal from spectra. Fourier series representation of continuous time periodic signals, numerical to obtain magnitude and phase spectra of given continuous time signal.	**[6]**
Unit 5: Fourier analysis of A-periodic signals: Synthesis and analysis equations of a discrete time a-periodic signal, review of properties of DTFT, numerical to draw magnitude and phase spectra of given signal, numerical to evaluate DTFT of the given signal, numerical to obtain time domain-domain signal from given DTFT and spectrum. Fourier Transform of continuous time a-periodic signals, numerical to obtain phase and magnitude spectra of a given continuous time signal.	**[6]**
Unit 6: The Z-Transforms: Z transform, properties of the region of convergence, numerical to find Z-transform and plot ROC time reversal time shifting, time scaling, convolution and differentiation in Z-domain. Initial and final value theorem, numerical to obtain Z-transform using properties, time domain signal from Z- domain using partial fraction method and power series expansion method, Z-Transform analysis of LTI system to obtain impulse response, unilateral Z-transform, Causality and stability of the system using ROC.	**[8]**

Textbooks:

1. Signals and Systems by P. Ramesh Babu, Fourth edition, Scitech Publication.
2. Signals and Systems, 2nd Edition by Simon Haykin, Barry Van Veen, Wiley
3. Robert A. Gabel and Richard A.Roberts, "Signals & Linear Systems", John Wiley
4. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson Education, 2007

Reference Books:

1. Signal and Systems by Anand Kumar, 3rd Edition, PHI
2. Edward W Kamen& Bonnie's Heck, "Fundamentals of Signals and Systems", Pearson Education, 2007
3. H P Hsu, Rakesh Ranjan, "Signals and Systems", Schaum's Outlines, Tata McGraw Hill, Indian Reprint, 2007.

Power Systems

EE404	PCC	Power Systems	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs./week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Network analysis and synthesis

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

CO1	Explain the layout of power system
CO2	Evaluate steady state analysis of AC systems
CO3	Determine transmission line parameters
CO4	Solve power flow, symmetrical and unsymmetrical fault analysis
CO5	Determine economic load dispatch problem
CO6	Distinguish power system stability problem

Contents:

Unit 1: Introduction to power systems: Brief history of power systems, structure of power systems, generation, transmission and distribution, Layout of power station and substation.	[6]
Unit 2: Steady state analysis of AC systems Representation of phasor quantities, power calculation in single phase and three-phase circuits, modelling of power system components, per unit representation, power factor correction.	[6]
Unit 3: Transmission Line Modelling	[7]

Resistance in transmission line, Bundled conductors, GMR and GMD of bundled conductors, Inductance calculation, capacitance calculation, different models of transmission line: Pi model, T model, ABCD parameters in transmission lines, voltage regulation and efficiency calculation, calculation of string efficiency of insulators	
Unit 4: Power flow and symmetrical fault analysis Calculation of admittance matrix, Gauss Seidel, Newton Raphson, Fast decoupled power flow, DC power flow, symmetrical fault analysis, symmetrical components, unsymmetrical fault calculations for L-G, LL-G and L-L faults	[7]
Unit 5: Economic load dispatch: Load duration curves, cost function of generators, incremental cost function, economic dispatch of generators without considering loss, economic dispatch considering loss function	[6]
Unit 6: Power system stability: Swing equation, transient stability, stable and unstable equilibrium, equal area criterion, critical clearing angle and critical clearing time	[6]
Textbooks: 1. "Power System Analysis", John J. Grainger and William D. Stevenson, Tata McGraw-Hill, 2003. 2. "Power system analysis" Hadi Saadat, Tata McGraw-Hill, 2002	
Reference Books: 1. "Electrical energy systems theory an introduction" Olle l. Elgerd, T M H Edition 2. "Power system engineering" I. J. Nagrath and D. P. Kothari, Tata McGraw-Hill, 2005 3. "Electrical Power Systems" C L Wadhwa, New Age International Publishers	

Elective-IA: Electrical Engineering Materials

EE405A	PEC	Electrical Engineering Materials	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs./week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electrical Engineering, Physics, Chemistry

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

CO1	Explain conducting Materials
CO2	Explain Super conducting Materials
CO3	Classify Insulating Materials
CO4	Summarize Magnetic Materials
CO5	Explain Dielectric Materials
CO6	Explain Nano Materials

Course Contents:

Unit 1: Conductive materials Free electron theory of metals, Effect of temperature on conducting materials, Factors affecting resistivity, Thermal conductivity of metals, Classification of conductor materials, Standards used in conducting materials	[6]
Unit 2: Super Conducting Materials Superconductivity, Factor affecting Superconductivity, Effect of magnetic temperature, Meissner effect, Type-I and Type-II superconductors, High temperature superconductors, Super conducting materials, Application of superconductors.	[6]
Unit 3: Insulating Materials General properties of insulating materials, Thermal classification, Dielectric gases, Liquid & solid insulating materials, Insulating materials for electrical devices, Effect of	[5]

Moisture on insulating materials.	
Unit 4: Magnetic Materials Magnetic parameters, Classification of magnetic materials, Dia, Para and ferromagnetism, Antiferromagnetic and Ferrimagnetic materials, properties of ferromagnetism, Soft magnetic materials, Hard magnetic materials, Magnetic materials for electric devices.	[7]
Unit 5: Dielectric Materials Classifications of dielectric materials ,Mechanism & Types of polarization, Clausius-Mosotti equation, Internal field in solids and liquids, Dielectric constant, dielectric loss, dielectric breakdown, ferroelectric, pyroelectric and piezoelectric materials, applications of dielectric materials.	[7]
Unit 6: Nano Materials: Nanomaterials : Introduction and properties, synthesis of nanomaterials, Carbon Nano Tubes, Characterization techniques of nanomaterials- SEM, TEM, EDAX, FMR, XRD., Applications of nanomaterials.	[7]
Textbooks: 1. A course in Electrical Engineering Materials, S.P. Seth, P.V. Gupta, Dhanpat Rai & Sons. 2. Electrical Engineering Materials, A.J. Dekker, PHI.	
Reference Books: 1. Materials Science for Electrical & Electronics Engineers, Ian P. Jones, Oxford. 2. Electrical Properties of Materials, L. Solymar& D. Walsh, Oxford. 3. Science of Engineering Materials and Carbon Nanotubes - C.M. Srivastava and C. Srinivasan.	

Elective-IB: Industrial Safety

EE405B	PEC	Industrial Safety	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electrical Engineering

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

CO1	Explain various hazards in Industry
CO2	Explain principles of accidents prevention
CO3	Explain significance of first aid
CO4	Explain significance of Personal Protective Equipment's
CO5	Explain concepts of Safety Management

Contents

Unit 1: Electrical Hazards in Industry Indian Electricity Act and Rules, Safe limits of amperages, voltages, distance from lines, etc., Joints and connections, Overload and Short circuit protection, Earthing standards and earth fault protection, Protection against voltage fluctuations, Effects of shock on human body, Hazards from Borrowed neutrals, Electrical equipment in hazardous atmosphere, Criteria in their selection, installation, maintenance and use, Control of hazards due to static electricity, Relevant IS and OSHA Standards	**[6]**
Unit 2: Fire and other Hazards Explosive Act and Rules, Gas Cylinders Rules, Static and Mobile Pressure Vessels (Unfired) Rule, General causes and classification of fire, Detection of fire, extinguishing methods, firefighting installations with and without water. Machine guards and its types, automation. High pressure hazards, safety, emptying, inspecting, repairing, hydraulic and nondestructive testing, Relevant IS and OSHA Standards	**[6]**

Unit 3: Principles of accidents prevention Definition: Incident, accident, injury, dangerous occurrences, unsafe acts, unsafe conditions, hazards, error, oversight, mistakes etc. Accident Prevention: Theories / Models of accident occurrences, Principles of accident prevention, Accident and Financial implications, Hazard identification and analysis: fault tree analysis, Event tree analysis, failure modes and effects analysis, Hazop studies, Job safety analysis – examples, Plant safety inspection - objectives and types check procedure inspection report, Factories Act 1948, Workman's Compensation Act 1923, Employees State Insurance Act 1948	**[6]**
Unit 4: First aid Need of First aid. Body structure and Functions, Position of causality, the unconscious casualty, fracture and dislocation, Injuries in muscles and joints, Bleeding, Burns, Scalds and accidents caused by electricity, Respiratory problems, Rescue and Transport of Casualty. Cardiac massage, poisoning, wounds, Statutory provisions, First Aider-Role & Responsibilities and Qualities	**[6]**
Unit 5: Personal Protective Equipment's Personal Protective Equipment's: Need, selection, supply, use, care and Maintenance, Personal protective devices for head, ear, face, eye, foot, knee and body protection, Respiratory personal protective devices. Training maintenance, precaution and care of PPE, Detection equipment, Testing Procedures and Standards	**[6]**
Unit 6: Safety Management Organizing for safety, Health and Environment Organization: Structure, Function and responsibilities Safety Committee: Structure and function, The competent person in relation to safety legislation - duties and responsibilities. Concept for training, Relevance of WTO regarding safety, Health and environment. Employee participation in safety - Role of Trade union in safety, Safety promotion and safety awards, safety, competitions. Safety Education & Training, Approaches to compliance & Violations, Safety Audit and Integrated Management System.	**[6]**
Text/Reference Books: 1. Industrial Safety –National Safety Council of India ISHET. 2. Dr. K. U. Mistry - Fundamentals of Industrial Safety & Health, Siddharth Prakashan, Ahmadabad.	
Text/Reference Books: 1. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai 2. Grimaldi and Simonds, Safety Management, AITBS Publishers, New Delhi (2001)	

Elective-IC: Electrical Estimation and Costing

EE405C	PEC	Electrical Estimation and Costing	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3hrs./week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electrical Engineering, Measurement and Instrumentation,

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

CO1	Explain estimation and costing
CO2	Explain types of earthing
CO3	Explain Service connection
CO4	Estimate for residential installation
CO5	Estimate for commercial installation
CO6	Estimate for Power circuits

Course Contents:

Unit 1: General Principles of Estimation: Introduction to estimation and costing, Electrical Schedule, catalogues, Market survey and source selection, recording of estimates, determination of required quantity of material, labour conditions, determination of cost of material and labour, contingencies, overhead charges, profit, purchase system, purchase enquiry and selection of appropriate purchase mode, call for quotation, comparative statement purchase order payment of bills, tender form general idea about IE rules, Indian electricity act and major applicable IE rules.	**[7]**
Unit-2: Earthing: Meaning of earthing, touch potential and step potential, necessity of earthing, Points to be earthed, factors influencing earth resistance, methods of reducing earth resistance, standard values of earth resistance for various installations, method of selecting the size of earth conductor, types /methods of earthing, Pipe earthing-diagram, specifications of pipe earthing, Plate earthing-diagram and specifications of plate earthing.	**[5]**
Unit 3: Service connection: Meaning of service mains, code of Practice for service mains, types of service mains-Over Head Service Mains -materials and specifications, UG Service Mains -materials	**[6]**

and specifications, Standard wire size table, current ratings for Aluminum, copper conductors and selection of size of conduit pipe as per the size and number of wires. Load calculation, selection of size and type of conductor/UG cable, discrimination of size of protective devices, Quantity calculation, schedules of materials and estimates for single phase OH service connection, three phase OH service connection, single phase UG service connection and three phase UG service connection.	
Unit 4: Electrification of Residential installation: General rules, guidelines for wiring of residential installation and positioning of equipment, the principles of circuit design in lighting and power circuits, procedure for designing circuit and deciding the number of circuits, selection of type of wiring and rating of wires and cables, load calculations and selection of size of conductor, selection of rating of main switch, distribution board, protective switch gear ELCB and MCB and wiring accessories, Earthing of residential installation, sequence to be followed for preparing estimate, preparation detailed estimates and costing of residential installation.	**[7]**
Unit 5: Electrification of commercial installation: Concept of commercial installation, differentiate between electrification of residential and commercial installation, design considerations for planning of and electrical installation system for commercial building, load calculation and selection of size of service connection and nature of supply, deciding the size of the cables, busbar and bus bar chambers mounting arrangements and positioning of switchboards, distribution boards main switch, earthing of the electrical installation, selection of type of wiring system, sequence to be followed to prepare estimate, preparation of detailed estimate and costing of commercial installation.	**[6]**
Unit 6: Electrical Installation for power circuits: Introduction, important considerations regarding motor installation wiring, determination of input power, determination of input current to motors, determination of rating of cables, determination of rating of fuse, determination size of conduit, distribution board main switch and starter.	**[6]**
Textbooks: 1. Electrical Wiring Estimation and Costing by S. L. Uppal, Khanna publications 2. Electrical Design Estimation and Costing by K. B. Raina and S. K. Bhatacharya New Age International publications.	
Reference Books: 1. A Course in Electrical Installation Estimation and Costing by J B Gupta, S K Katariya and Sons publications	

DC Machines & Transformers Laboratory

EE406	PCC	DC Machines & Transformers Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1:15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic Electrical Engineering

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

CO1	Test for performance parameters of transformers.
CO2	Demonstrate constructional details of DC machines.

List of Experiments: At least 8 experiments should be performed from the following list.

1. To verify turn ratio of transformer.
2. To verify relation in i) Scott connection ii) open delta connection
3. To determine efficiency by direct load test on single phase transformer.
4. To study the parallel operation of 3 phase transformer
5. Details and assembly of 3-phase transformer with design report.
6. To determine efficiency by Break load test on DC Shunt motor.
7. To Determine the constant losses and hence to find the efficiency of a given DC Machine at any desired load by Swinburne's Test.
8. To Determine the stray loss and hence to find the efficiency of the given DC shunt Motor & Shunt Generator by Hopkinson's Test.
9. To determine OCC of DC Shunt Generator.
10. To determine efficiency by direct load test on DC Generator.
11. Report based on Industrial visit to a manufacturing unit. (Transformer or DC motor).

Textbooks:

1. Bhattacharya S. K, "Electrical Machines", (Tata McGraw Hill Publications)
2. Kothari Nagrath, "Electrical Machines", (Tata McGraw Hill Publications)
3. M. N. Bandopadhyay, "Electrical Machines", (Tata McGraw Hill Publications)

Reference Books:

1. Fitzerland, "Electrical Machines", (Tata McGraw Hill Publications)
2. A Course in Electrical Machine Design, A.K.Sawhney, Dhanpat Rai & sons New Delhi
3. Principles of Electrical Machine Design, R. K. Agarwal, S. K. Katariya and sons.
4. A Text Book of Electrical Engineering Drawings, K.L. Narang, Satya Prakashan, New Delhi.
5. Electrical Machine Design Data Book, A Shanmugasundaram, G. Gangadharan, R. Palani, 3rd Edition, Wiely Eastern Ltd., New Delhi.

Control Systems Laboratory

EE407	PCC	Control Systems Laboratory	0-0-2	1 Credit

Practical Scheme	Evaluation Scheme
Practical: 2 hrs/ week	CA1:15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Network Analysis, Mathematics

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

CO1	Evaluate the transfer function of the system using block diagram reduction techniques
CO2	Determine the system response in time-domain.
CO3	Determine stability by applying Routh-Hurwitz criteria and Root Locus method
CO4	Determine the stability and response by constructing Polar, Nyquist& Bode plot
CO5	Evaluate the effect of P, PI, PD and PID controllers on system.
CO6	Explain control system models using state space models

Course Contents:

List of Experiments: At least **8** experiments should be performed from the following list.

1. Familiarization with MATLAB control system toolbox, MATLAB Simulink toolbox.
2. Linear Time-invariant Systems and Representation using MATLAB
3. Block Diagram Reduction using MATLAB
4. Time Response of Second Order System using MATLAB
5. Simulation of Step response & impulse response for type-0, type-1 & type-2 system with unity feedback using MATLAB
6. Determination of stability by using Root locus using MATLAB for 2^{nd}, 3^{rd} & 4^{th} order system of a Linear Time Invariant System.
7. Determination of stability by using Bode plot using MATLAB for 2^{nd}, 3^{rd} & 4^{th} order system of

a Linear Time Invariant System.

8. Determination of stability by using Nyquist plot using MATLAB for 2^{nd}, 3^{rd} & 4^{th} order system of a Linear Time Invariant System.
9. State Model for Classical Transfer Function & Vice-Versa Using MATLAB.
10. PID Controller using MATLAB

Textbooks:

1. Control System Engineering, I. J. Nagrath and M. Gopal, New Age International Publishers – Fourth edition
2. Control system: Principles and Design, M. Gopal, Tata Mc Graw-Hill Publication
3. Modern Control Engineering, K. Ogata, Eastern Economy, 5^{th} edition 2011.
4. Control System Engineering, I. J. Nagrath and M. Gopal, New Age publication, 5^{th} edition, 2008.

Reference Books:

1. Modern Control Engineering, Katsuhiko Ogata, Prentice Hall, 2010
2. Automatic Control System, B. C. Kuo, Wiley Publication 8^{th} edition.
3. Control System Engineering, Norman S. Nise, John Wiley and Sons, 6^{th} edition, 2014.
4. Digital Control and State Variable Methods, M.Gopal, Tata Mc Graw Hill, 3^{rd} edition.

Power Systems Laboratory

EE408	PCC	Power Systems Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2hrs./week	CA1:15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic Electrical Engineering, Network analysis

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

CO1	Analyze Sinusoidal voltages and currents, transmission lines model (pi and T model), Transient stability of Single Machine connected to Infinite Bus
CO2	Analyze Power Flow using Gauss-Seidel Methods and Newton Raphson Methods
CO3	Determine fault current in case of L-L, L-G and L-L-G and symmetrical faults
CO4	Determine load distribution between generators economically with and without losses.

List of Experiments:

At least 8 experiments should be performed from the following list.

1. Analysis of sinusoidal voltages and currents
2. Computation of GMR, inductance and capacitance of bundled conductors.
3. Analysis of pi and T model of transmission lines.
4. Formation of bus admittance model.
5. Power flow analysis using Gauss-Seidel method
6. Power flow analysis using Newton-Raphson method
7. Three phase symmetrical fault analysis for synchronous machines.
8. Calculation of fault current in case of L-L, L-G and LL-G faults
9. Determination of economic load dispatch of generators with and without losses
10. Transient stability analysis of Single Machine connected to Infinite Bus (SMIB)

Textbooks:

1. "Power System Analysis", John J. Grainger and William D. Stevenson, Tata McGraw-Hill, 2003.
2. "Power system analysis" Hadi Saadat, Tata McGraw-Hill, 2002.

Reference Books:

1. "Electrical energy systems theory an introduction" Olle l. Elgerd, T M H Edition
2. "Power system engineering" I. J. Nagrath and D. P. Kothari, Tata McGraw-Hill, 2005
3. "Electrical Power Systems" C L Wadhwa, New Age International Publishers.

Environmental Sciences

MDC02	MC	Environmental Sciences	2-0-0	Audit

Teaching Scheme	Evaluation Scheme
Lecture: 2 hrs./week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: --

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

CO1	Explain various natural resources and associated Problems
CO2	Summarize various ecosystems
CO3	Explain the importance of conservation of biodiversity and its importance in balancing the earth.
CO4	Recognize various causes of environmental pollution along with various protection acts in India to limit the pollution
CO5	Extract the information based of field study and prepare a report.

Course Contents:

Unit 1: Nature of Environmental Studies: Definition, scope and importance, Multidisciplinary nature of environmental studies. Need for public awareness.	**[2]**
Unit 2: Natural Resources and Associated Problems: a) Forest resources: Use and over-exploitation, deforestation, dams and their effects on forests and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems. c) Mineral resources: Usage and exploitation. Environmental effects of extracting and using mineral resources. d) Energy resources: Growing energy needs, renewable and nonrenewable energy resources, use of alternate energy sources. Solar energy, Biomass energy, Nuclear energy. e) Land resources: Solar energy, Biomass energy, Nuclear	**[6]**

energy, Land as a resource, land degradation, man induced landslides, soil erosion and desertification. f) Role of individuals in conservation of natural resources	
Unit 3: Ecosystems: Concept of an eco-system. Structure and function of an ecosystem. Producers, consumers and de composers. Energy flow in the eco system. Ecological succession. Food chain etc. in concern with forest ecosystem, Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chain etc. in concern with Grassland ecosystem, Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chain etc. in concern with Desert ecosystem, Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chain etc. in concern with various aquatic ecosystems	**[4]**
Unit 4: Biodiversity: Introduction- Definition: genetic, species and ecosystem diversity. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Various approaches for the conservation of biodiversity.	**[4]**
Unit 5: Environmental Pollution and Environmental Protection: Definition: Causes, effects and control measures of various types of pollution. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution, Concept of sustainable development: From Unsustainable to Sustainable development, Various environmental Protection Acts and their scope.	**[4]**
Unit 6: Field Work: The student should Visit to a local area to document environmental Assets-River/Forest/Grassland/Hill/Mountain. Or Visit to a local polluted site - Urban / Rural / Industrial /Agricultural. Or Study of common plants, insects, birds. or Study of simple ecosystems - ponds, river, hill slopes, etc. **The student should expect to do this activity in a group size of 4-5 and prepare and submit a report on it.**	**[4]**
Textbooks/Reference Books: 1. Aggarwal, K.C.2001, Environmental Biology, Nidi Pub. Ltd., Bikaner. 2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, India 3. Brunner R.C.,1989, Hazardous Waste Incineration, McGraw Hill Inc.	

Mini Project-III

PRJ03	PROJ	Mini Project-III	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2hr/week	CA1: 25 Marks CA2: 25 Marks

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

CO1	Develop software and Hardware skills.
CO2	Improve technical knowledge, Team Building, communication and management.

Instructions:

Students have to submit a report to the respective guide and demonstrate the mini project for the evaluation. Students have to carry out one mini project in a group of maximum four students.

Field Training / Industrial Training

IFT01	PROJ	Field Training /Industrial Training	0-0-0	Audit

Teaching Scheme	Evaluation Scheme
Lecture: --	CA1: 25 Marks CA2: 25 Marks

Course Outcomes: Students will be able to

CO1	Examine actual working environment
CO2	Demonstrate the use, interpretation and application of an appropriate engineering standard in a specific situation.
CO3	Identify sources of hazards, and assess/identify appropriate health & safety measures.
CO4	Summarize technical documents and give presentations related to the work completed

Instruction:

Students are expected to undergo industrial training for at least four weeks after II semester. Training session shall be guided and certified by qualified engineer / industry expert. Students should prepare detailed report on activities carried out during training. Evaluation shall be based on report and power point presentation.

Aptitude Skills –II

HMS03	HSMC	Aptitude Skills- II	1-0-0	Audit

Teaching Scheme	Evaluation Scheme
Lecture: 1 hrs/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Communication Skills, Aptitude Skills- I

Verbal Ability (12Hrs) (Compulsory)

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

CO1	Understand basic concepts of sentences and its structure
CO2	Understand the tenses and its use in daily life
CO3	Explain basic uses of speeches and voices in day to day life
CO4	Understand the use of modal verbs in sentence construction
CO5	Summarize various Phrases, Idioms and Proverbs
CO6	Summarize different words used in daily life

Course Contents:

Unit 1: English Grammar Structure and Types of Sentence, Conditional Sentences	**[2]**
Unit 2: Tenses Present tense, Past tense, Future tense, Use of Tenses in Sentence forming	**[2]**
Unit 3: Speeches and Voices Direct and Indirect Speech, Active and Passive Voice	**[2]**
Unit 4: Modal Use of Modal verbs in Sentence Forming, Substitution and Elimination	**[2]**
Unit 5: Proverbs, Idioms and Phrases Use of Proverbs, Idioms and Phrases in Sentence Construction, Judgment and Inference Sentence	**[2]**
Unit 6: Vocabulary Vocabulary Building in Various Situations	**[2]**

Textbooks:

1. Raymond Murphy, Essential English Grammar with Answers, Murphy
2. Objective General English by R.S. Aggarwal, S Chand Publishing; Revised edition (15 March 2017)

Reference Books:

1. Rao N, D, V, Prasada, Wren & Martin High School English Grammar and Composition Book, S Chand Publishing, 2017
2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press; Second edition

Language Skills- II

HMS04	HSMC	Language Skills- II	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Communication Skills, Language Skills- I

Languages (Any One)

C Programming (Technical Language) (24Hrs)

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

CO1	Illustrate the concept of Function Types, and its type
CO2	Make use of Structures and Unions.
CO3	Make use of Pointers
CO4	Illustrate the concept of File handling in C programming.

Course Contents:

Unit 1: Function Editing, Basic of functions, Types of functions, returning non-integers external variables, scope rules, Recursion Function.	**[6]**
Unit 2: Structures and Unions Variable Defining a Structure, Advantage of Structure, Size of Structure, Arrays of Structures, Structures and Functions, Defining Unions.	**[6]**
Unit 3: Pointers Pointers to integers, characters, floats, arrays, structures.	**[6]**
Unit 4: File handling Initializing Introduction to dynamic memory allocation- Malloc, Calloc, Realloc, Introduction to file management, Opening/Closing a file, Input/ Output operations on Files, Error handling during I/O Operations.	**[6]**

Textbooks

1. C Programming Absolute Beginner's Guide, Que Publishing; 3rd edition, 2013
2. C Programming Language 2nd Edition, Pearson Publication

Reference Books

1. C: The Complete Reference, McGraw Hill Education; 4th edition, 2017.
2. C Programming in easy steps, 5th Edition, In Easy Steps Limited
3. The C Programming Language, Second Edition, By Pearson Education India , 2015.

Foreign Languages (Any One)

Japanese Language Course I (12Hrs)

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

CO1	Converse in Standard Japanese to perform basic communicative tasks (e.g., exchange greetings/personal information, give time/directions/daily activities)
CO2	Make use of Japanese vocabulary effectively.
CO3	Demonstrate reading comprehension.

Course Contents:

Unit 1: Basic communicative tasks Learning expressions involving "---ni---gaimasu" pattern, Introduction of counters, simple translations, Communicative situations—shopping, Grammar: Introduction of adjectives, na-adjectives	**[4]**
Unit 2: Communicative situations Time relations, Communicative situations-confirming schedules etc, Particles and their functional use in Japanese sentences, Reading comprehension—a story	**[4]**
Unit 3: Easy conversation Introduction of past tense aspect in r/o verbs, and adjectives, Communicative situation: asking questions and answering, Easy conversation, Overall revision, and discussion	**[4]**
Text Book: 1. Netzwerk Arbetisbuch A1 Goyal Publisher. 2. "The Everything Learning German Book: Speak, Write and Understand Basic German in No Time" by Ed Swick 3. "German Made Simple: Learn to Speak and Understand German Quickly and Easily" by Eugene Jackson and Adolph Geiger	
Reference Books 1. "Hammer's German Grammar and Usage" (Fifth Edition) by Professor Martin Durrell 2. "Learn German with Stories: Café in Berlin" by André Klein	

Foreign Languages

German Language Course I (12Hrs)

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

CO1	Introduce herself or himself in German.
CO2	Understand alphabets, numbers in German language
CO3	Make basic and easy sentences required in day to day situations
CO4	Read, write, speak and listen basic and simple text in German.

Course Contents:

Unit 1: Introduce oneself Introduction, Greetings, German Alphabets, Numbers (1 -100), Giving and asking Information related to numbers	**[3]**
Unit 2: Formal and Informal form Difference between Formal and Informal form, Personal Pronouns, verb conjugation	**[3]**
Unit 3: Everyday situations Learning about the things in the classroom, Definite, indefinite, negative articles, Possessive Articles of all the nouns	**[3]**
Unit 4: Simple activities Watch timings learning, Routine activities	**[3]**
Textbooks 1. Netzwerk Arbetisbuch A1 Goyal Publisher 2. "The Everything Learning German Book: Speak, Write and Understand Basic German in No Time" by Ed Swick 3. "German Made Simple: Learn to Speak and Understand German Quickly and Easily" by Eugene Jackson and Adolph Geiger	
Reference Books 1. "Hammer's German Grammar and Usage" (Fifth Edition) by Professor Martin Durrell 2. "Learn German with Stories: Café in Berlin" by André Klein	

Teaching and Evaluation Scheme for T Y B. Tech

Department of Electrical Engineering

Semester: V

Department: Electrical Engineering **Rev:** Course Structure/00/2021-22

Class: T.Y. B.Tech. **Semester:** V

Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs.	CA1	CA2	MSE	ESE	Total	
EE501	PCC	Power Electronics	3	-	-	3	10	10	30	50	100	3
EE502	PCC	AC Machines	4	-	-	4	10	10	30	50	100	4
EE503	PCC	Microprocessor & Microcontroller	3	-	-	3	10	10	30	50	100	3
EE504	PEC	Elective- II	3	-	-	3	10	10	30	50	100	3
OE514	OEC	Open Elective-I	3	-	-	3	10	10	30	50	100	3
EE505	PCC	Power Electronics Laboratory	-	-	2	2	15	15	-	20	50	1
EE506	PCC	AC Machines Laboratory	-	-	2	2	15	15	-	20	50	1
EE507	PCC	Microprocessor & Microcontroller Laboratory	-	-	2	2	15	15	-	20	50	1
HMS05	HSMC	Aptitude Skills-III	1	-	-	1	25	25	-	-	50	1
HMS06	HSMC	Language Skills-III	-	-	2	2	25	25	-	-	50	Audit
PRJ04	PROJ	Mini Project - IV	-	-	2	2	25	25	-	-	50	1
Total			**17**	**-**	**10**	**27**	**170**	**170**	**150**	**310**	**800**	21

Elective –II:

A**.** Industrial Automation, PLC and SCADA
B. Python Programming
C. Power System Operation and Control
D. Energy Audit and Conservation

Open Elective-I: Electrical Measurements

Power Electronics

EE501	PCC	Power Electronics	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electronics Engineering, Analog and Digital Electronics

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

CO1	To explain characteristics of different power electronic switching devices
CO2	To explain working principle of rectifiers for different types of loads
CO3	To explain working principle of choppers
CO4	To explain working principle of voltage source and current source inverters in different modes
CO5	To explain working principle of AC voltage controllers
CO6	To explain working principle of cycloconverters

Course Contents:

Unit 1: Power Semiconductor Devices Types of power converters, Power semiconductor switches and their V-I characteristics-diodes, SCR, TRIAC, DIAC, BJT, power MOSFET, IGBT, Thyristor ratings and protection, Firing circuits for Thyristors, Methods of SCR commutation, Manufacturers of Semiconductor devices	[7]
Unit 2: Phase Controlled Rectifiers Principles of single-phase fully-controlled converter with R, RL, and RLE load, Principles of single-phase half-controlled converter with RL and RLE load, Principles of three-phase fully controlled converter operation with RLE load, Effect of source	[9]

impedances on performance of convertors, Numerical based on output voltage and current calculations, Dual converters	
Unit 3: Choppers Basic principles of step-down and step-up operation, Chopper classification, Control techniques, Study of Buck, Boost and Buck-Boost regulators, Fly back converters, Numerical on step-down and step-up chopper	[7]
Unit 4: Inverters Principle of operation, Performance parameters, Single phase full bridge VSI, Single phase current source inverter with ideal switches and load commutated CSI, 3-phase VSI - 120 and 180 degrees mode of operation, Voltage control of single phase inverters – single pulse width modulation, multiple pulse width modulation, sinusoidal pulse width modulation, Introduction to Multilevel Converter	[8]
Unit 5: A.C. Voltage Controllers Principle of operation of single phase voltage controllers for R, R-L loads, Derivation of output voltage, Introduction of two stage AC voltage regulator	[6]
Unit 6: Cycloconverters Principle of operation of single phase and three phase cycloconverters, Output voltage equation for cycloconverter, Load commutated cycloconverter	[6]
Textbooks: 1. Dr. P. S. Bimbhra, "Power Electronics", Khanna Publishers, Delhi 2. M H Rashid, "Power Electronics – circuits, devices and applications", 3rd edition, Pearson Education.	
Reference Books: 1. Power Electronics, M.D. Singh & K.B. Khanchandani, TMH 2. Ned Mohan, T. Undeland & W. Robbins, "Power Electronics Converters applications 3. and design" 2nd edition, John Willey & sons, Singapore 4. P.C. Sen, "Modern Power Electronics", S Chand & Co New Delhi 5. U. R. Moorthi, "Power Electronics, Devices, Circuits & Industrial Applications" , Oxford University Press, New Delhi, 2005	

AC Machines

EE502	PCC	AC Machines	4-0-0	4 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 4 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electrical Engineering

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

CO1	Analyze performance of induction motor.
CO2	Design various parts of Three Phase Induction Motor.
CO3	Analyze performance of Three phase alternator.
CO4	Design various parts of Alternators.
CO5	Analyze performance Synchronous Motor.
CO6	Design of Electrical Apparatus.

Course Contents:

Unit l: Three phase Induction Motor:- Generation of flux and mmf waves, development of circuit model, Rotor quantities (emf ,current, frequency, pf), torque equation, starting torque, running torque, Factors affecting torque, condition of maximum torque ,torque slip characteristics (numerical on torque equation), power flow diagram with numerical, cogging and crawling, deep bar/ double cage rotor, induction generator	[7]
Unit 2: Design of 3 Phase Induction Motor :- Main Dimension, Shapes of Stator Slots, No. of Stator Slots, Area of stator Slots, Length of Mean Turn, Stator Teeth, Stator Core, Rotor Design, length of air gap, Relation For Calculations of Length of air gap, No. of Rotor Slots, Design of rotor bars & Slots, (Rotor Bar Currents, Area of Rotor Bar, shapes & Size of Rotor Slots, Rotor Slot Insulations), Design of End Rings. Single and double layer single phase AC winding with integral and fractional slots, Numerical on winding.	[7]

Unit 3: Three phase alternator:- Construction, principle of operation of three phase alternator, EMF equation, Concept of synchronous reactance and synchronous impedance, armature reaction (at unity, lagging zero and leading zero power factor) , alternator on load (resistive, inductive & capacitive). Numerical on voltage regulation.	[7]
Unit 4: Design of Alternators:- Output equation, determination of no. of poles, winding and insulation. Main dimensions stator and rotor core, slots, conductors, armature winding, calculation of reactance & armature reaction. Numerical on Output equation.	[7]
Unit 5: Synchronous Motor:- Construction, types, principle of operation of synchronous motor, armature reaction, determination of synchronous reactance, Phasor Diagram of three phase synchronous motor at Unity, lagging and leading power factor, Effect of excitation on power factor and armature current, power angle characteristics, Applications of synchronous Motor.	[7]
Unit 6: Design of Electrical Apparatus:- Detailed design of heating coils, Design of Electrical Devices Field coils, Chokes and lifting magnets.	[6]

Textbooks:

1. Theory and Performance and Design of A.C. Machines, M.G. Say, ELBS London, 3rd Edition.
2. Electrical Machines, I. J. Nagrath, D. P. Kothari, Tata Mc-Graw-Hill publication IV
3. Edition.
4. Design of Electrical Machines, K. G. Upadhyay, New age publication.
5. Principles of Electrical Machine Design, R. K. Agarwal, S. K. Katariya and sons.
6. Design of Transformers, Indrajit Dasgupta, TATA Mc-Graw Hill Publication.

Reference books:

1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai & Sons
2. A Text Book of Electrical Engineering Drawings, K.L. Narang, Satya Prakashan, New Delhi.
3. Electrical Machine Design Data Book, A Shanmugasundaram, G. Gangadharan, R. Palani, 3rd Edition, Wiely Eastern Ltd., New Delhi.
4. A Course in Electrical Machine Design, A.K.Sawhney, Dhanpat Rai & sons New Delhi.

Microprocessor & Microcontroller

EE503	PCC	Microprocessor & Microcontroller	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Analog and Digital Electronics

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

CO1	Explain the architecture of 8085 Microprocessor and its programming
CO2	Analyze the 8085 interfacing technique
CO3	Explain the architecture of 8051 Microcontroller and its programming
CO4	Analyze the functions of 8051 Microcontroller
CO5	Explain the architecture of Arduino Microcontroller and its features
CO6	Develop the Arduino microcontroller programming

Course Contents:

Unit 1: Architecture of 8085 Microprocessor and Programming: Introduction: Number system, Architecture of 8085 microprocessor - Registers, ALU, Bus system, Instruction formats, Addressing modes, Interrupts, Instruction set, Basic arithmetic and logical programs.	[8]
Unit 2: Interfacing: **Memory Interfacing:** Interface requirements, Address space partitioning, Buffering of Buses, 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	[7]

and interrupt driven data transfer schemes, Applications of microprocessors.	
Unit 3: 8051 Microcontroller: Architecture of 8051 microcontroller and pin diagram, Memory Organization, Addressing modes, Instruction set, basic arithmetic and logical programs	[7]
Unit 4: 8051 Peripheral Functions: 8051 interrupts, Timer and serial functions, parallel port features, Interfacing of 8051 - LCD interfacing and ADC interfacing.	[7]
Unit 5: Introduction to Arduino microcontroller Introduction to Arduino, Types – Uno, Mega, Micro. Arduino Uno - Pin configuration and architecture, features, digital and analog ports, I/O Functions, Sensors, serial and parallel communication.	[6]
Unit 6: Arduino microcontroller programming and Interfacing Introduction to embedded C in Arduino platform, Basic Arithmetic and logical programs. Interfacing- Display interfacing, GSM/GPRS Arduino Interfacing, ADC interfacing	[6]

Textbooks:

1. Goankar, R.S., "Microprocessor Architecture Programming and Applications with the 8085/8080A", 3rd Edition, Penram International Publishing House, 1997.
2. M.A. Mazidi, R.D. McKinlay, J.G. Mazidi, "The 8051 Microcontroller: A Systems Approach", Pearson, 2013.
3. Richard Blum, "Arduino Programming", Sams Publishing, 1st Edition 2014.

Reference Books:

1. Singh. I.P., "Microprocessor Systems", Module 9: Microcontrollers and their Applications", IMPACT Learning Material Series IIT, New Delhi, 1997.
2. Douglas, V.Hall. "Microprocessor and Interfacing Programming and Hardware", 2nd Edition, McGraw Hill Inc., 1992.
3. Kenneth, L.Short., "Microprocessors and Programmed Logic", Prentice Hall of India, 2nd Edition, 1987

Elective-IIA: Industrial Automation, PLC and SCADA

EE504A	PEC	Industrial Automation, PLC and SCADA	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Electrical and Electronic Measurements and Instrumentation

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

CO1	Explain role of automation in industry and different ways of industrial automation
CO2	Explain role of PLC in industrial automation.
CO3	Explain various operations of PLC
CO4	Develop programs using ladder programming for PLC
CO5	Explain architecture of SCADA systems
CO6	Explain operation of elements of SCADA

Course Contents:

Unit 1: Industrial Automation Process Definition of process, Meaning of Automation and Control Role of automation in process Industry, Architecture of Industrial Automation Network. Types of Automation systems, Role of information in process automation, Process automation with smart intelligent instruments, Challenges of process automation, industry 1.0 to industry 4.0.	[6]
Unit 2: Programmable Logic Controller (PLC) Invention of PLC, Sustainability of PLC, Definition of PLC, Classification of PLC's, Role of PLC in Automation, Feature of a PLC, I/O devices of PLC, PLC programming devices, PLC Selection criteria, major PLC vendors and their products, Top five PLC Vendors.	[6]

Unit 3: Design and operation of PLC Design and operation of PLC, Architecture of PLC, Central Control Unit of PLC, Functional modes of PLC, PLC Program structure and execution, Programming devices for PLC, Selecting I/O devices for PLC -Sourcing and Sinking, Programming Languages, IEC611g Languages, IEC61131-structuring resource, Ladder diagram.	[5]
Unit 4: PLC Programming Variables and Data types, Register, Timer, On delay timer, off delay timer, pulse timer, Counter, Up counter, Down counter, Arithmetic functions-Addition(ADD), Subtraction(SUB), Division(DIV), Square root(SQRT), Data handling functions-MOVE(MV), Block Transfer(BT), TABLE AND REGISTER MOVE, Matrix function, Analog Signal handling, PID control with PLC, Digital bit function, Shift register function, Sequence function.(simple illustrative programs are expected)	[8]
Unit 5: SCADA System Introduction, Different SCADA System Topologies. SCADA Architectures-First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture, Functions of SCADA- Data acquisition, Data communication-Message Based polling mode, standard polling mode, polled report by exception, data presentation control.	[6]
Unit 6: Elements of SCADA Master Terminal Unit (MTU), Remote Terminal Unit (RTU)- RTU Topology, RTU requisites, RTU hardware and functionality, RTU software functions, Operation of RTU, Field data devices and interfacing- Human Machine Interface(HMI), Human Computer Interface (HCI), PLC based process control system. Alarm handling. Application areas of SCADA.	[5]
Textbooks: 1. Industrial Automation Technologies by Chanchal Dey Sunit Kumar Sen, CRC Press.	
Reference Books: 1. Industrial Automation Hand Book by Frank. Lamb Tata Mcgraw Hill India 2. Introduction to Industrial Automation by Stamatios Manesis George Nikolakopoulos CRC Press. 3. Programmable Logic Controllers by John Webb, Ronald A. Reis. PHI.	

Elective-IIB: Python Programming

EE504B	PEC	Python Programming	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: --

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

CO1	Describe the numbers, math functions, strings, tuples and lists in Python
CO2	Express different decision-making statements and Functions.
CO3	Interpret object-oriented programming in Python.
CO4	Demonstrate and summarize different file handling operations.

Course Contents:

Unit 1: Problem Solving Strategies Problem Analysis, Algorithms, Flow Charts, Introduction to Python : Introduction, python overview, getting started with python – installing python interpreter, simple python program, comments, python identifiers, reserved keywords, variables, standard data types, operators, statements and expressions, string operations, Boolean expressions, control statement, iteration, input from keyboard	[6]
Unit 2: Functions Functions: Built-in-functions, composition of functions, user defined functions, parameters and arguments, functions calls, the return statement, python recursive functions, the anonymous functions, writing python scripts.	[6]
Unit 3: Strings and Lists Strings- compound data type, len function, string slices, strings are immutable, strings	[6]

traversal, escape characters, string formatting operator, string formatting functions and Lists value and accessing elements, lists are mutable, built-in list operators, built-in methods.	
Unit 4: Tuples and Dictionaries Tuples-creating tuples, accessing values in tuples, tuples are immutable, tuple assignment, tuples as return value, variable-length argument tuples, basic tuples operations, built-in tuple functions and Dictionaries- creating a dictionary, accessing values in a dictionary, updating dictionary, deleting elements from dictionary, properties of dictionary keys, operations in dictionary, built-in dictionary methods.	[6]
Unit 5: Files and Exceptions Files- Text files, directories, exceptions- built-in exceptions, handling exceptions, exceptions with arguments, user defined exceptions.	[6]
Unit 6: Classes and Objects Overview of OOP, class definition, creating objects, objects as arguments, objects as written/return values, built-in class attributes, inheritance, method overriding, data encapsulation, data hiding. Graphical User Interface: Tkinter- pack(), grid() and place() methods. Widgets - button, canvas, check button, entry, frame, label, list box, menu button, message, scale, scrollbar, text.	[6]

Textbooks:

1. Introduction to Computing and Problem Solving Using Python, E Balagurusamy McGraw Hill Education Pvt. Ltd.
2. Programming and Problem Solving with Python, Kamthane, McGraw Hill Education Pvt. Ltd.
3. Python: The Complete Reference, Brown, McGraw Hill Education Pvt. Ltd

Reference Books:

1. "Python Programming: An introduction to Computer Science", John Zelle, Franklin, Beedle and Associates, Inc.
2. "Learning Python" , Mark Lutz, O'reilly, 5e
3. "Programming in Python",R. Pooja Sharma, BPB Publications

Elective-IIC: Power System Operation and Control

EE504C	PEC	Power System Operation and Control	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Power Systems

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

CO1	Explain Power System Operation.
CO2	Explain Real Power and Frequency Control.
CO3	Explain Reactive Power and Voltage Control.
CO4	Determine Economic Operation of Power System.
CO5	Explain Computer Control of Power System.
CO6	Explain Power System Security.

Course Contents:

Unit – 1: Power System Operation National and Regional load dispatch centers, requirements power system, necessity of voltage and frequency regulation, system load variation, load dispatching, load forecasting, sped governing mechanisms and modeling, sped load characteristics – regulation of two generators in parallel.	[6]
Unit – 2: Real power and frequency control Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases , LFC of two area system, block diagram representation of two area system tie line modeling , static and dynamic analysis of load , tie line with frequency bias control , ,integration of economic dispatch control with LFC	[6]

Unit-3: Reactive Power and Voltage Control Generation and absorption of reactive power, Automatic Voltage Regulator (AVR) , block diagram representation of AVR, brushless AC excitation system , stability compensation, concept of blackout in power system, methods of reactive power control-tap changing transformer, SVC (TCR+TSC) and STATCOM.	[6]
UNIT 4: Economic Operation of Power System concept of economic dispatch problem, input and output characteristics of thermal plant, incremental cost curve, optimal operation of thermal units without and with transmission loses (no derivation of transmission los coefficients), numerical treatment on economic dispatch statement of unit commitment (UC) problem, constraints on UC problem, solution of UC problem using priority list, special aspects of short term and long term hydrothermal problems.	[8]
UNIT 5: Computer Control of Power Systems Need and importance of computer control in power systems, Phasor Measurement Unit (PMU) for system monitoring, data acquisition and controls in power system, SCADA and EMS functions.	[8]
UNIT 6: Power System Security Power System State Classification, factors affecting power system security, Power system Security, security assessment- system monitoring, Contingency Analysis, security control	[6]

Textbooks:

1. Modern Power System Analysis – D. P. Kothari, I. J. Nagrath, TMH Publication
2. Power System Analysis – Hadi Saadat, Mc-GrawHill series publication

Reference Books:

1. An introduction to Reactive Power Control and Voltage Stability in Power Transmission Systems –A Chakrabarti, D P Kothari, A K Mukhopadhyay, Abhinandan De, PHI
2. Electrical Power Systems – P. Venkatesh, B.V. Manikandan, S.C. Raja, A. Srinivasan, PHI
3. Power System Analysis – J. J. Grainger, W.D. Stevenson, Mc-GrawHill series publication
4. Power Generation Operation and Control – A. J. Wood, B. F. Woolenberg, John Wiley and Sons
5. Advanced Power System Analysis and Dynamics – L. P. Singh, New Age International
6. Operation of Restructured Power Systems – K. Bhattacharya, H. J. Bollen, J. E. Daalder, Kluwer academic publishers

Elective-IID: Energy Audit & Conservation

EE504D	PEC	Energy Audit & Conservation	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Physics, Basic Electrical Engineering

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

CO1	Interpret the basic terminologies associated with energy audit and conservation
CO2	Explain process involved in the energy audit
CO3	Explain the concepts of thermal and mechanical systems which associated in the process of the energy audit
CO4	Explain the concepts of electrical systems which associated in the process of the energy audit
CO5	Explain the terminologies of Financial Management associated in the process of energy audit
CO6	Select the appropriate method for planning and monitoring of energy conservation projects

Course Contents:

Unit 1: Global Environmental Concerns: Global Environmental Issues, United Nations Framework Convention on Climate, Change (UNFCC), Kyoto Protocol, Conference of Parties (COP), Clean Development, Mechanism (CDM), Prototype Carbon Fund (PCF), Sustainable Development.	[5]
Unit 2: Energy Management & Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy	[6]

requirements, Fuel and energy substitution, Energy audit instruments.	
Unit 3: Thermal & Mechanical Systems: Boilers: Types, Combustion in boilers, Performances evaluation- Direct Method & Indirect Method of Boiler Efficiency, Energy conservation opportunities; Pumps and Pumping System: Types, Performance evaluation, Energy conservation opportunities; Cooling Tower: Types and performance evaluation, Energy saving opportunities; Cogeneration: Definition, Need, Application, Advantages, Classification, Saving potentials.	[8]
Unit 4: Electrical Systems: Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefit, Selection and location of capacitors, Performance assessment of PF capacitors, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls	[7]
Unit 5: Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques-Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs.	[6]
Unit 6: Case Studies Planning, Implementation & monitoring of energy conservation project, Case studies on various Industrial Sectors and Commercial Establishments.	[4]
Textbooks: 1. "Industrial Energy Conservation", Charles M Gottschalk, John Willey and Sons. 2. "Energy Management Handbook", Paul O Callagham, Tata Mc Graw Hill 3. "Energy Technology", S. Rao and B. Parulekar, Khanna Publishers	
Reference Books: 1. "Energy Management Handbook", Wayne C. Turner	

Power Electronics Laboratory

EE505	PCC	Power Electronics laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs /week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic Electrical Engineering.

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

CO1	Examine the firing circuit & characteristics of power semi converter devices
CO2	Analyze the ac to dc converter circuit
CO3	Analyze the dc to ac converter
CO4	Analyze the operation of dc to dc & ac to ac converter

List of Experiment [Minimum of 8 Mandatory]

1. To obtain V-I characteristics of SCR & determine latching current, holding current forward breakdown voltage.
2. To obtain V-I characteristics of IGBT (out characteristics & transfer characteristics)
3. To study firing circuit of SCR.
4. To determine output voltage current of single phase half wave controlled converter for R, RL & RLE Load.
5. To determine output voltage current of symmetrical & asymmetrical semi controlled converter.
6. To control the intensity of lamp by using ac voltage controller by using TRIAC & DIAC.
7. To study MOSFET/IGBT based single phase bridge inverter.
8. To study single phase cycloconverter.
9. To study DC Jones chopper with R & RL Loads.
10. To study single phase dual converter with RL Load.

11. To simulate three phase fully controlled rectifier for R,RL & RLE & Plot the waveform
12. To simulate three phase inverter.
13. To conduct survey/field visit to study applications of rectifier, inverter, chopper & ac voltage controller.

AC Machines Laboratory

EE506	PCC	AC Machines laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs /week	CA1: 15 Marks CA2: 15 Marks End Semester Evaluation: 20 Marks

Pre-Requisites: Basic Electrical Engineering.

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

CO1	Design 3-ph Induction motor with Determination of its performance characteristics
CO2	Design Alternator with Determination of its performance characteristics
CO3	Test Synchronous Motor

Course Contents:

List of Experiment [Minimum of 8 Mandatory]

1. Determination of equivalent circuit parameters of 3 Ph SCIM by conducting No Load & Blocked Rotor Test.
2. Study of starters and Speed control methods for 3 Ph induction motors.
3. Determination of efficiency & speed regulation of 3 phase Squirrel cage induction motor by direct loading method.
4. Determination of efficiency & speed regulation of 3 phase slip ring induction motor by direct loading method.
5. Determination of efficiency of Alternator by direct loading method
6. Determination of Voltage regulation of an alternator by EMF method
7. Determination of Voltage regulation of an alternator by MMF method
8. Determination of Voltage regulation of an alternator by ZPF method
9. Determination of V and Inverted V curves of a synchronous motor
10. To design 3-ph Induction Motor by using software tools
11. To design 3-ph Alternator by using software tools
12. To study design of 3-ph Induction Motor by field visit

Microprocessor & Microcontroller Laboratory

EE507	PCC	Microprocessor & Microcontroller Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs /week	CA1: 15 Marks CA2: 15 Marks End Semester Evaluation: 20 Marks

Pre-Requisites: Analog and Digital Electronics.

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

CO1	Develop 8085 microprocessor arithmetic and logical programs
CO2	Develop 8051 microcontroller programs
CO3	Build Arduino Microcontroller programs for basic applications.

Course Contents:

List of Experiments [Minimum of 8 Mandatory]

1. Assembly language program's for 8085 arithmetic operations
2. Assembly language program's for 8085 logical operations
3. Rolling display using 8051 microcontroller
4. led flashing using 8051 microcontroller
5. Speed and direction control of dc motor using 8051 microcontroller
6. Speed and direction of stepper motor using 8051 microcontroller
7. Automatic Street light control using 8051 microcontroller
8. Seven segment display using 8051 microcontroller
9. IR obstacle sensor using Arduino microcontroller
10. Relay control using Arduino microcontroller
11. Temperature controlled fan using Arduino microcontroller

Aptitude Skills-III

HMS05	HSMC	Aptitude Skills-III	1-0-0	1 Credit

Teaching Scheme	Evaluation Scheme
Lecture: 1hr/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Communication Skills, Aptitude Skills I, II

Group A

Aptitude (12Hrs) (Compulsory)

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

CO1	Solve the problems on system of equation
CO2	Solve the problems on seating arrangement
CO3	Solve the logical reasoning problems
CO4	Solve the critical analysis problems
CO5	Solve the problems of Data interpretation
CO6	Solve the problems of permutations and Combinations

Course Contents:

Unit 1: System of equations Quadratic equations, Surds and indices, solution of equations, Ages.	[2]
Unit 2: Seating Arrangements Linear seating Arrangement, Circular seating arrangement, Complex seating arrangement	[2]
Unit 3: Logical Reasoning Numerical based on sense of direction, Blood relations, Odd man Out	[2]
Unit 4: Critical analysis Clocks and Calendar based problems, Cryptarithmetic**,** heights and distances	[2]
Unit 5: Data Interpretation	[2]

Table form, Bar form, Line for Pi chart form	
Unit 6:Permutations and Combinations Numbers and Words Repetition allowed and Repetition not allowed	[2]
Textbooks: 1. RS Aggarwal "A Modern Approach to Verbal & Non-Verbal Reasoning", S. Chand Publisher; 2016 edition 2. RS Aggarwal, " Quantitative Aptitude for Competitive Evaluations", S. Chand Publisher; 2016 edition 3. Raymond Murphy "Essential English Grammar with Answers", Murphy	
Reference Books: 1. Rao N,D, V,Prasada, Wren & Martin High School English Grammar and Composition Book, S Chand Publishing, 2017 2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press; Second edition 3. RS Aggarwal, Objective General English, S. Chand Publisher; 2016 edition	

Group B

Verbal Ability (12Hrs) (Compulsory)

Pre-Requisites: Communication Skills Aptitude Skills I, II

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

CO1	Understand basic concepts of sentences and its structure
CO2	Understand the tenses and its use in daily life
CO3	Explain basic uses of speeches and voices in day to day life
CO4	Understand the use of modal verbs in sentence construction
CO5	Summarize various Phrases, Idioms and Proverbs
CO6	Summarize different words used in daily life

Course Contents:

Unit 1: Parts of Speech, Word Family (Using the same word as different Parts of Speech), Punctuation.	[2]
Unit 2: Analogy, Letter Writing (Formal), E-Mail Writing, CV Writing	[2]
Unit 3: Reading Comprehension, Paragraph Jumbles.	[2]
Unit 4: Spotting Errors (in different parts of sentence), Subject-Verb Agreement, Sentence Correction, Sentence Completion.	[2]
Unit 5: One Word Substitution, Narrating Events/Reports, Summary/Precise Writing	[2]
Unit 6: Dialogue Writing, Group Discussion, Interview Skills (Using formal notations & gestures etc.)	[2]
Textbooks: 1. Raymond Murphy, Essential English Grammar with Answers, Murphy 2. Objective General English by R.S. Aggarwal, S Chand Publishing; Revised edition	
Reference Books: 1. Rao N,D, V,Prasada, Wren & Martin High School English Grammar and Composition Book, S Chand Publishing, 2017 2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press, Second edition	

Language Skills-III

HMS06	HSMC	Language Skills-III	0-0-2	Audit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Language Skills I, II

Languages (Any One)

Python (Technical Language) (24Hrs)

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

CO1	Explain essentials and fundamentals of Python Programming
CO2	Illustrate data types and variables.
CO3	Illustrate Operators and Expressions.
CO4	Make a use of Decision making and Looping statements.

Course Contents:

Unit 1: Introduction What is Python, what can python do, why python, how to use Python, Python indentation, pythoncomments, basic syntax of program, first program of Python.	[6]
Unit 2: Variable and data types Creating variable ,casting, variable name ,global variable, local variable, built in data-types, string, constructor, function of data-type , type conversion	[6]
Unit 3: Operators in Python Unary Operator, Binary operator (arithmetic operator, logical operator ,assignment operator, membership operator ,identity operator, bitwise operator) , ternary operator	[6]
Unit 4: Statements and loops Input & Output Statements ,Conditional Statements ,Simple if Statement ,If-else statement , Else-ifLadder, Nested if statement, ,while loop ,for loop ,break ,continue ,pass statements	[6]

Mini Project- IV

PRJ04	PROJ	Mini Project- IV	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2hr/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites:

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

CO1	Select the appropriate method for solving the problem.
CO2	Make use of various engineering techniques and tools to give a solution.
CO3	Justify the method/tools used to develop the solution.
CO4	Demonstrate tangible solutions to the problem
CO5	Describe the solution with the help of a project report and presentation.

About Mini Project- IV

The project is a part of addressing societal and industrial needs. Mini Project is one of the platforms that students will use to solve real-world challenges. This course focuses on the selection of methods/engineering tools/analytical techniques for problem-solving. Through this course, students gain a thorough understanding of engineering basics and ideas, gain practical experience, have the opportunity to display their skills and learn about teamwork, financial management, communication skills, and responsibility.

Guidelines

1. Every student shall undertake the Mini Project-IV activity for semester V.
2. Minimum three and maximum of five students should work together in Mini Project-IV.
3. The students have to work on different approaches and finalize the best methodology to solve the problem in consultation with the project guide.
4. The students should use different tools /Techniques for the development of the solution to the problem.
5. While developing solutions, the student can take care of effective use of resources, follow ethical practices, finance management,
6. The solution should be optimal, affordable, user-friendly and environment friendly.

7. Critically analysis and testing of the solution provided.
8. By using IPR, students should reserve their rights of innovations as well as communicate new findings to society with the help of research papers.

The committee of senior faculty members and a project guide will be appointed to monitor the progress and continuous evaluation of each project. The assessment shall be done jointly by the guide and committee members.

Teaching and Evaluation Scheme for TY B. Tech

Department of Electrical Engineering

Semester: VI

Department: Electrical Engineering **Rev:** Course Structure/00/2021-22

Class: T.Y. B. Tech. **Semester:** VI

Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs.	CA1	CA2	MSE	ESE	Total	
EE601	PCC	Linear Integrated Circuits	3	--	--	3	10	10	30	50	100	3
EE602	PCC	Electric Drives	3	--	--	3	10	10	30	50	100	3
EE603	PEC	Elective-III	3	--	--	3	10	10	30	50	100	3
OE614	OEC	Open Elective-II	3	--	--	3	10	10	30	50	100	3
EE604	PCC	Switchgear and Protection	3	--	--	3	10	10	30	50	100	3
EE605	PCC	Switchgear and Protection Laboratory	--	--	2	2	15	15	--	20	50	1
EE606	PCC	Linear Integrated Circuits Laboratory	--	--	2	2	15	15	--	20	50	1
EE607	PCC	Electric Drives Laboratory	--	--	2	2	15	15	--	20	50	1
PRJ05	PROJ	Mega Project Phase –I (Seminar)	--	--	4	4	25	25	--	50	100	2
IFT02	PROJ	Industrial Training/ Field Training	--	--	--	--	25	25	--	--	50	Audit
HMS07	HSMC	Aptitude Skills-IV	1	--	--	1	25	25	--	--	50	Audit
HMS08	HSMC	Language Skills-IV	--	--	2	2	25	25	--	--	50	1
Total			**16**	**--**	**12**	**28**	**195**	**195**	**150**	**360**	**900**	**21**

Elective-III: A. Neural Networks and Fuzzy Logic

B. IOT Fundamentals

C. Deregulated Power Systems

D. E-Mobility

Open Elective-II: Energy Audit & Conservation

Linear Integrated Circuits

EE601	PCC	Linear Integrated Circuits	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Analog and Digital Electronics, Circuit Analysis

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

CO1	Explain various parameters of OP-AMP
CO2	Design Linear Circuits using OP-AMP
CO3	Design Filter circuits using OP-AMP
CO4	Design Analog to Digital and Digital to Analog converters.
CO5	Design waveform generator using OP-AMP
CO6	Explain the working of special function IC's.

Course Contents:

Unit-I Basics of OP-AMP: Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, Basic information about op-amps – Ideal Operational Amplifier – General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate.	[7]
Unit II Applications of OP-AMP: Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator.	[6]
Unit III Filter Circuits Using OP-AMP: Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass filters.	[6]

Unit IV Analog To Digital And Digital To Analog Converters: Analog and Digital Data Conversions, D/A converter – specifications – weighted resistor type, R-2 Ladder type, Voltage Mode and Current-Mode R – 2R Ladder types – switches for D/A converters high speed sample-and-hold circuits, A/D Converters – specifications – Flash type – Successive Approximation type	[8]
Unit V Waveform Generators: Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555,	[6]
Unit VI Special Function IC's: IC Voltage regulators – Three terminal fixed and adjustable voltage regulators – IC 723 general purpose regulator – Monolithic switching regulator, Low Drop–Out (LDO) Regulators – Switched capacitor filter IC MF10, Audio Power amplifier.	[7]
Textbooks: 1. Operational Amplifier and Linear Integrated Circuits by David Bell, TMH 2. OP-AMPS and Linear Integrated Circuit Technology by Ramakant A. Gaikwad, PHI	
Reference Books: 1. Linear Integrated Circuits by Roy Choudhary. 2. Linear Integrated Circuits and Applications by R. P. Punagin, Willey 3. Linear Integrated Circuits by K. Salivahan, TMH 4. Operational Amplifier with linear Integrated Circuits by William D Stanley, Pearson	

Electrical Drives

EE602	PCC	Electrical Drives	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Power Electronics, Electrical Machines

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

CO1	Explain the basic characteristics and fundamental equations of AC & DC motors.
CO2	Analyze control techniques of DC motor drives.
CO3	Analyze control techniques of Induction motor drives.
CO4	Analyze control techniques of Synchronous motor Drives.
CO5	Analyze control techniques of special purpose motor dives.
CO6	Select motors for different applications.

Course Contents:

Unit I Introduction: Dynamics of Electric Drives, Fundamental torque equation, types of loading, components of load torque, Steady State Stability, Load equalization. Closed loop control of drives, Selection of motor power rating.	[7]
Unit II DC Motor Drives: Braking and Speed Control, Ward Leonard Drives, Phase controlled converter fed DC drives, Dual-converter control of DC drives, Supply harmonics, Power factor and ripple in motor current, Chopper Control of DC drives.	[7]
Unit III Induction Motor Drives: Control of Induction Motor Fed from VSI and CSI, Operation of Induction Motor with Unbalanced Source Voltages and single phasing, Analysis of Induction Motor from Non-sinusoidal Voltage Supply; Slip power recovery-Static Scherbius and Cramer drives,	[8]

Linear Induction Motors. **Variable Frequency Drives(VFD):**Basics schematic of VFDs, Design of VFD drives, Benefits of VFDs, Industrial applications of VFDs.	
Unit IV Synchronous Motor Drives: Starting, Pull in and braking of synchronous motors, Speed control– variable frequency control, cycloconverters control.	[7]
Unit V Special Purpose Motor Drives: Variable Reluctance, Permanent Magnet, Important Features of Stepper Motors, Torque Versus Stepping rate Characteristics, Drive Circuits for Stepper Motor. Brushless DC Motor drives, Servo motor drives.	[7]
Unit VI Industrial Drives Applications: **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 and compressor drive. **Sugar Mill**: Requirements for various drive motors, selection of motors for various processes.	[8]

Textbooks:

1. G. K. Dubey : Fundamentals of Electrical Drives, 2nd Edition, Alpha Science International, 2001.
2. R. Krishnan: Electric Motor drives - Modelling, Analysis and Control, PHI India Ltd., 2002.
3. B.K. Bose, "Modern Power Electronics & AC drives", Prentice Hall Publisher, 2002
4. T. Kenjo, Stepping Motors and their Microprocessor Control, England, Clarendon Oxford Press, 1985
5. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, New Delhi, Prentice, Hall of India, 2009

Elective-IIIA: Neural Networks and Fuzzy Logic

EE603A	PEC	Neural Networks and Fuzzy Logic	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: ---

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

CO1	Explain basic principles of neuron structure and different algorithm for learning
CO2	Explain the single layer and multilayer perceptrons
CO3	Explain the radial basis function networks
CO4	Illustrate the concept of self-organizing maps
CO5	Explain the fuzzy sets and fuzzy systems
CO6	Interpret the hybrid fuzzy neural networks

Course Contents:

Unit 1: ANN Structure and Learning Processes Biological Neurons, Models of Neurons, Types of Activation functions- Threshold, Piecewise-Linear, Sigmoid, Network Architectures, State-space concepts, Error-correction learning, Memory-based learning, Hebbian learning, Competitive learning.	[8]
Unit 2: Perceptrons Single Layer Perceptrocs: Structure of perceptrons, Least Mean Square Algorithm, Perceptron Convergence Theorem, Bayes Classifier. Multilayer Perceptrons: Structures of Multi-layer Feedforward Networks, Back Propagation Algorithm, Limitations of Back Propagation Algorithm.	[8]

Unit 3: Radial Basis Function Networks Pattern Separability, Interpolation, Regularization Theory, Regularization Network, Radial Basis Function (RBF) Network, Comparison of RBF Network and Multilayer Perceptron.	[6]
Unit 4: Self Organizing Maps Two Basic Features of Mapping Models, Self Organizing Map, Properties of Feature Map, Learning Vector Quantization, Contextual Maps.	[6]
Unit 5: Fuzzy Sets and Fuzzy Systems: Fuzzy Sets, Membership Functions, Geometry of Fuzzy Sets, Simple Operations on Fuzzy Sets, Rule Composition and Defuzzification.	[6]
Unit 6: Hybrid Fuzzy Neural Networks Introduction, Hybrid System, Fuzzy Logic in Learning Algorithm, Fuzzy Neurons, Neural Network as Pre-processor or Post-processor, Neural Networks as Tuner of Fuzzy Logic Systems, Advantages and Drawbacks of Neurofuzzy Systems, Adaptive Neuro-Fuzzy Inference System (ANFIS)	[6
Textbooks: 1. "Neural Networks: A Classroom Approach", Satish Kumar, Mc Graw Hill. 2. "Fuzzy Logic and Neural Networks: Basic Concepts & Applications", Chennakesava R Alavala, New Age International Publishers. 3. "An Introduction to Fuzzy Logic and Fuzzy Sets", James J. Buckley, Esfandiar Eslami, Springer.	
Reference Books: 1. "Neural Networks- A Comprehensive Foundation", Simon Haykin, Pearson Education (US).	

Elective-IIIB: IoT Fundamentals

EE603B	PEC	IoT Fundamentals	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Microprocessor and Microcontrollers

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

CO1	Explain Functional blocks of IoT.
CO2	Infer communication protocols of IoT.
CO3	Develop IoT applications using Arduino.
CO4	Develop IoT applications using Raspberry Pi and Python programming .
CO5	Implement IoT applications and carry out Data handling and analytics.
CO6	Implement IoT solutions in Smart Homes, Smart Cities and Smart Grids etc.

Course Contents:

Unit-1 Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.	[7]
Unit 2 Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT.	[6]
Unit 3 Introduction to Arduino, Working of Arduino, Programming of Arduino, Integration of Sensors and Actuators with Arduino.	[6]
Unit 4 Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi	[6]
Unit 5 Implementation of IoT with Raspberry Pi, Introduction to Software defined Network	[6]

(SDN), SDN for IoT, Data Handling and Analytics,	
Unit 6 Cloud Computing, Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring switching regulator, Low Drop–Out (LDO) Regulators – Switched capacitor filter IC MF10, Audio Power amplifier.	[7]

Textbooks:

1. "The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Make Sensors": Terokarvinen, Kemo, Karvinen and Villey Valtokari, 1st edition, maker media,2014.

Reference Books:

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"
2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"
3. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress.

Elective-IIIC: Deregulated Power System

EE603C	PEC	Deregulated Power System	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Power System

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

CO1	To explain the traditional regulated structure of the electric industry
CO2	To explain the deregulated structure of the electric industry
CO3	To compare regulation and deregulation of electric utilities
CO4	To analyze the wholesale power marketplace
CO5	To analyze power distribution in the deregulated industry
CO6	To explain the deregulation scenario in India

Course Contents:

Unit 1:The Electric Industry and Its Traditional Regulated Structure Electric Utility Functions and Systems - Electric Utility Resources and Organization - Vertical Integration and Monopoly Regulation - Electric Utility Business Frameworks - Government Regulatory Agencies and Commissions	[7]
Unit 2: The Electric Industry Under De-Regulation De-Regulation: Concepts and Evolution, Competition at the Wholesale Generation Level, Independently Operated Regional Transmission Grids, History of the Electric Power Industry: Growth of Electrical Usage - The Growth of Electrical Systems Technology - The Rise of the Electrical Utility Industry	[7]

Unit 3: Distributed Generation and Storage Distributed Power Generation - Types of Distributed Generators - Distributed Power Storage, Regulation and De-Regulation: Why Were Electric Utilities Regulated? Why De-Regulate?, The Good and Bad of Utility Regulation, Goals for De-Regulation and Effects of De-Regulation	[6]
Unit 4:De-Regulation at the Wholesale Power Level Comparing Four Approaches to Regulation and De-Regulation - Increased Services From and Financial Pressures on LDCs, The Wholesale Power Marketplace – bidding of electricity - Buying Energy vs. Buying Capacity - Wholesale Power Pricing	[7]
Unit 5: Power Grid and Power Distribution in the De-Regulated Industry Generation and Transmission in a De-Regulated Industry - The Wholesale Transmission Level - Transmission Service Pricing- Location Based Pricing, Open Access Distribution - Changes in Distribution Operations - Will Distribution Performance Improve Due to "Competition"	[7]
Unit 6:Retail Sales in a Fully De-Regulated Industry Retail Sales in a Fully De-Regulated Industry: Load Aggregation and Services - RESCO Identities and Industry Position. Deregulation Scenario in India – Indian Electricity Act 2003.	[6]
Textbooks: 1. Understanding Electric Utilities and De-Regulation, H. Lee Willis, Lorrin Philipson, CRC Press, 2nd Edition. 2. Power System Restructuring and Deregulation" John Wiley and Sons, Lei Lee Lai. 3. Power System Economics: Designing markets for electricity - S. Stoft, wiley.	

Elective-IIID: E-Mobility

EE603D	PEC	E-MOBILITY	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electrical Engineering, Electrical Machines, Power Electronics

Course Outcomes:

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

CO1	Illustrate development scenario of EVs and the challenges of EVs.
CO2	Determine the battery parameters used in different batteries with EVs.
CO3	Identify the motors for drive technologies to EVs (BEV, HEV & FCEV).
CO4	Demonstrate the power electronics convertors used for EVs.
CO5	Develop range modeling of an electric vehicles and hybrid electric vehicles.
CO6	Explain Electric Vehicle communication and its applications.

Course Contents:

UNIT-1: Introduction Understand Mobility and its evolutions, Electric Mobility and Environmental Impact Reduction, Economic Analysis, Electric Mobility and Infrastructures: Technical and Economic Dimensions, Electric Mobility Today, Prospective: The Road to Electrification, Overview of EVs and challenges, and Technologies.	[6]
UNIT-2: Batteries **Batteries:** Electrochemical Batteries: Battery Parameters: Battery Capacity, Open Circuit and Terminal Voltages, Charge/Discharge Rate, State of Charge/Discharge, Depth of Discharge, Battery Energy Density and Specific Energy, Battery Power Density and Specific Power, Battery Efficiency, Electrochemical Batteries-Types, Ultracapacitors,	[6]

Ultrahigh-Speed Flywheels, Numerical Problems.	
UNIT-3: Electric and Hybrid Powertrain Technologies Introduction, BEVs, Electric Traction Motors, DC Motors-BLDC Motor, AC Motors-IM, PMSM, SR Motors, Energy sources and Energy carriers, Hybrid Electric Vehicles (HEV), Plug-in Hybrid Electric Vehicles (PHEV), FCEV.	[6]
UNIT-4: Power-Electronic Converters for EV Applications DC/DC Converters: Non-isolated converters: buck, boost, buck-boost, Cuk and charge-pump converters; bi-directional converters; Isolated converters: Half-Bridge, Full-Bridge, Fly-back, Forward and Push-Pull DC/DC converters; DC/AC Converter; Resonant DC-link Inverter.	[7]
Unit-5: Electric Vehicle Modelling Introduction, Tractive Effort, Rolling resistance force, Aerodynamics, Hill climbing force, Acceleration force, Total tractive effort , Modelling Vehicle Acceleration, Acceleration performance parameters, Modelling the acceleration of an electric scooter, Modelling the acceleration of a small car, Range modelling of battery electric vehicles, Range modelling of hybrid electric vehicles.	[7]
UNIT-6: EV Communication Basic Communication, V2V, V2G and its applications in power system - power saving & coordinated charging - layout of power converters for V2G operation, EV configurations: converted & purpose built EVs components of EV system, Wireless Power Transfer: Principle, Stationary WPT, and Dynamic WPT.	[6]

Textbooks:

1. Electric-Vehicle-Technology-Explained, James Larminie and John Lowry, John Wiley & Sons Ltd, 2012.
2. Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Husain, CRC Press, 2010.

Reference Books:

1. Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market Gianfranco Pistoia Consultant, Rome, Italy, Elsevier Publications, 2017.
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz M. Ebrahimi, CRC Press,2018.
3. Hybrid Electric Vehicle System Modelling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.

Switchgear and Protection

EE604	PCC	Switchgear and Protection	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Power System, DC & AC Machines

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

CO1	Explain Circuit Breakers
CO2	Explain Protective relaying used for power system protection
CO3	Explain Digital & Numerical Protection
CO4	Select Protection schemes used for protection of Alternator & Transformer
CO5	Select Protection schemes used for protection of Bus bar, Feeder and Transmission line
CO6	Explain Insulation co-ordination and Over Voltage Protection

Course Contents:

Unit 1: Circuit Interruption Voltage-current characteristics of arc, Principles of circuit interruption, arc phenomenon, A.C. and D. C. circuit breaker, Restricting and recovery voltage. Arc quenching methods, current chopping. 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, HVDC breakers ,H. R. C. fuses & its applications. Construction, working and application of MCB & MCCB	[8]
Unit 2: 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,	[8]

disc and cup type relays, induction relays, Current Setting & Time setting of Overcorrect relay, Time-current characteristics of over current Relays; directional, differential, percentage differential and distance (impedance, reactance, mho) relays, introduction to static relays	
Unit 3: Digital and Numerical Protection: Introduction, Advantages & Disadvantages of Numerical relays, Numerical relaying algorithms techniques Diff. methods of Digital and Numerical protection, Numerical over current protection, Numerical Distance protection, Numerical Differential protection	[6]
Unit 4: Protection of Alternators and Transformers: **Alternators** – Stator fault, stator inter turn protection, Percentage differential protection system, Negative phase sequence [NPS] protection, Excitation Failure & Protection against motoring **Transformer** – Use of Buccholz relay, differential protection, connection of C. T. and calculation of C.T. ratio needed for differential relaying, restricted earth fault protection, Frame leakage protection, Generator-Transformer unit protection	[8]
Unit 5: Protection of Bus bar, Feeder and Transmission line: Bus bar 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.	[7]
Unit 6: Insulation co-ordination and Over Voltage 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, Methods of earthing, Neutral earthing & its types.	[7]
Text/Reference Books: 1. Sunil S. Rao – Switchgear & Protection, Khanna Publications. 2. Power System Protection and Switchgear: B.Ram and B.N.Vishwakarma 3. Patara Basu & Chaudhary – Power System Protection, New Delhi Oxford and IBH. 4. Digital Protection: L.P.Singh	

Switchgear and Protection Laboratory

EE605	PCC	Switchgear and Protection Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 50 Marks

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

CO1	Select over current relay for different applications.
CO2	Explain microprocessor based impedance relay.
CO3	Demonstrate Power system protection equipment's.

Course Contents:

List of Experiments:

1. Experimental study of working of electromechanical over current relay.
2. Experimental study of working of a Directional over current relay.
3. Experimental realization of microprocessor based over current relay.
4. Experimental study of working of microprocessor based impedance relay.
5. Demonstration of LT Switchgear by Industrial visit
6. Demonstration of operation of protections systems for Feeder, Transmission lines by Industrial visits
7. Study of Transformer protection system in substation by Industrial visits.
8. Study of Generator protection system by field visit.
9. Study of Substation equipment's in power system by field system.

Linear Integrated Circuits Laboratory

EE606	PCC	Linear Integrated Circuits Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 50 Marks

Pre-Requisites: Analog and Digital Electronics, Circuit Analysis

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

CO1	Determine, average DC output voltage, ripple factor and Capacitor filter for Rectifier circuits
CO2	Design Analog Circuits using BJT
CO3	Design Linear circuits using OP-AMP(Ic-741)

Course Contents:

List of experiments

1. Study of basic electronic components: color coding of resistors, selection of capacitors, circuit symbols, CRO, Function generator.
2. Design Half wave rectifier with and without filter diode.
3. Design full wave rectifier with and without filter using diode.
4. Determine Input and output characteristic of BJT in CE configuration.
5. Design Darlington emitter follower circuit.
6. Design Voltage follower circuit using IC741.
7. Design inverting amplifier, non- inverting amplifier using ic741.
8. Design Summing amplifier and difference amplifier using IC741.
9. Design Zero crossing detector using IC 741.
10. Design Schmitt trigger using IC741.
11. Design Differentiator using IC741.
12. Design Integrator using IC741

Electrical Drives Laboratory

EE607	PCC	Electrical Drives Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1: 15 Marks CA2: 15 Marks End Semester Exam: 50 Marks

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

CO1	Examine control techniques of AC motor drives.
CO2	Examine control techniques of DC motor drives.
CO3	Examine the performance of AC & DC drives using simulation tool.

Course Contents:

List of Experiments:

1. To study speed control of single phase induction motor using VFD.
2. Speed control of three phase slip-ring motor using static scherbius drive
3. To perform speed control of separately excited dc motor using chopper.
4. Closed loop and open loop speed control of dc motor.
5. To perform Micro controller based speed control of 3 phase induction motor by stator voltage control.
6. Controlled Converter fed stepper motor drive.
7. Simulation of 3 phase induction motor drives.
8. Simulation of DC-DC converter drives.
9. Simulation of Stepper motor drives.

Mega Project Phase-I (Seminar)

PRJ05	PROJ	Mega Project Phase-I (Seminar)	0-0-4	2 Credits

Teaching Scheme	Evaluation Scheme
Practical: 4hr/week	CA1:25 Marks CA2: 25 Marks End Semester Exam: 50 Marks

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

CO1	Identify the problem statement.
CO2	Decide the methodology of proposed work.
CO3	Plan the project work in specified time frame.
CO4	Compose the progress report.

In Mega Project Phase-I, the students are expected to complete 50% of the total project by the end of semester VI. After completion of expected project work, they are expected to submit the consolidated report including the work done in phase-I.

The report shall be comprehensive and presented typed on A4 size sheets and spiral bound. The number of copies to be submitted is number of students plus one. The assessment would be carried out by the panel of examiners (Guide and Project Evaluation Members) for both, term work and oral Evaluations.

Field Training / Industrial Training

IFT02	PROJ	Field Training /Industrial Training	0-0-0	Audit

Teaching Scheme	**Evaluation Scheme:**
Lecture: --	CA1: 25 Marks CA2: 25 Marks

Course Outcomes: Students will be able to

CO1	Examine actual working environment
CO2	Demonstrate the use, interpretation and application of an appropriate engineering standard in a specific situation.
CO3	Identify sources of hazards, and assess/identify appropriate health & safety measures.
CO4	Summarize technical documents and give presentations related to the work completed

Instruction:

Students are expected to undergo industrial training for at least four weeks after III semester. Training session shall be guided and certified by qualified engineer / industry expert. Students should prepare detailed report on activities carried out during training. The evaluation shall be based on report and power point presentation.

Aptitude Skills IV

(Numerical Ability)

HMS07	HSMC	Aptitude Skills- IV	1-0-0	Audit

Teaching Scheme	Evaluation Scheme
Lecture: 1hr/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Aptitude Skills-I/II

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

CO1	Solve the problems on system of equation
CO2	Solve the problems on seating arrangement
CO3	Solve the logical reasoning problems
CO4	Solve the critical analysis problems
CO5	Solve the problems of Data interpretation
CO6	Solve the problems permutations and combinations

Course Contents:

Unit 1: System of equations quadratic equations, Surds and indices, solution of equations, Ages	**[2]**
Unit 2: Seating Arrangements Linear seating Arrangement, Circular seating arrangement, Complex seating arrangement,	**[2]**
Unit 3: Logical Reasoning Numerical based on sense of direction, Blood relations, Odd man Out	**[2]**
Unit 4: Critical analysis Clocks and Calendar based problems, Cryptarithmetic**,** heights and distance**.**	**[2]**
Unit 5: Data Interpretation Table form, Bar form, Line for Pi chart form	**[2]**
Unit 6: Permutation and combination Permutation and combinations	**[2]**

Textbooks:

1. RS Aggarwal, "Quantitative Aptitude for Competitive Evaluations ", S. Chand Publisher; 2016 edition.
2. Quantitative Aptitude for CAT, TMH Publications
3. Vedic Maths Made Easy By Dhaval Bhatiya , Jaico Publication House.

Aptitude Skills-IV

(Verbal Ability)

HMS07	HSMC	Aptitude Skills- IV	1-0-0	Audit

Teaching Scheme	Evaluation Scheme
Lecture: 1hr/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Aptitude Skills-I/II

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

CO1	Solve the questions on ordering of words & Parts of Speech
CO2	Organize contents of Business Communications such as CV, emails and letters.
CO3	Solve the questions based on jumbled paragraphs and reading comprehension.
CO4	Solve the questions on spotting error and sentence correction.
CO5	Summarize proceedings of any event or conference.
CO6	Discuss about current and critical issues during group discussion.

Course Contents:

Unit 1 Parts of Speech, Punctuation Word Family (Using the same word as different Parts of Speech)	[2]
Unit 2 Analogy, Letter Writing (Formal), E-Mail Writing, CV Writing	[2]
Unit 3 Reading Comprehension, Paragraph Jumbles	[2]
Unit 4 Spotting Errors (in different parts of sentence), Subject-Verb Agreement Sentence Correction, Sentence Completion	[2]
Unit 5 One Word Substitution, Narrating Events/Reports, Summary/Precis Writing	[2]
Unit 6 Dialogue writing Group Discussion, Interview Skills (Using formal notations & gestures etc.)	[2]

Textbooks:

1. Raymond Murphy, Essential English Grammar with Answers, Murphy
2. Objective General English by R.S. Aggarwal, S Chand Publishing; Revised edition, 2017.

Reference Books:

1. Rao and ,D,V,Prasada, Wren & Martin High School English Grammar and Composition Book, S Chand Publishing, 2017.
2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press; Second edition

Language Skills - IV

HMS08	HSMC	Language Skills- IV	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Language Skill III

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

CO1	Make use of Function in Python Programming.
CO2	Make use of Python collections.
CO3	Make use of classes and its objects in python.
CO4	Make use of file and it's handling functions.

Course Contents

Unit 1: Function Why we Need Function ,Categories of Functions-Predefined ,User-define , Parts of Functions Arguments, Return Value ,Definition of Function ,Function Calling ,Lambda(Introduction)	**[6]**
Unit 2: Python Collections List, tuple, set, dictionary—-> constructor, check, change , remove item ,list comprehension , Sort ,loop through ,joining	**[6]**
Unit 3: Class and Object OOP Characteristics , creating class ,_init_() method, creating Object , accessing methods andvariables of class ,constructor and destructor ,inheritance ,super(),function overloading	**[6]**
Unit 4: File handling Path & Directory Settings-Absolute, Relative, File Modes (r,w,a,etc) , Open & Close file Reading File using Python--Read Line By Line readline() function,Read Word,Read character(offset),Writing Text File using Python--Write Mode,Append Mode, Exception handling	**[6]**

Textbooks

1. Python Projects, Laura Cassell, Alan Gauld, Wrox publication
2. Murach's Python Programming, Michael Urban, Joel Murach, murach's Publication.
3. Fundamentals of Python (First Program) Cengage MINDTAP Publication 2nd Edition. Author: K.A. Kambert.

Teaching and Evaluation Scheme for Final Year B. Tech

Department of Electrical Engineering

Semester: VII

Department: Electrical Engineering **Rev:** Course Structure/00/2021-22

Class: Final Year B. Tech **Semester:** VII

Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					
			L	T	P	Total Hrs.	CA1	CA2	MSE	ESE	Total	Credits
EE701	PCC	High Voltage Engineering	3	-	-	3	10	10	30	50	100	3
EE702	PCC	Electrical System Design	2		-	2	10	10	30	50	100	2
EE703	PEC	Elective-IV	3	-	-	3	10	10	30	50	100	3
EE704	PEC	Elective-V	3	-	-	3	10	10	30	50	100	3
OE714	OEC	Open Elective-III	3	-	-	3	10	10	30	50	100	3
EE705	PCC	Electrical System Design Laboratory	-	-	2	2	25	25	-	-	50	1
EE706	PCC	High Voltage Engineering Laboratory	-	-	2	2	15	15	-	20	50	1
PRJ06	PROJ	Mega Project Phase -II	-	-	8	8	25	25	-	50	100	4
PRJ07	PROJ	Seminar	-	-	2	2	-	-	-	50	50	1
HMS09	HSMC	Values & Ethics	2	-	-	2	25	25	-	-	50	Audit
Total			**16**	**-**	**14**	**30**	**140**	**140**	**150**	**370**	**800**	**21**

Elective-IV: A. Advanced Control Theory
B. Data Analytics
C. FACTS and HVDC
D. EV Charging Station Design

Elective-V: A. Digital Control Systems
B. Artificial Intelligence and Machine Learning
C. Optimization in Power Systems
D. Grid Integrated Renewable Energy Sources

High Voltage Engineering

EE701	PCC	High Voltage Engineering	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Electrical Engineering Materials, Power Systems

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

CO1	Explain electric Stress with conduction and breakdown in gases.
CO2	Explain conduction and breakdown in liquid dielectrics.
CO3	Explain conduction and breakdown in solid dielectrics.
CO4	Compare different techniques of generation in high voltages and currents.
CO5	Illustrate different techniques employed for measurement of high voltages and currents
CO6	Explain insulation coordination and high voltage testing of electrical equipment's.

Course Contents:

Unit 1: Conduction and Breakdown in gaseous dielectrics: Electric Field Stresses, Finite Difference Method for electric field computation, Gases as insulating media, Collision Processes, Ionization Processes, Townsend Current Growth Equation, Current Growth in the presence of secondary processes, Townsend's Criterion for Breakdown, Time lags for Breakdown. Streamers Theory for breakdown on gases, Paschens Law, Breakdown in non-uniform fields and Corona discharges.	[7]
Unit 2: Conduction and Breakdown in Liquid dielectrics: Liquids as Insulators- Pure and Commercial liquids, Conduction and Breakdown in Commercial liquids- Purification of Transformer fluids, Conduction and Breakdown in Commercial Liquids, Testing of Insulating Oils (Transformer Fluids).	[6]
Unit 3:Conduction and Breakdown in Solid Dielectrics: Breakdown mechanisms in Solid Dielectrics -Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown, Chemical & Electrochemical Deterioration and Breakdown,	[7]

Breakdown due to Treeing and Tracking and Internal discharges, Breakdown in Composite Dielectrics- Properties of Composite Dielectrics, Examples of Solid Dielectrics used in practice.	
Unit 4: Generation of High Voltages and Currents: Generation of High Direct Current Voltages- Half & Full wave rectifiers, Voltage Doublers Circuits, Voltage Multiplier Circuits- Cockcroft Walton voltage multiplier, Generation of High Alternating Voltages- Cascaded Transformer Connection, Resonant Transformers, Generation of High Frequency AC High Voltages, Multistage Impulse Generators- Marx Circuit.	[7]
Unit5: Measurement of High Voltages and Currents- High Ohmic Series Resistance with Micro ammeter, Resistance Potential Divider for DC Voltages, Measurement of High AC and Impulse voltages, Measurement of High-Power frequency alternating currents.	[3]
Unit 6: High Voltage Testing in Electrical Apparatus. Overvoltage's due to Lightning phenomenon & Switching Surges, Principles of Insulation Coordination on High Voltage power systems, Testing of Insulators and Bushings, Testing of Isolators and Circuit Breakers, Testing of Cables, Testing of Transformers and Surge Arresters.	[6]

Textbooks

1. M S Naidu & V Kamaraju, High Voltage Engineering, Mc Graw Hill Publishing Company Ltd.- Sixth Edition.
2. C L Wadhwa, High Voltage Engineering, New Age International Publishers, 3rd Edition.

Reference Books:

1. Subir Ray, An Introduction to High Voltage Engineering, PHI-Second Edition.
2. E Kuffel, W.S.Zaengl, J Kuffel, High Voltage Engineering Fundamentals, Newnes,-Second Edition.
3. Ravindra Arora & Wolfgang Mosch, High Voltage Insulation Engineering, New Age International Publishers

Electrical System Design

EE702	PCC	Electrical System Design	2-0-0	2 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 2 hrs/week	CA1:10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Electrical Engineering, Power System

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

CO1	Design electrical circuits for various applications, considering voltage, current, power factor, and efficiency to meet specified objectives.
CO2	Design Internal electrical system.
CO3	Select Cable Size for single Phase and Three Phase electrical systems.
CO4	Design electrical Lighting system.
CO5	Design earthing system.
CO6	Design Solar PV System

Course Contents:

Unit 1: System planning Role of Acts in Electrical system Design, Electricity Act 2003,General awareness of IS Codes (IS 3043, IS 732, IS 2675, IS 5216-P1- 2, IS 2309), The Indian Electricity Act 1910, The Indian Electricity supply Act 1948, Indian Electricity Rules 1956, The Electricity Regulatory Commission Act 1998, Indian standard codes , Bureau of Energy Efficiency (BEE) and its labeling. National Electric Code (NEC) - scope and safety aspects applicable to low and medium (domestic) voltage installations, Electric services in buildings, Classification of voltages, standards and specifications.	[4]
Unit 2: Internal Electrification design General aspects of the design of electrical installations for domestic dwellings as per NEC guidelines (low and medium voltage installations)–connected load calculation, sub circuit determination, selection of main distribution board, sub distribution board, MCB, ELCB, MCCB and cables for sub circuits. Pre-commissioning tests of domestic installations.	[4]

Unit 3:Cable Sizing and Selection of single Phase and Three Phase: Medium and HV installations – selection of cables and cable glands, guidelines for cable installation in detail. Panel boards: LT & HT control panel boards. Installation of induction motors: Design of distribution systems with light power and motor loads	[4]
Unit 4:Design of illumination systems – Yard lighting, street lighting and flood lighting. Design and layout of installation for recreational or assembly buildings, cinema theatre and high rise building. Design of Electrical system related to firefighting, lifts and escalators	[4]
Unit 5:Earthing Design and Calculation of Power Plants Design of earthing system for an HT consumer, Dimensions and drawings of typical earth electrodes (1) Pipe Earthing, (2) Plate Earthing. Touch, Step and Transfer potentials at EHT Sub-Stations, Earth-mat, installations of special equipment like X-Ray, Neon-Sign, Basics of lightning arresters.	[4]
Unit 6: Solar PV System Sizing Determine power consumption demands, Size of the PV modules, Inverter sizing, Battery sizing, Solar charge controller sizing, Grid Connected PV System, Grid Connected Net Metering, Simplified Grid Connected PV System, Grid Connected System with Batteries	[4]

Textbooks: Reference books

1. Integration of Alternative sources of Energy, Felix A. Farret and M. Godoy Simoes, IEEE Press –Wiley-Interscience publication, 2006.
2. M.K.Giridharan, Electrical Systems Design, , M/s I K International Publishers, New Delhi, 2nd edition, 2016.
3. J. B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria & Sons; Reprint 2013.

Elective-IVA: Advanced Control Theory

EE703A	PEC	Advanced Control Theory	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs./week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Control Systems

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

CO1	Estimate State Feedback Gain Matrix and Observer Gain matrix with pole placement techniques.
CO2	Design of Lag, Lead, Lag-Lead Compensator Design Using Bode Plot and Root Locus Technique
CO3	Explain Linear Models of Physiological Systems
CO4	Analyze nonlinear system using Describing function approach and Phase plane analysis

Course Contents:

UNIT-1: POLE PLACEMENT TECHNIQUE Introduction, Pole Placement Design, Necessary and Sufficient conditions for Arbitrary Pole Placement, Evaluation of State Feedback Gain Matrix-using Transformation Matrix, Direct Substitution Method, Ackermann's Formula; Concept of State Observer, Selection of suitable value of Observer Gain matrix-Numerical problems.	[7]
UNIT-2: COMPENSATORS-1: Introduction, Classification: Series or cascade compensation, Feedback or parallel compensation, Load or series-parallel compensation, State feedback compensation, Forward compensation with series compensation, Feed-forward compensation **Lag Compensator:** Determination of Maximum Phase Angle, Electrical Representation, Effects, Limitations, Design of Lag Compensator Design Using Bode Plot, Design of Lag Compensator Using Root Locus Technique.	[7]

UNIT-3: COMPENSATORS-2: **Lead Compensator:** Determination of Maximum Phase Angle, Electrical Representation, Effects, Limitations, Design of Lead Compensator, Design of Lead Compensator Using Bode Plot, Design of Lead Compensator Using Root Locus Technique. **Lag–Lead Compensator**: Electrical Representation, Effects, Design of Lag–Lead Compensator, Design of Lag–Lead Compensator Using Bode Plot, Design of Lag–Lead Compensator Using Bode Plot.	[7]
UNIT-4: PHYSIOLOGICAL CONTROL SYSTEMS: Introduction, Properties of Physiological Control Systems: Target of the Homeostasis, Imbalance in the Homeostasis, Homeostasis Control Mechanisms, Block Diagram of the Physiological Control System: Types of Control Mechanism, Differences between Engineering and Physiological Control Systems, Linear Models of Physiological Systems: Lung Mechanism, Skeletal Muscle	[6]
UNIT-5: DESCRIBING FUNCTION ANALYSIS: Introduction to nonlinear systems, Types of nonlinearities, Non Linear Systems – Types of Nonlinearities – Saturation – Dead-Zone – Backlash – Jump Phenomenon, Linearization of nonlinear systems, Singular Points and its types describing functions, describing function analysis of nonlinear control systems.	[6]
UNIT-6: PHASE-PLANE ANALYSIS: Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.	[6]
Text/Reference Books: 1. Modern Control System Theory by M. Gopal, New Age International Publishers, 2nd edition, 1996. 2. Control Systems Engineering by S. Salivahanan, R. Rengaraj, G.R.Venkatakrishnan, Pearson Education. 3. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998 4. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd. 5. Modern Control Theory, U A Bakshi, M V Bakshi, Technical Publications	

Elective-IVB: Big Data Analytics

EE703B	PEC	Big Data Analytics	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: C Programming

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

CO1	Outline Data Analytics and Decision Making
CO2	Illustrate Distribution of a Single Variable.
CO3	Identify Relationships among Variables.
CO4	Illustrate Probability and Probability Distributions
CO5	Explain Normal, Binormal & Poisson Distributions
CO6	Apply Exponential Distribution to solve real time problems.

Course Contents:

Unit 1: Introduction to Data Analytics and Decision Making Introduction, Overview of the Book, The Methods, The Software, Modeling and Models, Graphical Models, Algebraic Models, Spreadsheet Models, Seven-Step Modeling Process.	[6]
Unit 2: Describing the Distribution of a Single Variable Introduction, Basic Concepts, Populations and Samples, Data Sets, Variables, and Observations, Types of Data, Descriptive Measures for Categorical Variables, Descriptive Measures for Numerical Variables, Numerical Summary Measures, Numerical Summary Measures with Stat Tools, Charts for Numerical Variables, Time Series Data, Outliers and Missing Values, Outliers, Missing Values, Excel Tables for Filtering, Sorting, and Summarizing.	[6]
Unit 3: Finding Relationships among Variables Introduction, Relationships among Categorical Variables, Relationships among	[6]

Categorical Variables and a Numerical Variable, Stacked and Unstacked Formats, Relationships among Numerical Variables, Scatterplots, Correlation and Covariance, Pivot Tables.	
Unit 4: Probability and Probability Distributions Introduction, Probability Essentials, Rule of Complements, Addition Rule, Conditional Probability and the Multiplication Rule, Probabilistic Independence, Equally Likely Events, Courseive Versus Objective Probabilities, Probability Distribution of a Single Random Variable, Summary Measures of a Probability Distribution, Conditional Mean and Variance, Introduction to Simulation.	[6]
Unit 5: Normal, Binormal, Poisson Distributions Introduction, The Normal Distribution, Continuous Distributions and Density Functions, The Normal Density, Standardizing :Z-Values, Normal Tables and Z-Values, Normal Calculations in Excel, Empirical Rules Revisited, Weighted Sums of Normal Random Variables,	[6]
Unit 6: Exponential Distributions The Binomial Distribution, Mean and Standard Deviation of the Binomial Distribution, The Binomial Distribution in the Context of Sampling, The Normal Approximation to the Binomial, Applications of the Binomial Distribution, The Poisson and Exponential Distributions, The Poisson Distribution, The Exponential Distribution, Applications of the Normal Random Distribution	[6]
Textbooks: 1. S C Albright and W L Winston, Business analytics: data analysis and decision making, 5/e Cengage Learning	
Reference Books: 1. ArshdeepBahga, Vijay Madisetti, "Big Data Analytics: A Hands-On Approach", 1st Edition, VPT Publications, 2018. 2. Raj Kamal and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine Learning", McGraw Hill Education, 2018	

Elective-IVC: FACTS and HVDC

EE703C	PEC	FACTS and HVDC	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Power system, Power Electronics

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

CO1	Classify different types of FACTS devices.
CO2	Explain the Static shunt compensators.
CO3	Explain the Static series compensators.
CO4	Explain the combined compensators.
CO5	Compare AC and DC transmission system.
CO6	Explain the control schemes for HVDC transmission systems.

Course Contents:

Unit 1: Introduction to FACTS Opportunities for FACTS, Flow of power in AC system, Basic types of FACTS Controllers, Brief description and definitions of FACTS controllers: Shunt connected controllers, Series connected controllers, Combined Shunt and Series connected controllers, Benefits from FACTS Technology	[6]
Unit 2: Static shunt compensators Objectives of shunt compensation, Methods of controllable VAR generation: Variable Impedance Type, Switching Converter Type, Construction and Working of : Hybrid VAR Generators, Static VAR compensators - SVC and STATCOM, Comparison between SVC and STATCOM	[6]
Unit 3: Static Series Compensators: Objectives of Series compensation, Construction and Working of : Thyristor switched series capacitor (TSSC), Thyristor Controlled series capacitor (TCSC), GTO Thyristor	[7]

Controlled series capacitor (GCSC), Switching converter type series compensators: Static synchronous series compensator (SSSC), Power angle characteristics, Basic operating control schemes	
Unit 4: Combined Compensators Introduction, unified power flow controller (UPFC): Basic operating principle, independent real and reactive power flow control, control structure, Unified Power Quality Conditioner (UPQC), Interline power flow controller (IPFC): Basic operating principle, control structure	[6]
Unit 5: HVDC System and Converters: Comparison of AC-DC transmission systems, Benefits of DC transmission, Types of DC Links, Typical layout of HVDC converter station, Line commutated converter, Voltage source converter	[6]
Unit 6: HVDC system control Principles of DC Link control, converter control characteristics, system control hierarchy, firing angle control, current and excitation angle control, starting and stopping of DC Link, Generation of Harmonics, Introduction of Filters	[8]
Textbooks: 1. Understanding FACTS, Concepts and Technology of Flexible AC Transmission systems, Narain. G.Hingorani, Laszlo Gyugyi, IEEE press, Wiley India 2. HVDC Power transmission systems, K R Padiyar, New Age International.	
Reference Books: 1. Thyristor Basd Controllers for Electrical Transmission Systems, R. Mohan Mathur, Rajiv K. Varma. Wiley India. 2. HVDC and FACTS Controllers applications of static converters in power systems, Vijay K. sood, Kluwer Accademic Publishers.	

Elective-IVD: EV Charging Station Design

EE703D	PEC	EV Charging Station Design	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Power Electronics

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

CO1	Understand Electric Vehicle Growth
CO2	Demonstrate EV Charging Infrastructure
CO3	Explain the concept of Charging station design.
CO4	Design Electrical architecture of EV charging station
CO5	Apply Energy and Asset Management
CO6	Explain Smart charging perspectives for optimal EV integration

Course Contents:

Unit 1: Electric Vehicle Growth Trends 2020 to 2030 – Electric vehicle sales penetration, annual electric vehicle electricity consumption, Global cumulative number of charging connectors; Different global initiatives – EV30@30, C40 CITIES, EV100, EVAPP, FAME-II, PLI-ACC Scheme, Battery Swapping Policy, Duty Reduction on Electric Vehicles, Special E-mobility Zone	[6]
Unit 2: EV Charging Infrastructure Hardware infrastructure; Data management; Maintenance and service; Battery Specifications of different EV segments; Types of charger - Slow AC charging, Moderate AC charging, DC fast charging; Power ratings of charger types; Modes of charging and connectors; Charging time calculation; Charging capacity for different battery type; IS 17017: EV charging standard in India; Private Charging; Semi-Public Charging; Public Charging	[6]

Unit 3: Charging station design IEC 61851 Part 1, Part 21-2, Part 23, Part 24; Public charging locations; Charging station design - Environmental characteristics, Charging station output, Authentication, Charging station communication;	[6]
Unit 4: Electrical Design Electrical installation design - Types of Earthing Systems (TT, IT, TN), Protection against electric shocks, Protection against transient over voltages; electrical architectures - Integration of EV supply equipment into an existing installation, Use of local energy supplies to compensate for the EV charging power demand, architecture with mode 3 charging stations according to different load management strategies, Example of EV charging infrastructure design	[8]
Unit 5: Energy and Asset Management EV charging Energy Management, EV charging with STATIC Load Management, EV charging with DYNAMIC Load Management, Dynamic load management with additional power from local production, Demand Response - Peak Shaving applied to EV charging, EV charging - Artificial Intelligence-based Load Management, Integration of EV charging into a Building Management System, EVSE Asset management - Preventive maintenance vs Predictive maintenance	[8]
Unit 6: Smart charging perspectives for optimal EV integration Definition of smart charging; Advanced smart charging: V1G, V2x options; Value of smart charging; Strong barriers for smart charging	[6]
Textbooks: 1. Electric Vehicle Charging Infrastructure Guide for DISCOM readiness a NITI AAYOG, RMI INDIA.	
Reference Books: 1. Handbook of Electric Vehicle Charging Infrastructure Implementation 2. An Overview on Electric Vehicle Charging Infrastructure Manoz Kumar M Tirupati, Tata Elxsi	

Elective-VA: Digital Control Systems

EE704A	PEC	Digital Control Systems	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2I: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Control Systems.

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

CO1	Understand basic concepts of Z & Laplace transform related to digital control systems.
CO2	Design of digital control system using Root locus, Controllers, compensators.
CO3	Explain state space representation & its forms.
CO4	Study state space equations, state transition matrix.
CO5	Design of controller by using Pole placement.
CO6	Design of observer by using Pole placement.

Course Contents:

Unit 1 - Digital Control System Review of Z transforms, Z transform method for solving difference equation, Impulse Sampling and Data Hold, Pulse Transfer Function, Sampling Theorem, Mapping between S Plane and Z Plane, Stability Analysis, Transient and Steady State Analysis	[6]
Unit 2 - Design of Digital Control System Construction of Root Locus, Design based on Root Locus, P,PI,PD,PID Controllers, Lead, Lag, Lead-Lag Compensators, Frequency Response Analysis, Bode Diagram.	[6]
Unit 3 - State Space Analysis of Digital Control System I State Space representation of Digital System, Controllable Canonical form, Observable	[6]

Canonical form, Diagonal form, Jordan form.	
Unit 4- State Space Analysis of Digital Control System II State Space Equations, solving State Space Equations, State Transition Matrix, Properties of State Transition Matrix, Pulse Transfer Function Matrix. Discretization of Continuous Time State Space Equation.	[6]
Unit 5 - State Space Design for Controller Controllability, Controller Design in State Space, Design via Pole Placement for Controller Design, Ackermann's Formula for Controller Design.	[6]
Unit 6 – State space Design for Observer Observability, Observer Design, Design via Pole Placement for Observer Design, Ackermann's Formula for Observer Design, Deadbeat Design, Design for Deadbeat Response.	[6]

Textbooks:

1. K. Ogata, "Discrete Time Control Systems", Second Edition, Pearson Education, 2005
2. C.L. Phillips, J.M. Parr, "Feedback Control Systems", Fifth Edition, Pearson Education,2013

Reference Books:

1. I.J. Nagrath, M.Gopal "Control Systems Engineering", New Age International, Sixth Edition, 2018,
2. B.C. Kuo, "Digital Control Systems", Oxford University Press, Second Edition, 2012

Elective-VB: Artificial Intelligence and Machine Learning

EE704B	PEC	Artificial Intelligence and Machine Learning	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

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

CO1	Explain the concept of Artificial Intelligence.
CO2	Interpret the concept of agent architectures and hierarchical control.
CO3	Explain the States, Searching, Features and Control of Artificial Intelligence.
CO4	Explain the concept of Machine Learning.
CO5	Interpret the concept learning and general to specific ordering.
CO6	Explain decision tree learning.

Course Contents:

Unit 1:Introduction to Artificial Intelligence Introduction, Foundation of Artificial Intelligence, History of Artificial Intelligence, Agents Situated in Environments, Prototypical Applications	[6]
Unit 2: Agent Architectures and Hierarchical Control Agents, Agent Systems, Hierarchical Control, Embedded and Simulated Agents, Acting with Reasoning	[6]
Unit 3: States, Searching, Features and Control Problem Solving as Search, State Spaces, Graph Searching, A Generic Searching Algorithm, Uninformed Search Strategies, Heuristic Search, More Sophisticated Search. Features and Constraints: Possible Worlds, Variables, and Constraints, Generate-and-Test Algorithms, Consistency Algorithms	[8]

Unit 4: Introduction to Machine Learning Well Posed Learning Problem, Design of Learning System, Perspectives and Issues in Machine Learning	[6]
Unit 5: Concept Learning and General to Specific Ordering Concept Learning Task: Inductive Learning Hypothesis, General to Specific Ordering of Hypotheses, List-Then-Eliminate, Candidate-Elimination Algorithm, Inductive Bias: Biased Hypothesis Space, Unbiased Learning, Futility of Bias-free Learning.	[6]
Unit 6: Decision Tree Learning Decision Tree Representation, Basic Decision Tree Learning Algorithm, Inductive Bias in Decision Tree Learning, Issues in Decision Tree Learning, Handling Attributes with Different Costs.	[8]
Textbooks: 1. "Machine Learning" by Tom M. Mitchell, McGraw-Hill Science/Engineering/Math; (March 1, 1997). 2. "Artificial Intelligence: Foundations of Computational Agents" by David L. Poole and Alan K. Mackworth, Cambridge University Press.	
Reference Books: 1. "Introduction to Artificial Intelligence" by Wolfgang Ertel, Springer 2011.	

Elective-VC: Optimization in Power Systems

EE704C	PEC	Optimization in Power Systems	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Mathematics-I & II

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

CO1	Remember different load flow methods
CO2	Understand Economic Load Dispatch of thermal Generating Units
CO3	Explain the concept of hydrothermal scheduling problems solution.
CO4	Solve Multi-Objective Generation Scheduling
CO5	Apply Stochastic Methods for Multi Objective Generation Scheduling
CO6	Formulate Evolutionary Programming for Generation Scheduling

Course Contents:

Unit 1: Load Flow Studies: Network model formulation; Y-bus formulation; Node elimination in Y-bus; Z-bus formulation; Load flow problem; Computation of line flow; modeling of regulating transformer; Gauss-Seidel method; Newton Raphson method; Decoupled Newton method; Fast Decoupled method; DC Load flow; AC-DC Load flow.	[6]
Unit 2: Economic Load Dispatch of thermal Generating Units: Introduction, Generator operating cost, Economic Dispatch problem on a bus bar, Optimal generation scheduling, Economic dispatch using Newton-Raphson method, Economic dispatch using the approximate Newton-Raphson method, Economic dispatch using efficient method, Function of generation & loads.	[6]
Unit 3: Optimal Hydro thermal Scheduling Introduction, Hydro plant performance Models, ShortRange Fixed-Head Hydro thermal	[6]

Scheduling, Newton-Raphson for short-range fixed –head hydro thermal scheduling, Approximate Newton-Raphson method for short –range fixed-head hydro thermal Scheduling, Short-Range variable-head hydro thermal scheduling-Classical Method, Approximate Newton-Raphson method for short -range variable-head hydro thermal scheduling, Hydro plant modeling for long term operation, Long-Range generation scheduling of hydro thermal systems.	
Unit 4: Multi-Objective Generation Scheduling Introduction, Multi objective optimization- State of the art, Fuzzy set theory in power system, the surrogate worth trade of approach for multi objective thermal power dispatch problem, multi objective thermal power dispatch- weighing method, multi objective dispatch for active & reactive power balance...	[6]
Unit 5: Stochastic Multi Objective Generation Scheduling Introduction, multi-objective stochastic optimal thermal power dispatch- $\in$ -constant method, multi-objective stochastic optimal thermal power dispatch- The surrogate worth trade-off method, multi-objective stochastic optimal thermal power dispatch- weighing method, stochastic economic-emission load dispatch, multiobjective optimal thermal dispatch- risk/dispersion method, stochastic multi-objective short term hydro thermal scheduling, stochastic multi -objective long-term hydro thermal scheduling.	[6]
Unit 6: Evolutionary Programming for Generation Scheduling Introduction; Fitness function; Genetic Algorithm Operators; Economic dispatch problem; Genetic Algorithm based on Real Power Search; Economic Dispatch with valve point loading; Economic Dispatch with Ramp Rate limit and prohibited operating zones; Evolutionary search method for economic dispatch; Particle Swarm Optimization for Economic Dispatch.	[6]
Textbooks: 1. D.P. Kothari and J.S. Dhillon, Power System Optimzation, , Prentice Hall of India 2. J. A. Momoh, Electric Power system Applications of Optimization, CRC Press.	
Reference Books: 1. J. Zhu, Optimization of power system operation, John Wiley & Sons.	

Elective-VD: Grid Integrated Renewable Energy Sources

EE704D	PEC	Grid Integrated Renewable Energy Sources	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1:10 Marks CA2I: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Power System

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

CO1	Understand various techniques of utilizing power from renewable energy sources.
CO2	Explain Interconnection of alternative energy sources with the grid
CO3	Explain Power quality and management
CO4	Explain principles of Grid stabilization
CO5	Explain Integration of alternate sources of energy
CO6	Assess renewable energy applications and projects in the context of integration

Course Contents:

Unit 1:Introduction Various techniques of utilizing power from renewable energy sources, concept of nano/micro/mini grid. Need of integrating large renewable energy sources, issues related to integration of large renewable energy sources, rooftop plants. Concept of VPP.	[6]
Unit 2: Interconnection of alternative energy sources with the grid Interconnection Technologies-:Synchronous Interconnection, Induction Interconnection, Inverter Interconnection, Interconnection Considerations: Voltage Regulation, Integration with Area EPS Grounding Synchronization, Isolation, Response to Voltage Disturbance, Response to Frequency Disturbance, Disconnection for Faults, Loss of Synchronism, Feeder Reclosing Coordination, Feeder Reclosing Coordination	[6]

Unit 3:Power quality and management THD, voltage sag, voltage swell, frequency change and its effects, network voltage management, frequency management, system protection, grid codes	[6]
Unit 4:Grid stabilization Scheduling and dispatch, Forecasting, reactive power and voltage control, frequency control, operating reserve, storage systems, electric vehicles Ancillary services in Indian Electricity Market (regulatory aspect), CERC and CEA orders (technical and safety standards)	[6]
Unit 5:Integration of alternate sources of energy Introduction, principles of power injection: converting technologies, power flow; instantaneous active and reactive power control approach; integrating multiple renewable energy sources; DC link integration; AC link integration; HFAC link integration; islanding and interconnection	[6]
Unit 6:Case studies Based on synchronous/induction generator for peak demand reduction, grid connected PV system	[6]

Textbooks:

1. Integration of Alternative sources of Energy, Felix A. Farret and M. Godoy Simoes, IEEE Press –Wiley-Interscience publication, 2006.
2. Grid integration of solar photovoltaic systems, Majid Jamil, M. Rizwan, D.P.Kothari, CRC Press (Taylor & Francis group), 2017
3. Renewable Energy Grid Integration, Marco H. Balderas, Nova Science Publishers, New York,2009.
4. Wind Power Integration connection and system operational aspects, B. Fox, D. Flynn L. Bryans,N. Jenkins, M. O' Malley, R. Watson and D. Milborrow, IET Power and Energy Series 50 (IET digital library), 2007

Reference Books :

1. Power Generation, Operation, and Control, Allen J. Wood, Bruce F. Wollenberg, Gerald B. Sheblé, John Wiley & Sons, New York, 2013 (3rd edition)
2. Power Electronics: Circuits, Devices, and Applications. M.H.Rashid, Pearson Education India, 2013
3. Advanced power system analysis and dynamics, L.P.Singh, New age international publishers, 2017

Electrical System Design Laboratory

EE705	PCC	Electrical System Design Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Basic Electrical Engineering

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

CO1	Design electrical circuits for various applications, considering voltage, current, power factor, and efficiency to meet specified objectives.
CO2	Design electrical Lighting system.
CO3	Select Cable Size for single Phase and Three Phase electrical systems.
CO4	Design Internal electrical system.
CO5	Design earthing system.
CO6	Evaluate estimation cost of electrical system.

Course Contents:

List of Experiments

1. Any Two Problems based on Electrical System planning.
2. Any Two Problems based on Lighting Design.
3. Any Two Problems based on Cable Sizing and Selection of single Phase and Three Phase
4. Any Two Problems based on Internal Electrification design.
5. Any Two Problems based on Earthing Design.
6. Any Two Problems based on Cost estimating of industrial power systems.

High Voltage Engineering Laboratory

EE706	PCC	High Voltage Engineering Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA1:15 Marks CA2: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basic Electrical Engineering, Electrical Engineering Materials, Power System

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

CO1	To determine dielectric high voltages withstand capability of gaseous medium.
CO2	To determine dielectric high voltages withstand capability of liquid medium.
CO3	To determine dielectric high voltages withstand capability of solid medium.

Course Contents:

List of Experiments: Any 8 from below mentioned experiment list

1. To demonstrate Horn Gap arrangement as surge diverter for corona arc discharge.
2. To measure audible sound in db and visible temperature using Thermal Imaging Camera in Faraday's cage arrangement.
3. To determine the effect of gap length on breakdown strength of liquid insulting Material (Transformer Oil).
4. To measure High Voltage Withstand capability of cables at DC Voltages (Max up to 10KV).
5. To determine Breakdown Voltage for Solid Composite Insulating Materials (30KV, 30mA test setup with jig).
6. To measure High Voltage withstand capability of cables at Power Frequency AC Voltages (Max up to 30KV).
7. To demonstrate development of Tracks and Trees of polymeric insulation.
8. To determine the effect of change in gap length over breakdown voltage in the air medium using sphere gap assembly.
9. To study Impulse voltage generator using Virtual Laboratory.
10. Visit to High Voltage Laboratory and to generate report over Layout and Components of High Voltage Laboratory.

Mega Project Phase-II

PRJ06	PROJ	Mega Project Phase-II	0-0-8	4 Credit

Teaching Scheme	Evaluation Scheme
Practical: 8 hrs/week	CA1: 25 Marks CA2: 25 Marks End Semester Exam: 50 Marks

Pre-Requisites:

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

CO1	Build an engineering project.
CO2	Discuss with engineers and the community at large in written an oral forms.
CO3	Demonstrate the knowledge, skills and attitudes of a professional engineer.

Since Mega Project Phase-II is in continuation to Mega Project Phase-I, the students are expected to complete the total project by the end of semester VII. After completion of project work, they are expected to submit the project report including the work done in Phase-I and Phase-II.

The report shall be comprehensive and presented typed on A4 size sheets and **hard 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 (Guide and Project Evaluation Members) for both, term work and oral Evaluations.

The project work should be published in any one of the national/international quality conference or reputed journal.

Report shall summarize the literature survey; spell out the scope of work, methodology and results. Viva-voce Evaluation shall be based on work carried out by the student.

Seminar

PRJ07	PROJ	Seminar	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	End Semester Exam: 50 Marks

Pre-Requisites:

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

CO1	Demonstrate the sound technical knowledge of the selected technical topic.
CO2	Demonstrate technical presentation skill.
CO3	Compose the progress report.

Student shall choose a topic of his/her interest in consultation with faculty in the Electrical department. The topic for seminar may be related to Recent Developments in Electrical 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.

Values & Ethics

HMS09	HSMC	Values & Ethics	2-0-0	Audit

Teaching Scheme	Evaluation Scheme
Lecture: 2 hrs/week	CA1: 25 Marks CA2: 25 Marks

Pre-Requisites: Nil

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

CO1	Interpret the principles of ethics and human values by examining their influence on personal behavior, public conduct, and value formation through family, society, and education.
CO2	Demonstrate improved attitude, morals, aptitude, and integrity in contributing positively to society
CO3	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO4	Explain the significance of value inputs in a classroom and start applying them in their life and profession.
CO5	Analyze publication ethics and misconduct to ensure adherence to ethical standards, authorship guidelines, and responsible research dissemination.
CO6	Evaluate the role of ethics, professional values, and gender sensitization in promoting responsible and equitable conduct in engineering and public life.

Course Contents:

Unit-1: Ethics and Human Interface Ethics and Human Interface, Essence, determinants and consequences of Ethics in human actions; Dimensions of ethics; ethics in private and public relationships, Human Values – lessons from the lives and teachings of great leaders, reformers and administrators, Role of family, society in inculcating values, role of educational institutions in inculcating values.	[4]
Unit-2: Attitude, Morals, Aptitude, Integrity towards Society Attitude: content, structure, function, Attitude and its influence and relation with thought and behavior, Aptitude and foundational values towards society , integrity, impartiality and non-partisanship, objectivity, dedication towards society, empathy, tolerance and compassion intelligence-concepts, and their utilities and application.	[4]
Unit-3:Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body', Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics	[4]

and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya, Understanding harmony in the Family.	
Unit-4: Value Education: Need, Guidelines, Content and Process for Value Education, Self-Exploration–; Natural Acceptance and Experiential Validation, Continuous Happiness and Prosperity, Right understanding, Relationship and Physical Facilities, Understanding Happiness and Prosperity correctly, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.	[4]
Unit-5: Publication Ethics Publication Ethics: Introduction, Scope & importance, Best practices/standards initiatives & Guidelines: COPE, WAME, etc., Conflict of Interest, Publication Misconduct: definition, concept, problems that lead to unethical behavior & Vice versa, Violation of Publication Ethics, Authorship & Contributor ship, Identification of Publication misconduct, complaints & appeals, Predatory publishers & Journals.	[4]
Unit-6: Ethics and Gender Sensitization Ethics - Meaning, Importance, & Types of Ethics, Values and Attitudes of Professional Engineers, Seven Principles of Public Life. Gender Sensitization: Introduction, Sex vs. Gender, Social construction of Gender, Gender Roles, Gender Stereotypes, Ending violence against girls/ women: Advancing safety and rights, Gender Equality.	[5]

Textbooks:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
3. Neeraj Kumar, "Lexicon for Ethics, Integrity & Aptitude", Chronicle Publication, 2016.
4. Santosh Ajmera, Nand Kishor Reddi, "Ethics - Integrity and Aptitude", Tata Mc Graw Hill Publication, 2014.
5. M. Karthikeyan, "Ethics, Integrity and Aptitude", Tata Mc Graw Hill Publication, 2015.
6. Dr. Vara Lakshmi G, Dr. R V Anuradha, "Gender Sensitization", Neelkamal Publications.

Reference Books:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA.
2. A N Tripathy, 2003, Human Values, New Age International Publishers.
3. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers, Oxford University Press.
4. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
5. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.

Teaching and Evaluation Scheme for Final Year B. Tech

Department of Electrical Engineering

Semester: VIII

Department: Electrical Engineering **Rev:** Course Structure/00/2021-22

Class: Final Year B. Tech **Semester:** VIII

Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs	CA1	CA2	MSE	ESE	Total	
EE801	HSMC	Self-Learning Cours-1	3	-	-	3	10	10	30	50	100	3
EE802	PEC	Self-Learning Course-2	3	-	-	3	10	10	30	50	100	3
IFT03	PROJ	Internship	-	-	20	20	50	50	-	100	200	10
Total			**6**	**-**	**20**	**26**	**70**	**70**	**60**	**200**	**400**	**16**

Self-Learning Course-1

A Foundations of Accounting & Finance

B Financial Management for Managers

C Principles of Management

D Financial Accounting

Self-Learning Course-2

A Introduction to Embedded System Design

B Cloud Computing

C Smart Grid: Basics to Advanced Technologies

D Operations and Planning of Power Distribution Systems

Self-Learning Course-1: Foundations of Accounting & Finance

EE801A	HSMC	Foundations of Accounting & Finance	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: Nil	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Conceptual Basis of Financial Accounting, Concepts and Interactions of Financial Statements, Terminologies in Financial Accounting
Week 2: Financial Statements: Balance sheet, Financial Statements: Income Statement, Financial Statements: Cash flow Statement
Week 3: Financial Statement Analysis, Reading financial statements, Financial Ratios
Week 4: Conceptual basis of Cost Accounting, Cost behavior, Elements of cost and preparation of cost statement, Cost Classification, Direct & Indirect cost, Overhead allocation / absorption, Traditional Method, Primary and Secondary Distribution, Activity Based Costing
Week 5: Cost-Volume-Profit Analysis, Contribution Margin, Break-Even Point, Marginal Costing, Operating Leverage, Decision making using Marginal Costing
Week 6: Performance Evaluation, Budgeting, Flexible Budget, Production Budget, Sales Budget Master Budget, Variance Analysis

Week 7: Introduction to Corporate Finance, Time Value of Money, Discounted Cash Flows
Week 8: Valuing Bonds, Valuation of Stocks as Investments,
Week 9: Valuing Projects NPV and IRR, Valuing Projects Risk Analysis
Week 10: Risk, Return and the Capital Asset Pricing Model
Week 11: Cost of Debt, Equity, WACC, Capital Budgeting, Capital Market Efficiency, Capital Structure and Cost of Capital
Week 12: Dividends and other Payouts, Course Summary
Textbooks/ Reference Books: 1. Accounting: Text and Cases; Robert N Anthony, David F Hawkins and Kenneth A Merchant, McGraw Hill Education. 2. Cost Accounting; Horngren, Foster & Dattar; PHI Publication 3. Corporate Finance by Ross, Westerfield, Jaffe, Jordan and Kakani, McGraw Hill Education

Self-Learning Course-1: Financial Management For Managers

EE801B	HSMC	Financial Management For Managers	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: Nil	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Financial management-an overview, Financial decisions in the firms, the fundamental principles of finance, goals of financial management, building blocks of modern finance.
Week 2: Risk-return trade off, Organization of finance functions, Emerging role of financial managers' in India, Over view of financial statements – Income statement, Balance Sheet, Cash flow statement, Analysis of financial statements
Week 3: Financial Planning & forecasting, Tools & techniques of Financial Planning & Forecasting, Sources of finance.
Week 4: Time Value of Money, Future value of a single amount, Present value of a single amount, Future value of Annuity, Present value of Annuity & Perpetuity.
Week 5: Capital Budgeting –Concept and overview, Capital budgeting process, Project classification, Techniques of capital budgeting, Investment criteria
Week 6: Net present value, internal rate of return, Modified Internal rate of return, Benefit cost ratio, Pay-back period method.

Week 7:

Accounting rate of return, Investment appraisal in practice, Estimation of project cash flows – overview, Estimation of project cash flows-tools & techniques, Estimation of project cash flows-tools & techniques

Week 8:

Accounting rate of return, Investment appraisal in practice, Estimation of project cash flows – overview, Estimation of project cash flows-tools & techniques, Estimation of project cash flows-tools & techniques.

Week 9:

Break-even analysis, some other models and tools of risk analysis, Project selection under risk, cost of Capital-Overview, Cost of debt & preference capital.

Week 10:

Cost of equity, Determining the proportions, WACC, WA Marginal cost of capital, Determining the optimum capital budget.

Week 11:

Capital structure of firms-An overview, Net income approach, Net operating income approach, Traditional proposition, MM Proposition.

Week 12:

Dividend decisions-An overview, Relevance of dividend, Dividend policy formulation, Dimensions of divined policy, Legal & procedural aspects of dividend decisions.

Textbooks/Reference Books:

1. Prasanna Chandra "Financial Management: Theory and Practice" 9th Edition, McGraw Hill Education Publishers.
2. Van Horne, J.C, "Fundamentals of Financial Management", 13th Edition, Prentice Hall Publishers.
3. Brealey and Myers," Principles of Corporate Finance", 11th Edition, McGraw Hill Education Publishers
4. Pandey I.M., "Financial Management", 11th Edition, Vikas Publishers.
5. Khan, M.Y. and Jain, P.K., "Financial Management", 7th Edition, McGraw-Hill Education Publishers.

Self-Learning Course-1: Principles of Management

EE801C	HSMC	Principles of Management	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: Nil	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Introduction to Management: Management – An Emerging Profession, Definition, Nature, Scope, Purpose, and characteristics of Management, Functions, roles, skills of an effective Manager.
Week 2: Evolution of Management Thought : Classical Theory, Scientific Management , Management Process or Administrative Management, Bureaucracy, Behavioral Science Approach, Quantitative Approach, Systems Approach, Contingency Approach, Operational Approach
Week 3: Planning: Types of Plans, Planning Process, Introduction to Strategic Management, Types of Strategies, Understanding environment of business: Environmental appraisal – Industry Analysis - Porter's Model of competitive advantage, analysis of organizational resources and capabilities
Week 4: Forecasting and Premising : Introduction to Forecasting, Essential Components in Business Forecasting, Determinants of Business Forecasts, Benefits of Forecasting, Techniques of Forecasting, Limitations of Forecasting
Week 5: Decision-making: Introduction, Components of Decision-making, Decision-making Process, Group Decision-making, Creativity Problem-solving.
Week 6: Management by Objectives and Styles of Management : Core Concepts of MBO, Characteristics

of Management by Objectives, Process of MBO, Defining the Goal, Action Plan, Final Review, Benefits of Management by Objectives, Limitations of Management by Objectives, Styles of Management, American Style of Management, Japanese Style of Management, Indian Style of Management
Week 7: Organizing and Directing: Introduction, Organizational Design, Hierarchical Systems , Organization Structure, Types of Organization Structure, Formal and Informal Organization, Factors Determining Span of Management, Centralization and Decentralization, Span of control, Understanding authority and responsibility, Principles of Delegation, Authority, Developing a culture of Innovation and performance.
Week 8: Staffing and Coordination: Introduction, Human Resource Management, Recent Trends in HRM, Technology in HRM, Economic Challenges, Workforce Diversity, Concept of Coordination, Need for Coordination, Importance of Coordination, Principles of Coordination, Coordination Process, Types of Coordination, Issues and Systems Approach to Coordination, Techniques of Coordination.
Week 9: Career Development Strategy: Introduction, Concept and Elements of Career, Overview of Career Development, Significance and Advantages of Career Development, Objectives of Career Development, Types of Career Development Programmes, Different Stages or Cycles of Career Development Process, Career Anchors, Steps in the Career Planning Process.
Week 10: Leadership styles of Managers: Leadership Concept, Nature, Importance, Attributes of a leader, Role of a leader in demonstrating awareness of legal, personnel, and strategic issues relating to globalization, culture and gender diversity in an organization, Role of leader in conflict resolution and negotiations
Week 11: Organizational Communication: Communication in Organizations: Introduction, Importance of Communication in the Workplace; Understanding Communication Process, Barriers to Communication, Use of tone, language and styles in Communication, Role of Perception in influencing communication, Role of culture in communication
Week 12: Change management: Concept of change, change as a natural process, Importance & Causes of

change – social, economic, technological, organizational, Developing a climate for learning, Concept of learning organizations Challenges of Contemporary Business: Role of Ethics, Corporate social responsibility, and environmental issues

Textbooks/ Reference Books:

1. Stephen P. Robbins, David A. Decenzo, 2016. Fundamentals of Management, Pearson Education, 9th Edition
2. Harold Koontz, O'Donnell and Heinz Weihrich, 2012. Essentials of Management. New Delhi, 9th edition, Tata McGraw Hill
3. Management Fundamentals: Concepts, Applications, & Skill Development, 6th edition, Sage, 2014
4. Richard L. Daft, Principles Of Management, Cengage Learning, 2009
5. Robbins, Management, 9th edition Pearson Education, 2008

Self-Learning Course-1: Financial Accounting

EE801D	HSMC	Financial Accounting	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: Nil	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: A primer on business organizations and need for accounting

Introduction to Financial Accounting, Definition of accounting, Course contents, Preparation of financial statements: Accounting cycle, Decision making using financial statements, Accounting: An art or a science?, Environment of financial reporting, Company form of business, 1What is a company?, 2Types of companies, Private company vs Public company, Visuals test to identify public companies, Accounting as an information system, Business and information requirement, Stakeholders of a business, Information: Tip of accounting ice-berg, Key accounting terms: Assets, Liabilities, Income, Expenses, Four key terms in accounting, Sources of funds, Use of funds, The sources vs The uses , Types of Assets, Types of Liabilities, Types of Incomes, Types of Expenses, Tutorial: Key accounting terms: Assets, Liabilities, Income, Expenses, Identifying the category and sub category of various accounting terms.

Week 2: Accounting equation, GAAP Principle and Fundamentals of double entry system

Accounting equation, What is the accounting equation?, Working of accounting equation, Example: accounting equation, Summary: accounting equation, Walkthrough of Balance Sheet I, Walkthrough of Balance Sheet II, Walkthrough of Balance Sheet III, Walkthrough of Income Statement , Generally Accepted Accounting Principles I, Business Entity Concept, Money Measurement Concept, Going Concern Concept, Accounting Period Concept, Cost Concept, Generally Accepted Accounting Principles II, Conservatism Concept, Accrual Concept, Matching Concept, Full Disclosure Concept, Materiality, Recap and way forward, Types of accounts, What is an account?, What are types of accounts?, Tutorial - Types of accounts.

Week 3:

Planning: Types of Plans, Planning Process, Introduction to Strategic Management, Types of Strategies, Understanding environment of business: Environmental appraisal – Industry Analysis -

Porter's Model of competitive advantage, analysis of organizational resources and capabilities
Week 4: Forecasting and Premising : Introduction to Forecasting, Essential Components in Business Forecasting, Determinants of Business Forecasts, Benefits of Forecasting, Techniques of Forecasting, Limitations of Forecasting
Week 5: Decision-making: Introduction, Components of Decision-making, Decision-making Process, Group Decision-making, Creativity Problem-solving.
Week 6: Management by Objectives and Styles of Management : Core Concepts of MBO, Characteristics of Management by Objectives, Process of MBO, Defining the Goal, Action Plan, Final Review, Benefits of Management by Objectives, Limitations of Management by Objectives, Styles of Management, American Style of Management, Japanese Style of Management, Indian Style of Management
Week 7: Organizing and Directing: Introduction, Organizational Design, Hierarchical Systems , Organization Structure, Types of Organization Structure, Formal and Informal Organization, Factors Determining Span of Management, Centralization and Decentralization, Span of control, Understanding authority and responsibility, Principles of Delegation, Authority, Developing a culture of Innovation and performance.
Week 8: Staffing and Coordination: Introduction, Human Resource Management, Recent Trends in HRM, Technology in HRM, Economic Challenges, Workforce Diversity, Concept of Coordination, Need for Coordination, Importance of Coordination, Principles of Coordination, Coordination Process, Types of Coordination, Issues and Systems Approach to Coordination, Techniques of Coordination.
Week 9: Career Development Strategy: Introduction, Concept and Elements of Career, Overview of Career Development, Significance and Advantages of Career Development, Objectives of Career Development, Types of Career Development Programmes, Different Stages or Cycles of Career Development Process, Career Anchors, Steps in the Career Planning Process.
Week 10:

Leadership styles of Managers: Leadership Concept, Nature, Importance, Attributes of a leader, Role of a leader in demonstrating awareness of legal, personnel, and strategic issues relating to globalization, culture and gender diversity in an organization, Role of leader in conflict resolution and negotiations

Week 11:

Organizational Communication: Communication in Organizations: Introduction, Importance of Communication in the Workplace; Understanding Communication Process, Barriers to Communication, Use of tone, language and styles in Communication, Role of Perception in influencing communication, Role of culture in communication

Week 12:

Change management: Concept of change, change as a natural process, Importance & Causes of change – social, economic, technological, organizational, Developing a climate for learning, Concept of learning organizations Challenges of Contemporary Business: Role of Ethics, Corporate social responsibility, and environmental issues

Textbooks /Reference Books:

1. Stephen P. Robbins, David A. Decenzo, 2016. Fundamentals of Management, Pearson Education, 9th Edition
2. Harold Koontz, O'Donnell and Heinz Weihrich, 2012. Essentials of Management. New Delhi, 9th edition, Tata McGraw Hill
3. Management Fundamentals: Concepts, Applications, & Skill Development, 6th edition, Sage. 2014
4. Richard L. Daft, Principles of Management, Cengage Learning, 2009.
5. Robbins, Management, 9th Edition Pearson Education, 2008.

Self-Learning Course-2: Introduction to Embedded System Design

EE802A	PEC	Introduction to Embedded System Design	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: Nil	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Introduction to Embedded Systems and Computer Systems Terminology. Modular approach to Embedded System Design using Six-Box model: Input devices, output devices, embedded computer, communication block, host and storage elements and power supply.
Week 2: Microcontroller Based Embedded System Design. Salient Features of Modern Microcontrollers. Elements of Microcontroller Ecosystem and their significance.
Week 3: Design of Power Supply for Embedded Systems. Linear Regulator Topologies. Switching Power Supply Topologies. Power Supply Design Considerations for Embedded Systems.
Week 4: Introduction to MSP430 Microcontroller. MSP430 CPU Architecture. Programming Methods for MSP430. Introduction to Lunchbox Platform.
Week 5: Fundamentals of Physical Interfacing. Connecting Input Devices: Switches, Keyboard and Output devices: LEDs, Seven Segment Displays (SSD). Assignment: MCQ/MSQ
Week 6: Advanced Physical Interfacing: Driving load - high side, low side and H-bridge. Multiplexing displays including Charlieplexing. Shaft encoder.

Week 7:

Programming the MSP430. Basics of version control system - Git. Installing and using Code Composer Studio (CCS). Introduction to Embedded C. Interfacing LEDs and Switches with MSP430 using Digital Input and Output.

Week 8:

MSP430 Clock and Reset System. MSP430 Clock sources and distribution. Types of Reset sources. Handling Interrupts in MSP430. Writing efficient Interrupt Service Routine (ISR).

Week 9:

Interfacing Seven Segment Displays and Liquid Crystal Displays with MSP430. Low Power Modes in MSP430. Introduction to MSP430 Timer Module and its Modes of Operation.

Week 10:

Generating Pulse Width Modulation (PWM) using Timer Capture Mode. ADC operation in MSP430. Interfacing analog inputs. Generating random numbers using LFSR and other methods. Adding DAC to MSP430. Custom Waveform generation using MSP430.

Week 11:

Timer Capture Modes. Measuring frequency and time period of external signals and events. Serial Communication Protocols: UART, SPI, I2C. Interfacing Universal Serial Communication Interface (USCI) Module of the MSP430 for UART Communication. Advanced Coding Exercises based on Interrupt driven Programming. Building an Electronics Project.

Week 12:

Circuit Prototyping techniques. Designing Single Purpose Computers using Finite State Machine with Datapath (FSMD) approach. MSP430 Based Project Design and Implementation. Recap of Course Coverage.

Textbooks /Reference Books:

1. Designing Embedded Hardware, John Catsoulis. 2nd edition. Shroff Publishers and Distributors.
2. Embedded System Design: A Unified Hardware / Software Introduction. Tony Givargis and Frank Vahid. Wiley.
3. MSP430 Microcontroller Basics. John H. Davies. Elsevier.
4. Programming Embedded Systems in C and C++. Micheal Barr. Shroff Publishers and Distributors.

Self-Learning Course-2: Cloud Computing

EE802B	PEC	Cloud Computing	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: Nil	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Introduction to Cloud Computing
Week 2: Cloud Computing Architecture.
Week 3: Service Management in Cloud Computing.
Week 4: Data Management in Cloud Computing.
Week 5: Resource Management in Cloud
Week 6: Cloud Security
Week 7: Open Source and Commercial Clouds, Cloud Simulator.
Week 8: Research trend in Cloud Computing, Fog Computing

Week 9: VM Resource Allocation, Management and Monitoring
Week 10: Cloud-Fog-Edge enabled Analytics
Week 11: Serverless Computing and FaaS Model
Week 12: Case Studies and Recent Advancements.
Textbooks/Reference Books: 1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011 2. Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010 3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010 4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010

Self-Learning Course-2: Smart Grid: Basics to Advanced Technologies

EE802C	PEC	Smart Grid: Basics to Advanced Technologies	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: Nil	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Introduction to Smart Grid-I., Introduction to Smart Grid-II., Architecture of Smart Grid system, Standards for Smart Grid system, Elements and Technologies of Smart Grid System-I
Week 2: Elements and Technologies of Smart Grid System-II, Distributed Generation Resources-I, Distributed Generation Resources-II, Distributed Generation Resources-III, Distributed Generation Resources-I
Week 3: Introduction to energy storage devices Different types of energy storage technologies, Analytical modelling of energy storage devices, Optimal sizing and siting of storages, Battery management system (BMS)
Week 4: Wide area Monitoring Systems-I, Wide area Monitoring Systems-II, Phasor Estimation-I, Phasor Estimation-II, Digital Relays for Smart Grid Protection.
Week 5: Islanding Detection Techniques–I, Islanding Detection Techniques –II, Islanding Detection Techniques –III, Smart Grid Protection-I, Smart Grid Protection-II
Week 6: Smart Grid Protection-III, Smart Grid Protection-IV, Modelling of storage devices, Modelling of

DC smart grid components, Operation and control of AC Microgrid-I
Week 7: Operation and control of AC Microgrid –II, Operation and control of DC Microgrid –I, Operation and control of DC Microgrid –II, Operation and control of AC-DC hybrid Microgrid –I, Operation and control of AC-DC hybrid Microgrid -II
Week 8: Phasor measurement unit placement, Cyber security and resiliency, Virtual inertia and ancillary support, Demand side management of smart grid, Demand Response Analysis of smart grid
Week 9: Demonstration of solar power generation, Demonstration of wind power generation, Demonstration of Battery Management System, Demonstration of EV charging system, Hierarchical control techniques in hybrid ac-dc microgrid
Week 10: Simulation and case study of AC Microgrid, Simulation and case study of DC Microgrid, Simulation and case study of AC-DC Hybrid microgrid, Demonstration of parallel inverter operation in AC microgrid, Harmonic effects and its mitigation techniques.
Week 11: Energy management, Design of Smart Grid and Practical Smart Grid Case Study-I, Design of Smart Grid and Practical Smart Grid Case Study-II, System Analysis of AC/DC Smart Grid, Demonstration of grid-connected DC microgrid.
Week 12: Demonstration of energy management in microgrid, Demonstration of PHIL experimentation for symmetric and asymmetric fault analysis of grid-connected DFIG wind turbine, Demonstration of ancillary support from virtual synchronous generator, Demonstration on peak energy management using energy storage system, Conclusions.

Textbooks/ Reference Books:

1. Smart power grids by A Keyhani, M Marwali.
2. Computer Relaying for Power Systems by ArunPhadke
3. Microgrids Architecture and control by Nikos Hatziargyriou
4. Renewable Energy Systems by Fang Lin Luo, Hong Ye
5. Voltage-sourced converters in power systems_ modeling, control, and applications by Amirnaser Yazdani, Reza Iravani"

Self-Learning Course-2: Operations and Planning of Power Distribution Systems

EE802D	PEC	Operations and Planning of Power Distribution Systems	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: Nil	CA1: 10 Marks CA2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Contents:

Week 1: Introduction, overview, and Load modelling
Week 2: Load modelling
Week 3: Basic features of distribution systems
Week 4: Basic features of distribution systems.
Week 5: Reliability and Power quality assessment of distribution systems
Week 6: Reliability and Power quality assessment of distribution systems
Week 7: Distribution system load flow approach
Week 8:

Reactive power compensation in distribution systems
Week 9: Distribution system planning and reconfiguration: Different approaches
Week 10: Distribution system planning and reconfiguration: Different approaches.
Week 11: Active distribution networks with the integration of Distributed Generation (DG)
Week 12: Distribution system automation and smart grid
Textbooks /Reference Books: 1. T. Gonen. Electric Power Distribution System Engineering; CRC Press, 3rd Edition, 2014. 2. H. Lee. Willis. Power Distribution Planning Reference Book; CRC press; 2nd Edition, Revised and Expanded, 2004. 3. S. Pabla, Electric Power Distribution; Tata Mcgraw-Hill Publishing Company Ltd., 5th Edition, 2007. 4. Math Bollen and Fainan Hassan, Integration of Distributed Generation in the Power System; IEEE Press, 2011. 5. R. Billington and R. Allan, Reliability Evaluation of Power Systems; Springer, Berlin, 2nd Edition, 1996.

Internship

IFT03	PROJ	Internship	0-0-20	10 Credits

Teaching Scheme	Evaluation Scheme
Practical: --	CA1: 50 Marks CA2: 50 Marks End Semester Exam: 100 Marks

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

CO1	Apply foundational engineering knowledge to effectively address real-world industrial challenges during the internship.
CO2	Demonstrate heightened interpersonal communication skills by interpreting and expressing ideas effectively within various professional environments.
CO3	Apply a comprehensive understanding of industry activities and functions, showcasing the ability to navigate and contribute effectively in professional engineering settings.
CO4	Analyze and synthesize experiences, observations, and learned concepts from the internship to compose technically proficient reports for effective communication.
CO5	Apply professionalism, punctuality, and responsible task completion as manifestations of a strong work ethic within the internship.
CO6	Synthesize initiative, curiosity, and active engagement, creating a mindset conducive to meaningful contributions to assigned tasks during the internship period.

Description:

An essential step in bridging the knowledge gap between academic study and practical application for engineering students is the internship program. Minimum eighteen-week internship program begins at the end of the seventh semester and allows students to interact with industries, associations for professionals, or research facilities. Strong communication skills and a basic comprehension of technical topics are essential qualities. The course outcomes place a strong emphasis on developing interpersonal communication skills, confirming technical knowledge in real-world situations, comprehending industry processes in depth, and writing thorough technical reports. It is encouraged of students to be on time, act professionally, and take initiative in their internships.

Guidelines emphasize the need of communication and call on students to promptly and politely discuss any problems they may have with coordinators and supervisors. Additionally stressed are initiative, enthusiasm, and timely execution of duties assigned. After the internship, students must put together a thorough report that is an invaluable tool. This report is evaluated according to standards including uniqueness, sufficiency, structure, and real-world application of

principles learnt. In addition, a panel of experts evaluates the quality, efficiency, and organization of students' content delivery when assessing their presenting abilities.

A comprehensive assessment of the students' performance is provided by the overall evaluation, which also includes departmental reports and attendance records. The internship program's all-encompassing strategy attempts to promote engineering students' overall growth as they enter the workforce by instilling practical skills, industry understanding, and good communication.

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