

**MRSPTU B.TECH. (EE, ECE, ETE, EI, EEE) 1ST YEAR SYLLABUS 2019 BATCH
ONWARDS**

**GROUP-A
1ST SEMESTER**

Course		Contact Hrs.			Marks			Credits
Code	Name	L	T	P	Internal	External	Total	
BPHYS3-101	Physics (Waves and Optics and Introduction to Quantum Mechanics)	3	1	0	40	60	100	4
BMATH3-101	Mathematics-I (Calculus and Differential Equations)	3	1	0	40	60	100	4
BMECE0-101	Engineering Graphics & Design	2	0	0	40	60	100	2
BELEE0-101	Basics Electrical Engineering	3	1	0	40	60	100	4
BPHYS3-102	Physics (Wave, Optics & Quantum Mechanics) Lab.	0	0	2	60	40	100	1
BMECE0-102	Engineering Graphics & Design Lab.	0	0	6	60	40	100	3
BELEE0-102	Basics Electrical Engineering Lab.	0	0	2	60	40	100	1
BHUMA0-104	Drug Abuse: Problem, Management and Prevention	3	0	0	100	0	100	0
BCOBE0-101	Introduction to Concerned Branch of Engineering	2	0	0	100	0	100	0
Total		16	3	10	540	360	900	19

Note:

1. There will be Induction Programme of 3 weeks before start of normal classes.
2. Drug Abuse: Problem, Management and Prevention and Introduction to Concerned Branch of Engineering are non-credit Courses; however, it is necessary to secure at least E grade in each of them.

2ND SEMESTER

Course		Contact Hrs.			Marks			Credits
Code	Name	L	T	P	Internal	External	Total	
BCHEM0-101	Chemistry-I	3	1	0	40	60	100	4
BMATH3-201	Mathematics-II (Linear Algebra, Transform Calculus and Numerical Methods)	3	1	0	40	60	100	4
BHUMA0-101	English	2	0	0	40	60	100	2
BCSCE0-101	Programming for Problem Solving	3	0	0	40	60	100	3
BCHEM0-102	Chemistry-I Lab.	0	0	2	60	40	100	1
BHUMA0-102	English Lab.	0	0	2	60	40	100	1
BCSCE0-102	Programming for Problem Solving Lab.	0	0	4	60	40	100	2
BMFPR0-101	Manufacturing Practices	1	0	4	60	40	100	3
BHUMA0-103	Human Values & Professional Ethics	3	0	0	100	0	100	0
Total		15	2	12	500	400	900	20

Note:

1. Human Values & Professional Ethics is a non-credit Course; however, it is necessary to secure at least E grade in it.
2. Marks of 4 Week Manufacturing Practices Training during Summer Vacation will be included in 3rd Semester

**GROUP-B
1ST SEMESTER**

Course		Contact Hrs.			Marks			Credits
Code	Name	L	T	P	Internal	External	Total	
BCHEM0-101	Chemistry-I	3	1	0	40	60	100	4
BMATH3-101	Mathematics-I (Calculus and Differential Equations)	3	1	0	40	60	100	4
BHUMA0-101	English	2	0	0	40	60	100	2
BCSCE0-101	Programming for Problem Solving	3	0	0	40	60	100	3
BCHEM0-102	Chemistry-I Lab.	0	0	2	60	40	100	1
BHUMA0-102	English Lab.	0	0	2	60	40	100	1
BCSCE0-102	Programming for Problem Solving Lab.	0	0	4	60	40	100	2
BMFPR0-101	Manufacturing Practices	1	0	4	60	40	100	3
BHUMA0-103	Human Values & Professional Ethics	3	0	0	100	0	100	0
BCOBE0-101	Introduction to Concerned Branch of Engineering	2	0	0	100	0	100	0
Total		17	2	12	600	400	1000	20

Note:

1. There will be Induction Programme of 3 weeks before start of normal classes.
2. Human Values & Professional Ethics and Introduction to Concerned Branch of Engineering are non-credit Courses; however, it is necessary to secure at least E grade in each of them.

2ND SEMESTER

Course		Contact Hrs.			Marks			Credits
Code	Name	L	T	P	Internal	External	Total	
BPHYS3-101	Physics (Waves and Optics and Introduction to Quantum Mechanics)	3	1	0	40	60	100	4
BMATH3-201	Mathematics-II (Linear Algebra, Transform Calculus and Numerical Methods)	3	1	0	40	60	100	4
BMECE0-101	Engineering Graphics & Design	2	0	0	40	60	100	2
BELEE0-101	Basics Electrical Engineering	3	1	0	40	60	100	4
BPHYS3-102	Physics (Wave, Optics & Quantum Mechanics) Lab.	0	0	2	60	40	100	1
BMECE0-102	Engineering Graphics & Design Lab.	0	0	6	60	40	100	3
BELEE0-102	Basics Electrical Engineering Lab.	0	0	2	60	40	100	1
BHUMA0-104	Drug Abuse: Problem, Management and Prevention	3	0	0	100	0	100	0
Total		14	3	10	440	360	800	19

Note:

1. Drug Abuse: Problem, Management and Prevention is a non-credit Course; however, it is necessary to secure at least E grade in it.
2. Marks of 4 Week Manufacturing Practices Training during Summer Vacation will be included in 3rd Semester

PHYSICS (WAVES AND OPTICS AND INTRODUCTION TO QUANTUM MECHANICS)

Subject Code: BPHYS3-101

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3 1 0 4**

Duration: 38 Hrs.

UNIT-I

Electromagnetic Waves and Dielectrics: (10 Hrs.)

Introduction and physical significance of Gradient, Divergence & Curl, Dielectric polarization (qualitative only), Types of polarization, Displacement Current Maxwell's Equations, Equation of EM waves in free space, velocity of EM waves, Poynting vector, Electromagnetic Spectrum (Basic ideas of different region).

Propagation of Light and Geometric Optics: (10 Hrs.)

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction. Brewster's angle, total internal reflection. Huygens' principle, superposition of waves and interference of light by wave-front splitting and amplitude splitting; Young's double slit experiment, Newton's ring experiment. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

UNIT-III

Lasers and Applications: (8 Hrs.)

Spontaneous and stimulated emission, stimulated absorption, pumping and population inversion, Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO₂), solid-state lasers (ruby), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

UNIT-IV

Quantum Mechanics: (10 Hrs.)

Introduction to Quantum mechanics, Wave nature of particles, De Broglie's concept, Time-dependent and time-independent Schrodinger equation for wave-function, probability current, Free-particle wave-function and wave-packets, Uncertainty principle, application of uncertainty principle: nonexistence of electron in the nucleus, expectation value. Schrodinger equation for one dimensional problems– particle in a box, linear harmonic oscillator, Concept of scattering from a potential barrier and tunneling.

Recommended Books:

1. David Griffiths, 'Introduction to Electrodynamics'.
2. Gupta & Gaur, 'Engineering Physics', Dhanpat Rai.
3. Malik and Singh, 'Engineering Physics', Tata McGraw Hill.
4. Ian G. Main, 'Oscillations and Waves in Physics'.
5. H.J. Pain, 'The Physics of Vibrations and Waves'.
6. E. Hecht, 'Optics'.
7. Ghatak, 'Optics'.
8. O. Svelto, 'Principles of Lasers'.

MATHEMATICS-I (CALCULUS AND DIFFERENTIAL EQUATIONS)

Subject Code: BMATH3-101

L T P C

Duration: 47 Hrs.

3 1 0 4

UNIT –I

Calculus: (7 Hrs.)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima. Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Sequences and Series: (7 Hrs.)

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions.

UNIT –II

Multivariable Calculus: Differentiation: (10 Hrs.)

Limit, continuity and partial derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence: Geometrical interpretation and basic properties, Directional derivative.

UNIT –III

Multivariable Calculus-Integration: (12 Hrs.)

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes (statement only), Simple applications involving cubes, sphere and rectangular parallelepipeds.

UNIT –IV

First Order Ordinary Differential Equations: (5 Hrs.)

Linear and Bernoulli's equations, exact equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary Differential Equations of Higher Order: (6 Hrs.)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Frobenius method.

Recommended Books:

1. G.B. Thomas and R.L. Finney, 'Calculus and Analytic Geometry', Pearson, **2002**.
2. T. Veerarajan, 'Engineering Mathematics', McGraw Hill, New Delhi, **2008**.
3. B.V. Ramana, 'Higher Engineering Mathematics', McGraw Hill, New Delhi, **2010**.
4. B.S. Grewal, 'Higher Engineering Mathematics', Khanna Publishers, **2000**.
5. E. Kreyszig, 'Advanced Engineering Mathematics', John Wiley & Sons, **2006**.
6. W.E. Boyce and R.C. DiPrima, 'Elementary Differential Equations and Boundary Value Problems', Wiley India, **2009**.
7. S.L. Ross, 'Differential Equations', Wiley India, **1984**.
8. E.A. Coddington, 'An Introduction to Ordinary Differential Equations', Prentice Hall India, **1995**.
9. E.L. Ince, 'Ordinary Differential Equations', Dover Publications, **1958**.
10. G.F. Simmons and S.G. Krantz, 'Differential Equations', McGraw Hill, **2007**.

Course Outcomes:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful

in their disciplines.

The students will learn:

1. To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
2. The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
3. The tool of power series and Fourier series for learning advanced Engineering Mathematics.
4. To deal with functions of several variables that are essential in most branches of engineering.
5. The essential tool of matrices and linear algebra in a comprehensive manner.

ENGINEERING GRAPHICS & DESIGN

Subject Code: BMECE0-101

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Duration: 30 Hrs.

1. Introduction

Engineering Drawing/Engineering Graphics/Technical Drawing - a Visual Science. Types of Engineering Drawing, Introduction to drawing equipment and use of instruments. Symbols and conventions in drawing Practice. Types of lines and their use, BIS codes for lines, Technical lettering as per BIS codes, Introduction to Dimensioning, Concepts of scale in drawing, Types of scales. Basic Definition of geometrical objects: Points, lines, planes and solids.

2. Theory of Projections - Relevance of projection, Type of projections, Perspective, Orthographic, Axonometric and their basic principles, System of orthographic projection: in reference to quadrants and octants, illustration through simple problems of projection.

3. Projection of Points- Projection of points in quadrants and octants. Projection of point on Auxiliary planes.

4. Projection of Lines -Parallel to both H P and V P, Parallel to one and inclined to other, and inclined to both, contained in profile plane. True length and angle orientation of straight line: rotation method and auxiliary plane method. Distance between two nonintersecting lines, and trace of line.

5. Projection of Planes- Difference between plane and lamina. Projection of lamina Parallel to one and perpendicular to other, Perpendicular to one and inclined to other, Inclined to both reference planes, and Lamina oblique to three reference planes. Application of auxiliary planes, and trace of planes.

6. Projection of Solids- Definition of solids, types of solids, and elements of solids. Projection of solids in first or third quadrant, with axis parallel to one and perpendicular to other, axis parallel to one inclined to other, axis inclined to both the principle plane, axis perpendicular to profile plane and parallel to both H P and V P. Visible and invisible details in the projection. Use rotation and auxiliary plane method to draw the projections.

7. Section of Solids Definition of Sectioning and its purpose. Procedure of Sectioning, Types of sectional planes. Illustration through examples.

8. Development of Surface Purpose of development, Parallel line, radial line and triangulation method. Development of prism, cylinder, cone and pyramid surface for both right angled and oblique solids, and development of surface of sphere.
9. Isometric Projection Classification of pictorial views, Basic Principle of Isometric projection, Difference between isometric projection and isometric drawing. Isometric projection of solids such as cube, prism, pyramid and cylinder, and assignments on isometric projection of simple machine parts.
10. Orthographic Projection Review of principle of Orthographic Projection, Sketch/drawing of blocks, and of simple machine parts.

Recommended Text/Reference Books

1. N.D. Bhatt, V.M. Panchal & P.R. Ingle, 'Engineering Drawing', Charotar Publishing House, 2014.
2. M.B. Shah & B.C. Rana, 'Engineering Drawing and Computer Graphics', Pearson Education, 2008.
3. B. Agrawal & C.M. Agrawal, 'Engineering Graphics', TMH Publication, 2012.
4. K.L. Narayana & P. Kanniah, 'Text book on Engineering Drawing', Scitech Publishers, 2008.

BASIC ELECTRICAL ENGINEERING

Subject Code: BELEE0-101

**L T P C
3 1 0 4**

Duration: 42 Hrs.

UNIT-1

DC Circuits: (8 Hrs.)

Electrical circuit elements (R, L and C), voltage and current sources, Ohm's law, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation Superposition, Thevenin and Norton Theorems. Step response of RL, RC circuits.

UNIT-2

AC Circuits: (12 Hrs.)

Representation of sinusoidal waveforms, average, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC series and parallel combinations, series and parallel resonance. Three phase voltage source, phase sequence, three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-3

Transformers: (10 Hrs.)

Magnetic materials, BH characteristics, Single-phase Transformer, no load and full load conditions, phasor diagrams, equivalent circuit, calculation of losses in transformers, regulation and efficiency, Auto-transformers, their applications and comparison with two winding transformers.

UNIT-4

Electrical Machines: (8 Hrs.)

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Direct-On-Line and Star-Delta starters. Construction and working of single-phase motors (Split phase, shaded pole, capacitor start, capacitor run, capacitor start and run motors).

Electrical Installations: (4 Hrs.)

Components of LT Switchgear: Switch Fuse Unit (SFU), Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), Moulded Case Circuit Breaker (MCCB), Types of Wiring, Earthing.

Recommended Books:

1. D.P. Kothari and I.J. Nagrath, 'Basic Electrical Engineering', Tata McGraw Hill, **2010**.
2. D.C. Kulshreshtha, 'Basic Electrical Engineering', McGraw Hill, **2009**.
3. L.S. Bobrow, 'Fundamentals of Electrical Engineering', Oxford University Press, **2011**.
4. E. Hughes, 'Electrical and Electronics Technology', Pearson, **2010**.
5. V.D. Toro, 'Electrical Engineering Fundamentals', Prentice Hall, India, **1989**.
6. J.P.S. Dhillon. J.S. Dhillon and D. Singh, 'Principles of Electrical & Electronics Engineering', Kalyani Publishers, New Delhi, **2005**.

Course Outcomes:

1. To understand and analyze basic DC and AC circuits.
2. To study the use and working principle of single phase transformers.
3. To study the application and working principles of three phase and single phase induction motors.
4. To introduce to the components of low voltage electrical installations.

PHYSICS (WAVE, OPTICS & QUANTUM MECHANICS) LAB.

Subject Code: BPHYS3-102

L T P C

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Note: Students will have to perform at least 10 experiments from the given topic/list.

Experiments based on Wave, Optics & Quantum Mechanics (Broad Area):

Photoelectric effect experiment.

1. Frank Hertz Experiment.
2. Recording Hydrogen atom spectrum.
3. Diffraction and interference experiments (From ordinary light/laser pointers).
4. Measurements of speed of light on table top using modulation.
5. Minimum deviation from a prism.

Experiments based on the above mentioned topics:

1. To determine the numerical aperture of a given optic fibre and hence to find its acceptance angle.
2. To determine attenuation & propagation losses in optical fibres.
3. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
4. Study of diffraction using laser beam and thus to determine the grating element.
5. To study laser interference using Michelson's Interferometer.
6. To determine the grain size of a material using optical microscope.
7. To find the refractive index of a material/glass using spectrometer.
8. To find the refractive index of a liquid using spectrometer.
9. To find the velocity of ultrasound in liquid.
10. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.
11. To study the characteristic of different p-n junction diode - Ge and Si.
12. To analyze the suitability of a given Zener diode as voltage regulator.
13. To find out the intensity response of a solar cell/Photo diode.
14. To find out the intensity response of a LED.
15. To understand the phenomenon Photoelectric effect as a whole.

Physics Virtual Lab. Experiments:

16. To find the resolving power of the prism.
17. To determine the angle of the given prism.
18. To determine the refractive index of the material of a prism
19. To determine the numerical aperture of a given optic fibre and hence to find its acceptance angle.
20. To calculate the beam divergence and spot size of the given laser beam.
21. To determine the wavelength of a laser using the Michelson interferometer.

22. To set up and observe Newton's rings.
 23. To determine the wavelength of the given source.
 24. To understand the phenomenon Photoelectric effect as a whole.
 25. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
 26. To determine the Planck's constant from kinetic energy versus frequency graph.
 27. To plot a graph connecting photocurrent and applied potential.
 - 28. To determine the stopping potential from the photocurrent versus applied potential graph.**
- Note: Any other experiment based on the above mentioned broad topics may be included.**

ENGINEERING GRAPHICS & DESIGN LAB.

Subject Code: BMECE0-102

L T P C
0 0 6* 3

Duration: 45 Hrs.

1. Overview of Computer Graphics

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

2. Customization & CAD Drawing

Consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

3. Annotations, Layering & other Functions

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques.

* Lab work will be performed in two parts:

- (i) **Computer Lab (2 hours)** Computer Graphics, CAD Drawing etc.
- (ii) **Drawing Hall (04 hours)** Manual practice on drawing sheets of theory content the relevant theory part of Engineering Graphics & Design may also be covered in Lab work.

BASIC ELECTRICAL ENGINEERING LAB.

Subject Code: BELEE0-102

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EXPERIMENTS/DEMONSTRATIONS

1. To study basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. real-life resistors, capacitors and inductors.
2. To verify Ohm's law.
3. To verify Kirchhoff's voltage and current laws.
4. To verify Superposition Theorem.
5. To verify Thevenin Theorem.
6. To obtain the sinusoidal steady state response of R-L circuit – impedance calculation and verification. Observation of phase differences between current and voltage.
7. To obtain the sinusoidal steady state response of R-C circuit – impedance calculation and verification. Observation of phase differences between current and voltage.
8. To study resonance phenomenon in R-L-C series circuits.
9. To perform open circuit and short circuit test on a single phase transformer and calculate the efficiency.
10. Demonstration of cut-out sections of machines: Induction machine (squirrel cage rotor and slip ring arrangement) and single-phase induction machines.
11. To connect, start and reverse the direction of rotation by change of phase-sequence of connections of three phase induction motor.
12. To connect, start and reverse the direction of rotation of single-phase induction motor.
13. To demonstrate working of DOL starter for three-phase induction motor.
14. To demonstrate working of star-delta starter for three-phase induction motor.
15. To demonstrate the components of LT switchgear.

Laboratory Outcomes:

1. Get an exposure to common electrical components and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the usage of common electrical measuring instruments.
4. Understand the basic characteristics of transformers and electrical induction motors.

DRUG ABUSE: PROBLEM, MANAGEMENT AND PREVENTION

Subject Code: BHUMA0-104

L T P C

Duration: 30 Hrs.

3 0 0 0

UNIT-I

Meaning of Drug Abuse:

Meaning: Drug abuse, Drug dependence and Drug addiction. Nature and extent of drug abuse in India and Punjab.

UNIT-II

Consequences of Drug Abuse:

Individual: Education, Employment, Income.

Family: Violence.

Society: Crime.

Nation: Law and Order problem.

UNIT-III

Prevention of Drug Abuse:

Role of Family: Parent-child relationship, Family support, supervision, shipping values, active scrutiny.

School: Counselling, Teacher as role-model, Parent-teacher-health professional coordination, Random testing on students.

UNIT-IV

Treatment and Control of Drug Abuse:

Medical Management: Medication for treatment and to reduce withdrawal effects.

Psychological Management: Counselling, Behavioural and Cognitive therapy.

Social Management: Family, Group therapy and Environmental intervention.

Treatment: Medical, Psychological and Social Management.

Control: Role of Media and Legislation.

Recommended Books:

1. Ram Ahuja, 'Social Problems in India', Rawat Publications, Jaipur, 2003.
2. 'Extent, Pattern and Trend of Drug Use in India', Ministry of Social Justice and Empowerment, Govt. of India, 2004.
3. J.A. Inciardi, 'The Drug Crime Connection', Sage Publications, Beverly Hills, 1981.
4. T. Kapoor, 'Drug Epidemic among Indian Youth', Mittal Publications, New Delhi, 1985.
5. Kessel, Neil and Henry Walton, 'Alcoholism, Harmond Worth', Penguin Books, 1982.
6. Ishwar Modi and Shalini Modi, 'Addiction and Prevention', Rawat Publications, Jaipur, 1997.
7. 'National Household Survey of Alcohol and Drug Abuse', Clinical Epidemiological Unit, All India Institute of Medical Sciences, New Delhi, 2003 & 2004.
8. Ross Coomber and Others, 'Key Concept in Drugs and Society', Sage Publications, New Delhi, 2013.
9. Bhim Sain, 'Drug Addiction Alcoholism, Smoking Obscenity', Mittal Publications, New Delhi, 1991.
10. Ranvinder Singh Sandhu, 'Drug Addiction in Punjab: A Sociological Study', Guru Nanak Dev University, Amritsar, 2009.
11. Chandra Paul Singh, 'Alcohol and Dependence among Industrial Workers', Shipra, Delhi, 2000.
12. S. Sussman and S.L. Ames, 'Drug Abuse: Concepts, Prevention and Cessation', Cambridge University Press, 2008.
13. P.S. Verma, 'Punjab's Drug Problem: Contours and Characteristics', Vol. LII, No. 3, P.P. 40-43, Economic and Political Weekly, 2017.
14. 'World Drug Report', United Nations Office of Drug and Crime, **2016.**
15. 'World Drug Report', United Nations Office of Drug and Crime, **2017.**

CHEMISTRY-I

Subject Code: BCHEM0-101

L T P C
3 1 0 4

Duration: 42 Hrs.

Course Objectives

1. To understand the atomic and & molecular nature of various molecules
2. To understand the band structures
3. To elaborate the applications of spectroscopic techniques
4. To understand the thermodynamic functions and their applications
5. To rationalize periodic properties
6. To understand the concepts of stereochemistry and preparation of organic molecules

UNIT-I

1. Atomic and Molecular Structure: (12 Hrs.)

Bohr Theory of Hydrogen atom, Spectrum of H atom, Sommerfeld extension of Bohr Theory, Particle and wave nature of electron, De-Broglie equation, Aufbau principle, Compton effect, Schrodinger wave equation, Laplacian and Hamiltonian operator, Linear Combination of atomic orbitals. Molecular orbitals of diatomic molecules and Energy level diagrams of homonuclear and heteronuclear diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

UNIT-II

2. Spectroscopic Techniques and Applications: (8 Hrs.)

Principles and selection rules of Electronic spectroscopy and Fluorescence spectroscopy along with their applications. Principles and selection rules of Vibrational and rotational spectroscopy of diatomic molecules and their Applications. Nuclear magnetic resonance up to spin-spin coupling and magnetic resonance imaging.

3. Intermolecular Forces and Potential Energy Surfaces: (4 Hrs.)

Ideal gas equation, Ionic, dipolar and van Der Waals interactions. Real gas equation. Equations of state of real gases and critical phenomena. Potential energy surfaces of H₃, and HCN

UNIT-III

4. Use of Free Energy in Chemical Equilibria: (6 Hrs.)

Ideal Solution, Non Ideal Solutions, Thermodynamic functions: energy, entropy and free energy. Numerical problems based on entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Thermodynamic properties of ideal solutions. Introduction to Electrochemical Corrosion and its mechanism. Use of free energy considerations in metallurgy through Ellingham diagrams.

5. Periodic Properties: (4 Hrs.)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases principle

UNIT-IV

6. Stereochemistry: (4 Hrs.)

Representations of 3-dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis of butane. Isomerism in transitional metal compounds.

7. Organic Reactions and Synthesis of a Drug Molecule: (4 Hrs.)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule – β lactum, Paracetamol, Chloroquine and Aspirin

Recommended Books:

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

Course Outcomes:

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

1. Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalize bulk properties and processes using thermodynamic considerations.
3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
4. Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5. List major chemical reactions that are used in the synthesis of molecules.

MATHEMATICS-II

Subject Code: BMATH3-201

L T P C
3 1 0 4

Duration: 46 Hrs.

UNIT-I

Linear Algebra: (10 Hrs.)

Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

UNIT-II

Numerical Methods-I: (12 Hrs.)

Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

UNIT-III

Numerical Methods-II: (12 Hrs.)

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predictor-corrector methods. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

UNIT-IV

Transform Calculus: (12 Hrs.)

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.

Recommended Books:

1. D. Poole, 'Linear Algebra: A Modern Introduction', Brooks/Cole, **2005**.
2. B.S. Grewal, 'Higher Engineering Mathematics', Khanna Publishers, **2010**.
3. V. Krishnamurthy, V.P. Mainra and J.L. Arora, 'An Introduction to Linear Algebra', Affiliated East-West Press, **2005**.

Course Outcomes:

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

The students will learn:

1. The mathematical tools needed in evaluating multiple integrals and their usage.
2. The effective mathematical tools for the solutions of differential equations that model physical processes.
3. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

ENGLISH

Subject Code: BHUMA0-101

**L T P C
2 0 0 2**

Duration: 25 Hrs.

UNIT-I

1. Vocabulary Building:

The concept of Word Formation

Root words from foreign languages and their use in English

Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.

Synonyms, antonyms, and standard abbreviations.

UNIT-II

2. Basic Writing Skills:

Sentence Structures

Use of phrases and clauses in sentences

Importance of proper punctuation

Creating coherence

Organizing principles of paragraphs in documents

Techniques for writing precisely

UNIT-III

3. Identifying Common Errors in Writing:

Subject-verb agreement

Noun-pronoun agreement

Misplaced modifiers

Articles

Prepositions

Redundancies

Clichés

UNIT-IV

4. Nature and Style of Sensible Writing:

Describing

Defining

Classifying

Providing examples or evidence

Writing introduction and conclusion

5. Writing Practices:

Comprehension

Précis Writing

Essay Writing

Recommended Books:

1. Michael Swan, 'Practical English Usage', OUP, **1995**.
2. F.T. Wood, 'Remedial English Grammar', Macmillan, **2007**.
3. William Zinsser, 'On Writing Well', Harper Resource Book, **2001**.
4. Liz Hamp-Lyons and Ben Heasley, 'Study Writing', Cambridge University Press, **2006**.
5. Sanjay Kumar and Pushp Lata, 'Communication Skills', Oxford University Press, **2011**.
6. 'Exercises in Spoken English', Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Course Outcomes:

1. The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

PROGRAMMING FOR PROBLEM SOLVING

Subject Code: BCSCE0-101

**L T P C
3 0 0 3**

Duration: 41 Hrs.

UNIT-I

1. Introduction to Programming: (6 Hrs.)

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

2. Arithmetic Expressions and Precedence: (12 Hrs.)

Conditional Branching and Loops. Writing and evaluation of conditionals and consequent branching. Iteration and loops.

UNIT-II

3. Arrays: (5 Hrs.)

Arrays (1-D, 2-D), Character arrays and Strings

4. Basic Algorithms: (5 Hrs.)

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT-III

5. Function: (4 Hrs.)

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference

6. Recursion: (4 Hrs.)

Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT-IV

7. Structure: (3 Hrs.)

Structures, Defining structures and Array of Structures

8. Pointers: (2 Hrs.)

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

9. File Handling: (only if time is available, otherwise should be done as part of the lab)

Recommended Text Books:

1. Byron Gottfried, 'Schaum's Outline of Programming with C', McGraw Hill.

2. E. Balaguruswamy, 'Programming in ANSI C', Tata McGraw Hill.

Recommended Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, 'The C Programming Language', Prentice Hall of India.

Course Outcomes:

The student will learn

1. To formulate simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs (in C language).
3. To test and execute the programs and correct syntax and logical errors.
4. To implement conditional branching, iteration and recursion.
5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
6. To use arrays, pointers and structures to formulate algorithms and programs.
7. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
8. To apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration.

CHEMISTRY-I LAB.

Subject Code: BCHEM0-101

L T P C

0 0 2 1

Course Objectives:

1. To learn the preparation and standardization of solutions
2. To learn the estimation of various physical properties of given liquid samples
3. To estimate various crucial parameters for water sample
4. To learn the preparation of various molecules and detection of functional groups.

Choice of 10-12 experiments from the following:

1. Preparation of a standard solution
2. Determination of surface tension and viscosity
3. Thin layer chromatography
4. Determination of total Alkalinity/ Acidity of a water sample.
5. Determination of residual chlorine in water sample
6. Estimation of total, temporary and permanent hardness of water
7. Determination of the rate constant of a reaction
8. Determination of strength of an acid conductometrically
9. Potentiometry - determination of redox potentials and emfs
10. Synthesis of a polymer
11. Saponification /acid value of an oil
12. Detection and confirmation of organic functional groups.
13. Models of spatial orientation
14. To test the validity of Lambert Beer law/ Determination of $\lambda_{\max}$ / Determination of unknown concentration of a solution.
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Synthesis of a drug – Acetaminophen, Aspirin

Laboratory Outcomes:

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The

students will learn to:

1. Estimate rate constants of reactions from concentration of reactants/products as a function of time
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
3. Synthesize a small drug molecule and analyze a salt sample

ENGLISH LAB.

Subject Code: BHUMA0-102

L T P C
0 0 2 1

Oral Communication

(This unit involves interactive practice sessions in Language Lab.)

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

PROGRAMMING FOR PROBLEM SOLVING LAB.

Subject Code: BCSCE0-102

L T P C
0 0 4 2

NOTE: The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.

Tutorial 1: Problem solving using computers:

Lab 1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:

Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:

Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:

Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings

Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:

Lab 7: Simple functions

Tutorial 8 & 9: Numerical methods (Root finding, numerical differentiation, numerical integration):

Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls

Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures

Tutorial 12: File handling:

Lab 12: File operations

Laboratory Outcomes:

1. To formulate the algorithms for simple problems
2. To translate given algorithms to a working and correct program
3. To be able to correct syntax errors as reported by the compilers
4. To be able to identify and correct logical errors encountered at run time
5. To be able to write iterative as well as recursive programs
6. To be able to represent data in arrays, strings and structures and manipulate them through a program
7. To be able to declare pointers of different types and use them in defining self-referential structures.
8. To be able to create, read and write to and from simple text files.

MANUFACTURING PRACTICES (THEORY & LAB.)

Subject Code: BMFPR0-101

**L T P C
1 0 4 3**

Duration: 80 Hrs.

Lectures & Videos: (10 Hrs.)

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing Methods.
2. CNC machining, Additive manufacturing.
3. Fitting operations & power tools.
4. Sheet Metal Operations.
5. Electrical & Electronics.
6. Carpentry.
7. Plastic moulding (injection moulding, blow moulding, extrusion moulding), glass cutting.
8. Metal casting.
9. Welding (arc welding & gas welding), brazing.

Recommended Books:

1. S.K. Hajra Choudhury, A.K. Hajra Choudhury and S.K. Nirjhar Roy, 'Elements of Workshop Technology', Vol.-I, **2008** and Vol.-II **2010**, Media Promoters and Publishers Pvt. Ltd., Mumbai.
2. S. Kalpakjian, Steven S. Schmid, 'Manufacturing Engineering and Technology', 4th Edn., Pearson Education India Edn., 2002.
3. Gowri P. Hariharan and A. Suresh Babu, 'Manufacturing Technology – I', Pearson, 2008.
4. Roy A. Lindberg, 'Processes and Materials of Manufacture', 4th Edn., Prentice Hall India, 1998.
5. P.N. Rao, 'Manufacturing Technology', Vol.-I and Vol.-II, Tata McGraw Hill House, 2017.

Course Outcomes:

1. Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Workshop Practice: (70 Hrs.)

1. Machine shop (10 Hrs.)
2. Fitting shop (8 Hrs.)
3. Carpentry (6 Hrs.)
4. Electrical & Electronics (8 Hrs.)
5. Welding shop (8 Hrs. (Arc welding 4 Hrs. + Gas welding 4 Hrs.))
6. Casting (8 Hrs.)
7. Sheet Metal Operations (10 Hrs.)
8. Smithy (6 Hrs.)

9. Plastic moulding & Glass Cutting (6 Hrs.)

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

Laboratory Outcomes:

1. Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
2. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. By assembling different components, they will be able to produce small devices of their interest.

HUMAN VALUES AND PROFESSIONAL ETHICS

Subject Code: BHUMA0-103

**L T P C
3 0 0 0**

Duration: 20 Hrs.

UNIT-I (8 Hrs.)

Meaning of values, Values as social fact, Universal values – equality, justice, freedom/ liberty, inclusion. Distinction between social and culture values and values associated with crafts and occupations. Work and leisure as values – Marx and Veblen

UNIT-II (9 Hrs.)

Values, morality, ethics and their relation with Religion, values as mechanisms of control and coercion. Functional Theory of Values of Talcott Parsons, Theory of Basic Values of Shalom Schwartz, Theory of Protestant Ethic and Capitalism of Max Weber, Bhagwat Gita and Theory of Karma-Dharma, Sikhism and theory of work, dignity of labour, meditation and sharing.

UNIT-III (7 Hrs.)

Meaning and types of Professional Ethics, Goals of professional work and their problems, Normative and evaluative elements in professional work, Duties and obligations, Professional rights, Virtues in professional life (honesty, trustworthiness, transparency, competence, integrity and exemplary conduct), Engineering ethics and service ideals.

UNIT-IV (6 Hrs.)

Technology for and against mankind and environment- fulfilment of human needs, and industrial disasters: case studies – Bhopal Gas Tragedy, Chernobyl and Fukushima Disasters; Equality at work place: gender discrimination and caste/class-based exclusions.

Recommended Books:

1. Schwartz, H. Shalom, 'An Overview of the Schwartz Theory of Basic Values'. Online Readings in Psychology and Culture. **2** (1). doi:10.9707/2307-0919.1116, **2012**.
2. John Berry, Janek, Pandey; Poortinga, Ype 'Handbook of Cross-cultural Psychology', 2nd Edn.. Boston, MA: Allyn and Bacon. p. 77. ISBN 9780205160747, **1997**.
3. Timo Airaksinen, 'The Philosophy of Professional Ethics', University of Helsinki, Finland.
4. Manju Jitendra Jain, 'Yes, It's Possible', Kalpana Publications, Mumbai, **2011**.

INTRODUCTION TO ELECTRICAL ENGINEERING

Subject Code: BCOBE0-101

**L T P C
2 0 0 0**

Duration: 24 Hrs.

Learning Objectives:

1. To make the students aware about the **major study areas** of Electrical Engineering.
2. To make them familiar with **the main subjects** under these study areas.

3. To provide some insight to the **contents of these subjects** by introductory topics.

UNIT I (03 Hours)

Preface to Basics of Electrical Engineering & Measurement

Electrical Engineering Fundamentals: Basics of electrical elements, circuit laws and network theorems, time & frequency domain analysis, network synthesis and filters synthesis

Electrical Measurements & Instrumentation: Introduction to various indicating and integrating instruments, analog and digital instruments, measurement of electrical quantities: R, L, C using bridges different types of transducers, display devices and recorders, their classification and application, introduction to telemetry and SCADA.

UNIT II (03 Hours)

Preface to Electronics Engineering

Analog Electronics: Diodes, bipolar junction transistor (BJT), field effect transistor (FET), MOSFET, rectifiers, op amp, oscillators.

Digital Electronics: Number System: binary, decimal, octal, hexadecimal and their inter conversions: binary to decimal, decimal to binary, octal, hexadecimal, binary addition, subtraction, multiplication & division. Logic gates & truth tables, encoder, decoder, multiplexer, demultiplexer, D/A & A/D converter. Flip flops & semiconductor memories.

Power Electronics: Introduction to Thyristors, DIAC, TRIAC, SCR and their switching characteristics, controlled rectifiers, half wave, full wave & bridge converter, dual converters, inverters, choppers, cycloconverters.

UNIT III (03 Hours)

Preface to Electrical Machines

Transformers: Introduction to transformer, working principle, construction of single phase transformer, three phase transformer, auto transformer, winding connections, cooling techniques.

DC Machines: DC machine construction and working principle, motor and generator working, types, characteristics, speed control of dc motor, losses and applications.

Induction Motors: Introduction to working principle and construction of induction motors, various sizes and their applications.

Synchronous Machines: Working principle and parts of synchronous machine, application of synchronous alternator in power plants.

UNIT-IV (05 Hours)

Preface to Control Systems

Linear Control Systems: control requirements and examples of industrial control problems, study of open loop and closed loop feedback control systems and their characteristics, study of frequency –response analysis.

Non-Linear Digital Control Systems: Brief discussion about state variable representation of systems by various methods, solution of state variable model. Controllability and observability. Introduction to sampled data system and describing function analyses. Z-transform.

Computer Architecture: Introduction to computer architecture, processor and control unit, computer applications.

Microprocessor & Micro-Controllers: Introduction to microprocessors and their applications, classification of instructions, interfacing a microprocessor. Micro-Controller and its comparison with microprocessor, microcontroller applications.

Programmable Logic Controllers (PLC): Introduction to PLC, Operation of PLC, programming languages, ladder logic, basic elements used such as timers, counters etc.

UNIT V (04 Hours)

Preface to Generation and Utilization of Electricity

Generation of Electrical Power: Fundamentals of power generation, load factor, demand factor, capacity factor, utilization factor, base and peak load plants, operating and fixed cost of

power plant, tariff and power factor improvement, economical operation of steam plant, hydro thermal coordination.

Power Plant Engineering: Introduction to various power plants: steam power plant, hydro power plants, nuclear power plants, gas and diesel power plants, pollution control methods.

Distribution of Electrical Power: DC 2-wire and 3-wire systems, AC single phase, three phase and 4- wire systems, primary and secondary distribution systems.

Transmission of Electrical Power: Line parameters; calculation of inductance and capacitance of single and double circuit transmission lines, ABCD constants, short, medium and long lines. Line performance: regulation and efficiency of short, medium and long lines, classification of cables based upon voltage and dielectric material, insulation resistance.

Switchgear and Protection: Introduction to circuit breaker, protective relays, bus bar protection, transformer protection, generator protection, bus bar protection.

Utilization of Electrical Energy: Introduction to electrical drives & mechanical drives, various types of traction system, methods of electric heating & welding, production of light by different methods, terms used, laws of illumination, refrigeration and air conditioning, laws of electrolysis.

UNIT VI (02 Hours)

Preface to Miscellaneous Topics

Fundamentals of High Voltage Engineering: Insulating materials for high voltage, conduction and breakdown in gases, liquids and solid dielectrics, generation and measurement of high voltages and currents.

Power Transmission using High Voltages: Extra High Voltage (EHVAC) Transmission, High Voltage Direct Current (HVDC) Transmission.

Electro Magnetic Field Theory: Review of vector analysis, electrostatics, steady magnetic field, Maxwell's equations and Poynting vector, electromagnetic waves.

Non-Conventional Energy Sources: Limitation of conventional energy sources, need and growth of alternative energy source, application of direct energy conservation. Geothermal system, hydro-electric plants, wind power, tidal energy, Bio-mass energy.

INTRODUCTION TO ELECTRONICS & COMMUNICATION ENGINEERING

Subject Code: BCOBE0-101

**L T P C
2 0 0 0**

Duration: 30 Hrs.

Course Objectives:

1. To make the students aware about the major study areas of Electrical Engineering.
2. To make them familiar with the main subjects under these study areas.
3. To make the students aware about the major advantages of Electronics & Communication Engineering.
4. To provide some insight to the various professional opportunities/ Recruiters and higher education opportunities.

Course Outcomes:

1. Students shall be able to know about various diversified fields which they can take up as their career.
2. Students shall be able to appreciate the role of Electronics and Communication in Day to Day life.
3. Students shall be able to appreciate the role of an Electronics Engineer towards Nation Building.

Unit-I (7 Hrs)

Preface to Basics of Electronics and Communication Engineering

Electronics and Communication Engineering Fundamentals: Introduction and familiarization with various electronic/electrical components- Resistors, Capacitors, Inductors and Transformers, diodes, LEDs, , ICs, bread boards, CRO, Function Generator, Power Supply, Multi-Meter, IC Tester, soldering techniques.

UNIT-II (8 Hrs)

Introduction to Analog Electronics: Introduction to an Electronic system, Various components of electronic system, introduction to semiconductors and their classifications, junction diodes, bipolar junction transistor, field effect transistor their operation and application as switch and amplifier

Unit-III (8 Hrs)

Introduction to Digital Electronics, Difference between analog and digital signals and systems, various logic gates, introductory concept of combinational and sequential circuits, microprocessors and microcontrollers.

Unit-IV (7 Hrs)

Introduction to Electronics Communication: Wired and wire-less electronic communication, need for wireless communication, electromagnetic model for communication, EM spectrum, various forms of communication like optical fibre/mobile/satellite/microwave and radar communication, conceptual knowledge of 2G, 3G, 4G and 5G communication.

B. TECH. ELECTRICAL ENGG. SYLLABUS 2018 BATCH ONWARDS
(UPDATED ON 24.05.2019)

Semester III [Second year]

Sr. No	Course Code	Course Title	Hours per week			Marks			Credits
			L	T	P	Int	Ext	Total	
1.	BELES1-301	Electrical Circuit Analysis	3	1	0	40	60	100	4
2.	BELES1-302	Analog Electronic Circuits	3	0	0	40	60	100	3
3.	BELES1-303	Analog Electronic Circuit Lab	0	0	2	60	40	100	1
4.	BELES1-304	Electrical Machine – I	3	1	0	40	60	100	4
5.	BELES1-305	Electrical Machine Lab-I	0	0	2	60	40	100	1
6.	BELES1-306	Electromagnetic Fields	3	1	0	40	60	100	4
7.	BELES1-307	Institutional Training	0	0	--	60	40	100	2
8.	BMECE0-001	Engineering Mechanics	3	1	0	40	60	100	4
9.	BMNCC0-002	Environment Science	2	0	0	--	--	--	0
		Total	17	4	4	380	420	800	23

#Workshop training will be imparted in the institution at the end of 2nd semester for four weeks duration (Minimum 30 hours Per week). Industrial tour will also form a part of this training.

Semester IV [Second year]

Sr. No	Course Code	Course Title	Hours per week			Marks			Credits
			L	T	P	Int.	Ext	Total	
1.	BELES1-401	Digital Electronics	3	0	0	40	60	100	3
2.	BELES1-402	Digital Electronics Lab	0	0	2	60	40	100	1
3.	BELES1-403	Electrical Machines – II	3	1	0	40	60	100	4
4.	BELES1-404	Electrical Machines–II Lab	0	0	2	60	40	100	1
5.	BELES1-405	Power Electronics	3	0	0	40	60	100	3
6.	BELES1-406	Power Electronics Lab	0	0	2	60	40	100	1
7.	BELES1-407	Signals and Systems	3	1	0	40	60	100	4
8.	BMATH3-301	Mathematics-III (Probability & Statistics)	3	1	0	40	60	100	4
9.	BMNCC0-001	Constitution of India	2	0	0	--	--	--	0
		Total	17	3	6	380	420	800	21

#After 4th semester, student will go for 6-Week Institutional/Industrial Training in which he/she should cover at least one of the software; such as: MATLAB/LabVIEW/C/C++/Automation/AutoCAD (Electrical)/Data Analysis using Excel or the upcoming advanced software which may be useful for Electrical Engineering.

B. TECH. ELECTRICAL ENGG. SYLLABUS 2018 BATCH ONWARDS
(UPDATED ON 24.05.2019)

ELECTRICAL CIRCUIT ANALYSIS

Sub Code: BELES1-301	L	T	P	C	Duration: 60 Hrs.
	3	1	0	4	

UNIT 1

Network Theorems (14 Hours)

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of Duality and dual networks.

UNIT 2

Solution of First and Second Order Networks (10 Hours)

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

UNIT 3

Sinusoidal Steady State Analysis (12 Hours)

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

UNIT 4

Electrical Circuit Analysis using Laplace Transforms (12 Hours)

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

UNIT 5

Two Port Network and Network Functions (12 Hours)

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Text / References:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.

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3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.
6. Mohan, Sudhakar Sham, 'Circuits and Networks Analysis and Synthesis', TMH, 2005.

Course Outcomes:

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

- 1) Apply network theorems for the analysis of electrical circuits.
- 2) Obtain the transient and steady-state response of electrical circuits.
- 3) Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
- 4) Analyse two port circuit behaviour.

ANALOG ELECTRONIC CIRCUITS

Sub Code: BELES1-302

L	T	P	C
3	0	0	3

Duration: 45 Hrs.

UNIT 1

Diode Circuits

(5 Hours)

Introduction to Semiconductors and their classifications, P-N junction diode, I-V characteristics of a PN diode, PN diode as half-wave and full-wave rectifiers, Clamping and clipping device, Zener diode, Zener diode as voltage regulator.

BJT Circuits

(10 Hours)

Bipolar Junction Transistor (BJT) and its operation, Various BJT configurations and I-V characteristics, Biasing techniques and bias stability, BJT as a switch, BJT as an amplifier: Small-signal model, Current mirror; Common-emitter, Common-base and Common-collector amplifiers; Small signal equivalent circuits, High-frequency equivalent circuits.

UNIT 2

Field Effect Transistor Circuits

(8 Hours)

Field Effect Transistor and its operation, various configurations and I-V characteristics, Biasing techniques, FET as a switch and as an amplifier, MOS capacitor, C-V characteristics.

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

UNIT 3

Operational Amplifiers

(10 Hours)

Differential amplifier; Basic structure and principle of operation, Ideal op-amp, Non-idealities in an op-amp such as; Output offset voltage, Input bias current, Input offset current, Slew rate, Gain bandwidth product, calculation of differential gain, common mode gain, CMRR and ICMR, OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation.

UNIT 4

Applications of OP-AMP

(12 Hours)

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, Integrator and Differentiator, Summing amplifier, Differential amplifier, Instrumentation amplifier, Active filters: Low pass, high pass, band pass and band stop, design guidelines, Voltage regulator, Oscillators (Wein bridge and phase shift).

Hysteresis comparator, Zero crossing detector, Schmitt trigger and its applications, Square-wave and triangular-wave generators, Precision rectifier, Peak detector, Monoshot vibrator.

Text/References:

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

Course Outcomes:

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

1. Understand the characteristics of transistors.
2. Design and analyse various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.

B. TECH. ELECTRICAL ENGG. SYLLABUS 2018 BATCH ONWARDS
(UPDATED ON 24.05.2019)

ANALOG ELECTRONIC CIRCUITS LAB

Sub Code: BELES1-303	L	T	P	C
	0	0	2	1

EXPERIMENTS

1. To draw V-I characteristics of PN junction diode.
2. To draw V-I characteristics of Zener diode.
3. To analyse the response of Zener diode as regulator.
4. To study the response of clamping and clipping circuits.
5. To analyse the response of half wave, full wave and Bridge rectifiers.
6. To study and compare various biasing techniques for transistors.
7. To plot the input and output characteristics of CE configuration.
8. To plot the input and output characteristics of CB configuration.
9. To plot the input and output characteristics of CC configuration.
10. To plot the characteristics of JFET.
11. To plot the characteristics of MOSFET.
12. To discuss the response of RC phase shift oscillator and determine frequency of oscillation.
13. To analyse the response of Wien Bridge oscillator and determine frequency of oscillation.
14. Study of OP-AMP as inverting amplifier.
15. Use OP-AMP as a differentiator.
16. Use of OP-AMP as an integrator circuit.
17. OP-AMP as square wave/triangular wave generator.

Note: At least ten experiments should be performed in semester.

ELECTRICAL MACHINES – I

Sub Code: BELES1-304	L	T	P	C	Duration: 60 Hrs.
	3	1	0	4	

UNIT 1

Magnetic Fields and Magnetic Circuits

(14 Hours)

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air

Influence of highly permeable materials on the magnetic flux lines, B-H curve of magnetic materials; flux-linkage v/s current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit.

UNIT 2

DC Machines

(14 Hours)

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil.

Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

UNIT 3

DC machine - Motoring and Generation

(14 Hours)

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series.

Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed, V-I characteristics and Torque-speed characteristics of separately excited, shunt and series motors.

Speed control through armature voltage, Losses, Load testing and back-to-back testing of DC machines

UNIT 4

Transformers

(18 Hours)

Single-phase transformers - Principle, construction and operation of, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses

Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers,

Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current,

Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

Text / References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.

B. TECH. ELECTRICAL ENGG. SYLLABUS 2018 BATCH ONWARDS (UPDATED ON 24.05.2019)

2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Course Outcomes:

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

1. Understand the concepts of magnetic circuits.
2. Understand the operation of D.C. machines.
3. Analyse the differences in operation of different D.C. machine configurations.
4. Analyse single phase and three phase transformers circuits.

ELECTRICAL MACHINES LAB - I

Sub Code: BELES1-305

L	T	P	C
0	0	2	1

EXPERIMENTS

1. To study three point and four point starters of D.C. shunt motor.
2. To obtain torque and speed characteristics of different types of D.C. motors.
3. To obtain external characteristics of D.C. shunt generators.
4. To obtain external characteristics of D.C. series generators.
5. Speed control of a D.C. shunt motor by varying armature circuit and field circuit methods.
6. To calculate the power rating of D.C. machines.
7. To determine losses and efficiency of various types of D.C. machines.
8. To check the transformation ratio and polarity of single phase transformer.
9. To perform open and short circuit test on single phase transformer and to determine its efficiency
10. To perform load test on a single phase transformer and to determine voltage regulation.
11. To perform parallel operation on single phase transformers.

Note: At least ten experiments should be performed in a semester.

Course Objectives

1. To understand the characteristics of D.C. Machines.
2. To understand speed control methods and testing methods.
3. To determine efficiency and voltage regulation of transformers.

Course Outcomes

1. To acquire skills to operate all types of D.C. machines.
2. Ability to analyse the speed control methods and efficiency of DC machines.
3. To be able to compute efficiency and voltage regulation of transformers.

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(UPDATED ON 24.05.2019)

ELECTROMAGNETIC FIELDS

Sub Code: BELES1-306

L	T	P	C
3	1	0	4

Duration: 60 Hrs.

UNIT 1

Review of Vector Calculus

(12 Hours)

Vector algebra, addition, subtraction, Components of vectors, Scalar and vector multiplications, Triple products, Three orthogonal coordinate systems (rectangular, cylindrical and spherical), Vector calculus, differentiation, Partial differentiation, Integration, Vector operator del, Gradient, Divergence and curl; Integral theorems of vectors, Conversion of a vector from one coordinate system to another.

UNIT 2

Static Electric Field

(8 Hours)

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, surface and volume charge distributions. Gauss law and its applications. Absolute electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic energy and energy density.

Conductors, Dielectrics and Capacitance

(10 Hours)

Current and current density, Ohms law in point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

UNIT 3

Static Magnetic Fields

(6 Hours)

Biot-Savart Law, Ampere law, Magnetic flux and magnetic flux density, Scalar and vector magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Magnetic Forces, Materials and Inductance

(8 Hours)

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, Inductances and mutual inductances.

UNIT 4

Time Varying Fields and Maxwell's Equations

(6 Hours)

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional electromotive forces. Boundary conditions.

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Electromagnetic Waves

(10 Hours)

Derivation of wave equation, Uniform plane waves, Maxwell's equation in phasor form, Wave equation in phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect, Poynting theorem.

Text / References:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
5. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.

NOTE: This course shall have Lectures and Tutorials. Most of the students find it difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.

Course Outcomes:

At the end of the course, students will demonstrate the ability

1. To understand the basic laws of electromagnetism.
2. To obtain the electric and magnetic fields for simple configurations under static conditions.
3. To analyse time varying electric and magnetic fields.
4. To understand Maxwell's equation in different forms and different media.
5. To understand the propagation of EM waves.

ENGINEERING MECHANICS

Subject Code: BMECE0-001

L	T	P	C
3	1	0	4

Duration: 60 Hrs.

Course Objectives:

1. The concepts of friction in screw jack & inclined plane.
2. To draw shear force and bending moment diagrams by analytical method
3. To find forces in simple trusses by using joints and section methods
4. The concepts related to torsions and mechanics of fluids.

UNIT-I

Introduction to Engineering Mechanics

(14 Hours)

Force Systems, Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its

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Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.

UNIT-II

Friction

(13 Hours)

Types of Friction, Limiting Friction, Angle of Repose, Coefficient of Friction, Laws of Friction, Static & dynamic Friction, Screw Jack, Minimum force required to drag a body on rough horizontal plane, body tending to move upwards on an inclined plane, body moving down the plane.

UNIT-III

Centroid, Centre of gravity and Moments

(21 Hours)

Centroid of composite sections, Parallel & perpendicular axes theorem, Moment of area, Moment of inertia of standard sections and composite sections, mass moment of inertia of cylinder cone sphere, and Polar moment of inertia, Shear force and bending moment diagram, simple trusses, Method of joints, Method of section

UNIT-IV

Kinematics of Particles

(12 Hours)

Rectilinear motion, plane curvilinear motion-rectangular coordinates, normal and tangential component, Kinetics of Particles: Equation of motion, rectilinear motion and curvilinear motion, work energy equation, conservation of energy, impulse and momentum, conservation of momentum, impact of bodies, co-efficient of restitution, loss of energy during impact.

Expected Outcomes:

After going through these contents the student shall be able to solve the simple problems related to:

1. Kinematics of particles,
2. Co-planar and concurrent forces,
3. Solids mechanics,
4. Moment of inertia and centre of gravity
5. Role of friction in screw Jack and inclined planes.

Recommended Books:

1. Theory of machines by V.P Singh Dhanpat rai & Co
2. Jindal U.C Engineering Mechanics Part-I, Galgotia Publications
3. Sadhu Singh, 'Strength of Materials', Khanna Publishers
4. Dr. Kirpal Singh, 'Mechanics of Materials', Standard Publishers
5. E.P. Popov, 'Mechanics of Materials', Pearson Education
6. K.L. Kumar, 'Engineering Fluid Mechanics', S. Chand
7. P.N. Chandramouli, 'Engineering Mechanics', PHI

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(UPDATED ON 24.05.2019)

ENVIRONMENTAL SCIENCES

(Mandatory Non-Credited course)

Sub. Code-BMNCC0-002	L	T	P	C
	2	0	0	0

Course Objectives:

1. To identify global environmental problems arising due to various engineering/industrial and technological activities and the science behind these problems.
2. To realize the importance of eco-system and bio-diversity for maintaining ecological balance.
3. To identify the major pollutants and abatement devices for environmental management and sustainable development.
4. To estimate the current world population scenario and thus calculating the economic growth, energy requirement and demand.
5. To understand the conceptual process related with the various climatologically associated problems and their plausible solutions.

UNIT-I

The Multi-disciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness.

Natural Resources: Renewable and Non-renewable Resources: Natural resources and associated problems.

Forest Resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

Water Resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food Resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

Energy Resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.

Land Resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification

Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.

UNIT-II

Environmental Pollution: Definition, causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution

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Solid Waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies,

Disaster management: floods, earthquake, cyclone and landslides.

UNIT-III

Social Issues and the Environment: From unsustainable to sustainable development, **Urban Problems:** related to Energy, Water conservation, Rain water harvesting, Watershed management, Resettlement and rehabilitation of people; its problems and concerns, Wasteland reclamation, Consumerism and waste products, Case studies.

Environmental Ethics: Issues and possible solutions, Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear accidents and Holocaust, Case studies.

Protection Acts: Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife protection Act, Forest conservation Act, Issues involved in enforcement of environmental legislation

UNIT-IV

Human Population and the Environment: Population growth, Variation among nations, Population explosion – Family Welfare Programmes, Environment and human health, Human rights, Value education, HIV/AIDS, Women and child welfare, Role of information technology in environment and human health, Case studies.

Environmental Science related activities:

We as human being are not an entity separate from the environment around us. Rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two types of activities.

(a) Awareness Activities:

- i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste.
- ii) Slogan making event
- iii) Poster making event
- iv) Cycle rally
- v) Lectures from experts.

(b) Actual Activities:

- i) Plantation
- ii) Gifting a tree to see its full growth
- iii) Cleanliness drive
- iv) Drive for segregation of waste
- v) To live with some big environmentalist for a week or so to understand his work
- vi) To work in kitchen garden for mess
- vii) To know about the different varieties of plants
- viii) Shutting down the fans and ACs of the campus for an hour or so

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(UPDATED ON 24.05.2019)

DIGITAL ELECTRONICS

Sub Code: BELES1-401	L	T	P	C	Duration: 45 Hrs.
	3	0	0	3	

UNIT 1

Fundamentals of Digital Systems and Logic families (10 Hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates

Number systems-binary, signed binary, octal and hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes.

UNIT 2

Combinational digital circuits (10 Hours)

Standard representation for logic functions, Simplification of logic functions using K-map, Minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders,

Adders, Subtractors, BCD arithmetic, Carry look ahead adder, Serial adder, Arithmetic and Logic unit (ALU), elementary ALU design, popular MSI chips.

Digital comparator, Parity checker/generator, Code converters, Priority encoders, Decoders/drivers for display devices.

UNIT 3

Sequential Circuits and Systems (10 Hours)

Flip-flops and Registers: A 1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, J- K, D and T flip-flops, Applications of flip-flops, Shift registers, Applications of shift registers, Serial to parallel converter, Parallel to serial converter.

Counters: Ring counter, Sequence generator, Ripple(Asynchronous) counters, Synchronous counters, Counters design using flipflops, special counter IC's, Asynchronous sequential counters, applications of counters.

UNIT 4

Semiconductor memories and Programmable logic devices (6 Hours)

Memory organization and operation, Expanding memory size, Classification and characteristics of memories, Sequential memory, Read only memory (ROM), Read and write memory(RAM), Content addressable memory (CAM), Charge de-coupled device memory (CCD),

B. TECH. ELECTRICAL ENGG. SYLLABUS 2018 BATCH ONWARDS (UPDATED ON 24.05.2019)

Commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, Complex programmable logic devices (CPLDs), Field programmable gate array (FPGA).

Analog-to-Digital (A/D) and Digital-to-Analog (D/A) Converters (9 Hours)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit,

Analog to digital converters: quantization and encoding, Parallel comparator A/D converter, Successive approximation A/D converter, Counting A/D converter, Dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, Example of A/D converter ICs.

Text/References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
4. Malvino and Leach, "Digital Principles and Applications", TMH, 4th Ed. 1991

Course Outcomes:

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

1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Be able to use PLDs to implement the given logical problem.

DIGITAL ELECTRONICS LAB

Sub Code: BELES1-402	L	T	P	C
	0	0	2	1

EXPERIMENTS

1. To Study Logic Gates: Truth-table verification of OR, AND, NOT, XOR, NAND and NOR gates and realization of OR, AND, NOT and XOR functions using universal gates.
2. To design Half Adder using Logic gates on bread board.
3. To design Full Adder using Logic gates on bread board.
4. To design Half Subtractor using Logic gates on bread board.
5. To design Full Subtractor using Logic gates on bread board.
6. To design 4-Bit Binary-to-Gray Code Converter on bread board.
7. To design 4-Bit Gray-to-Binary Code Converter on bread board.
8. To study and design 4-Bit magnitude comparator using logic gates on bread board.

B. TECH. ELECTRICAL ENGG. SYLLABUS 2018 BATCH ONWARDS (UPDATED ON 24.05.2019)

9. Design and verification of Truth-table of multiplexer.
10. Realization of Half adder and Full adder using MUX.
11. Design and verification of Truth-table of Demultiplexer.
12. Realization of half subtractor and full subtractor using DEMUX.
13. To study and verify Truth-table of RS, JK, D, JK Master Slave Flip Flops.
14. To design MOD-7 Synchronous up-counter using JK/RS/D Flip Flops.
15. To Study different shift registers: SIPO, SISO, PIPO, and PISO.

Note: At least ten experiments should be performed in semester.

Course Objectives

1. To give students a practical knowledge about various types of gates and verify their truth tables.
2. To give students a working knowledge to connect digital circuits and verify their truth tables.
3. To give students knowledge of working of different combinational and sequential circuits.

ELECTRICAL MACHINES –II

Sub Code: BELES1-403

L	T	P	C
3	1	0	4

Duration: 60 Hrs.

UNIT 1

Fundamentals of AC Machine Windings

(12 Hours)

Physical arrangement of windings in stator and cylindrical rotor; Slots for windings; Single-turn coil - active portion and overhang; Full-pitch coils, Concentrated winding, Distributed winding, Winding axis, 3D visualization of the above winding types.

Air-gap MMF distribution with fixed current through winding, Concentrated and distributed winding, Sinusoidally distributed winding, Winding distribution factor.

UNIT 2

Pulsating and Revolving Magnetic Fields

(12 Hours)

Constant magnetic field, Magnetic field produced by a single winding - fixed current and alternating current, Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), Revolving magnetic field.

UNIT 3

B. TECH. ELECTRICAL ENGG. SYLLABUS 2018 BATCH ONWARDS (UPDATED ON 24.05.2019)

Three-phase Induction Machines

(12 Hours)

Construction, Types (squirrel cage and slip-ring), Torque-slip characteristics, Starting and maximum torque. Equivalent circuit. Phasor diagram, Losses and efficiency.

Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors.

Generator operation. Self-excitation. Doubly-fed induction machines.

Single-phase Induction Motors

(8 Hours)

Constructional features, Double revolving field theory, Equivalent circuit, Determination of parameters. Split-phase, Starting methods and applications.

UNIT 4

Synchronous Machines

(16 Hours)

Constructional features, Cylindrical rotor synchronous machine - Generated EMF, Equivalent circuit and phasor diagram, Armature reaction, Synchronous impedance, Voltage regulation. Operating characteristics of synchronous machines, V-curves.

Salient pole machine - Two reaction theory, Analysis of phasor diagram, Power angle characteristics. Parallel operation of alternators - Synchronization and Load division.

Text/References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

Course Outcomes:

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

1. Understand the concepts of rotating magnetic fields.
2. Understand the operation of ac machines.
3. Analyse performance characteristics of ac machines.

ELECTRICAL MACHINES LAB – II

Sub Code: BELES1-404	L	T	P	C
	0	0	2	1

EXPERIMENTS

1. To perform load-test on three-phase induction motor and to plot speed-torque characteristics.
2. To perform no-load and blocked rotor test on three-phase induction motor to obtain equivalent circuit parameters and to draw circle diagram.
3. To study the speed control of three-phase induction motor by Kramer's method.
4. To study the speed control of three-phase induction motor by cascading of two induction motors.
5. To study star- delta starters and
 - a) To draw electrical connection diagram.
 - b) To start the three-phase induction motor using it.
 - c) To reverse the direction of three-phase induction motor.
6. To start a three-phase slip ring induction motor by inserting different levels of resistance in the rotor circuits and to plot speed- torque characteristics.
7. To perform no-load and blocked rotor test on single-phase induction motor and to determine the parameters of equivalent circuit.
8. To perform load test on single-phase induction motor and plot speed-torque characteristics.
9. To perform no load and short circuit test on three-phase alternator and draw open and short circuit characteristics.
10. To find voltage regulation of an alternator by zero power factor (ZPF) method.
11. To study effect of variation of field current upon the stator current and power factor of synchronous motor running at no load and draw V and inverted V curves of motor.
12. To synchronise two 3-phase alternators using dark lamp method, and two-bright & one dark lamp method.
13. To start a synchronous motor using appropriate method.

Note: At least ten experiments should be performed in the semester.

Course Objectives:

1. To plot speed-torque characteristics of three-phase and single-phase induction motors.
2. To obtain equivalent circuit parameters of three-phase and single-phase induction motors.
3. To study speed control of induction motors using different techniques.
4. To plot characteristics of a three-phase alternator and a synchronous motor.
5. To synchronise two 3-phase alternators by different methods

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(UPDATED ON 24.05.2019)

Course Outcomes:

Students will be able to

1. Obtain equivalent circuit parameters of single-phase and three-phase Induction motors.
2. Control speed of Induction motors by different methods.
3. Draw open and short circuit characteristics of three-phase alternator and V and inverted V curves of synchronous motor.
4. Find out voltage regulation of an alternator by different tests.
5. Synchronise two or more 3-phase alternators.

POWER ELECTRONICS

Sub Code: BELES1-405

L T P C
3 0 0 3

Duration: 45 Hrs.

UNIT 1

Power Switching Devices

(12 Hours)

Power Diode, MOSFET, Insulated gate bipolar transistor(IGBT): V-I characteristics, Gate drive circuits for MOSFET and IGBT.

Thyristor family: Introduction, Silicon controlled rectifier (SCR), Static and dynamic Characteristics, Turn-on methods, Firing circuits for thyristors, Commutation circuits for thyristors.

Uni-junction transistor (UJT): Construction, V-I characteristics and use in firing circuits

UNIT 2

Thyristor Rectifiers (AC – DC converters)

(10 Hours)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load;

Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

UNIT 3

Choppers (DC-DC converters)

(6 Hours)

Elementary chopper with an active switch and diode, Duty ratio and average voltage, Buck converter: analysis and waveforms at steady state, duty ratio control of output voltage, Boost converter: analysis and waveforms at steady state, duty ratio and average output voltage.

AC Voltage Controllers and Cycloconverters (AC - AC converters)

(5 Hours)

B. TECH. ELECTRICAL ENGG. SYLLABUS 2018 BATCH ONWARDS (UPDATED ON 24.05.2019)

Single phase AC voltage controllers using thyristors, phase control and integral cycle control, Single phase cyclo-converters, applications.

UNIT 4

Voltage Source Inverters (DC – AC converters)

(12 Hours)

Single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and uni-polar sinusoidal modulation, modulation index and output voltage.

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation.

Text/References:

1. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
5. Bimbhra P.S., Power Electronics, Khanna Publishers, 2004.
6. P. C. Sen, Power Electronics, Tata McGraw-Hill Company Limited, New Delhi, 1992.

Course Outcomes:

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

1. Understand the differences between signal level and power level devices.
2. Analyse controlled rectifier circuits.
3. Analyse the operation of DC-DC choppers.
4. Analyse the operation of voltage source inverters.

POWER ELECTRONICS LAB

Sub Code: BELES1-406

L	T	P	C
0	0	2	1

EXPERIMENTS

1. To obtain V-I characteristics of SCR and measure latching and holding currents.
2. To plot V-I Characteristics of UJT.
3. To obtain triggering pulses for SCR by using UJT as relaxation oscillator.
4. To obtain triggering wave forms for SCR using R and RC firing circuits.
5. To obtain output voltage waveforms of single phase half wave controlled rectifier for R-L load.
6. To obtain output voltage wave forms for single phase full-wave controlled rectifiers with resistive and inductive loads.

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7. To simulate three phase bridge rectifier and draw load voltage and load current waveform for resistive and inductive loads.
8. To study different types of chopper circuits and obtain waveforms for at least one of them.
9. To simulate single phase inverter using different modulation techniques and obtain load voltage and load current waveforms for different types of loads.
10. To simulate single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load.
11. To study single phase cycloconverter.
12. To study speed control of induction motor using thyristor.
13. To study speed control of DC motor using thyristor.

Note: At least ten experiments should be performed in the semester.

Recommended Books

1. K.R. Varmah, K. John Ginnes, Abraham Chikku, 'Power Electronics, Design, Testing and Simulation, Laboratory Manual', 1st Edn., CBS Publishers & Distributors Pvt. Ltd., **2017**.
2. O.P. Arora, 'Power Electronics Laboratory, Theory, Practice and Organization', Narosa Publishing House, **2007**.

Course Objectives:

1. To obtain the characteristics of SCR and UJT and to obtain triggering pulses for them.
2. To verify the performance of various converter circuits by measuring the currents and voltages at different points in the circuit and to display their waveforms.
3. To control speed of motors by using thyristors.

Course Outcomes:

1. Students will be able to verify the characteristics of SCR and UJT and triggering pulses for them.
2. They will be able to visualize and analyse the performance of various converter circuits.
3. They will be able to control the speed of motors using thyristors.

SIGNALS & SYSTEMS

Sub Code: BELES1-407	L	T	P	C	Duration: 60 Hrs.
	3	1	0	4	

UNIT 1

Introduction to Signals and Systems

(14 Hours)

Signals and systems in electrical engineering and science, Signal properties: Periodicity, absolute integrability, determinism and stochastic character.

Some special signals of importance: Unit step, Unit impulse, Sinusoid, Complex exponential, Special time-limited signals; Continuous and discrete time signals, Continuous and discrete amplitude signals.

System properties: Linearity, additivity and homogeneity, Shift-invariance, causality, stability, realizability, Examples.

UNIT 2

Continuous and Discrete-time Linear Time invariant (LTI) systems

(14 Hours)

Impulse response and step response, Convolution, Input-output behaviour with aperiodic convergent inputs, Cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations.

UNIT 3

Fourier and Z- Transforms

(20 Hours)

Fourier series representation of periodic signals, Waveform symmetries, Calculation of Fourier coefficients. Fourier Transform, Convolution/multiplication and their effect in the frequency domain, Magnitude and phase response, Fourier domain duality.

The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT), Parseval's Theorem, The Z-Transform for discrete time signals and systems, System functions, Poles and zeros of systems and sequences, Z-domain analysis.

UNIT 4

Sampling and Reconstruction

(12 Hours)

The Sampling Theorem and its implications. Spectra of sampled signals, Reconstruction: ideal interpolator, zero-order hold, first-order hold, Aliasing and its effects.

Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text/References:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schaffer, "Discrete-Time Signal Processing", Prentice Hall, 2009.
6. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
7. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

Course Outcomes:

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

1. Understand the concepts of continuous time and discrete time systems.
2. Analyse systems in complex frequency domain.
3. Understand sampling theorem and its implications.

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(UPDATED ON 24.05.2019)

MATHEMATICS - III
(Probability and Statistics)

Sub Code: BMATH3-301

L	T	P	C
3	1	0	4

Duration: 60 Hrs.

UNIT 1

Basic Probability

(18 Hours)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

UNIT 2

Continuous Probability Distributions

(6 Hours)

Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Bivariate Distributions

(6 Hours)

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

UNIT 3

Basic Statistics

(12 Hours)

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

UNIT 4

Applied Statistics

(13 Hours)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Small Samples

(5 Hours)

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Text / References:

- 1) E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.

B. TECH. ELECTRICAL ENGG. SYLLABUS 2018 BATCH ONWARDS
(UPDATED ON 24.05.2019)

- 2) P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
- 3) S. Ross, "A First Course in Probability", Pearson Education India, 2002.
- 4) W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 1968.
- 5) N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
- 6) B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2000.
- 7) T. Veerarajan, "Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2010.

CONSTITUTION OF INDIA

Subject Code: BMNCC0-001

L	T	P	C
2	0	0	0

Duration: 24 Hrs.

Course Contents:

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

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BATCH ONWARDS**

Total Contact Hours = 26

Total Marks = 1000

Total Credits = 26

Semester 5 TH		Contact Hours			Max Marks		Total Marks	Credits
Subject Code	Subject Name							
		L	T	P	Int.	Ext.		
BELES1-501	Power Systems – I (Transmission & Distribution)	3	1	0	40	60	100	4
BELES1-502	Control Systems	3	1	0	40	60	100	4
BELES1-503	Microcontrollers & PLC	3	0	0	40	60	100	3
BELES1-504	Power Systems - I Laboratory	0	0	2	60	40	100	1
BELES1-505	Control Systems Laboratory	0	0	2	60	40	100	1
BELES1-506	Microcontrollers & PLC Laboratory	0	0	2	60	40	100	1
BELES1-507	Institutional/Industrial Training (6-Week) *	0	0	--	60	40	100	3
Departmental Elective - I (Select any One)		3	0	0	40	60	100	3
BELED1-511	Electrical Drives							
BELED1-512	Electrical Machine Design							
BELED1-513	Electromagnetic Waves							
BELED1-514	Electrical Materials							
	Open-Elective	3	0	0	40	60	100	3
BHSMC0-019	Economics for Engineers	3	0	0	40	60	100	3
Total		18	2	6	480	520	1000	26

*Note: During the summer vacation after 4th semester.

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POWER SYSTEMS - I				
(Transmission & Distribution)				
Subject Code:	L	T	P	C
BELES1-501	3	1	0	4
Course Objectives: 1. To introduce the students to the structure of power and distribution systems. 2. To introduce them to overhead transmission lines and underground cables and make them to understand their operating characteristics. 3. To make them familiar with the components and the mechanical design aspects of overhead transmission lines.				
Course Outcomes: Students will be able: 1. To choose working voltage and economic size of conductors for transmission and distribution systems. 2. To analyse performance of transmission lines and underground cables. 3. To select and design overhead line insulators and transmission lines.				
UNIT-I (15 Hours)				
Basics of Power Systems: Evolution and present-day scenario of a power system, Structure of a power system, Bulk power grids and micro-grids, Introduction to electrical energy generation, Distributed energy resources.				
Transmission and Distribution Systems: Line diagrams, Transmission and distribution voltage levels and topologies (meshed and radial systems), Synchronous grids (AC) and Asynchronous (DC) interconnections, Comparison of cost of conductors, Choice of working voltage for transmission and distribution, Economic size of conductors, Kelvin's law, Radial and mesh distribution networks, Voltage regulation.				
UNIT-II (15 Hours)				
Transmission Line Parameters: Types of conductors; Solid, Stranded, ACSR, Hollow and Bundle conductors, Electrical and magnetic fields around conductors, Line parameters of single and double circuit transmission lines, Resistance of transmission lines, Inductance of single phase two wire line, concept of geometric mean distance (G.M.D.), Inductance of three phase lines, Use of bundle conductors, Transposition of power lines, Capacitance of 1-phase and 3-phase lines, Effect of earth on capacitance of conductors.				
Performance of Transmission Lines: Sinusoidal steady state representation of lines by equivalent circuits; Representation of short transmission line and medium length line by nominal T & π circuits, Representation of long length line by hyperbolic equations and equivalent T & π circuits, Power flow through transmission lines, Generalized ABCD constants, Voltage regulation and efficiency of short, medium and long lines, Ferranti effect.				

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UNIT-III (15 Hours)

Circle Diagram and Line Compensation: Receiving end circle diagram for long transmission lines based on ABCD constants, equivalent T circuits, power loci, Surge impedance loading, Reactive power requirement of system, Series and shunt compensation, Synchronous phase modifiers, Rating of phase modifiers.

Cables: Classification of cables based upon voltage and dielectric material, Insulation resistance and Capacitance of single core cable, Dielectric stress, Capacitance of 3 core cables, Methods of laying, Heating effect, Maximum current carrying capacity, cause of failure, Comparison with overhead transmission lines.

UNIT-IV (15 Hours)

Overhead Line Insulators: Types of insulators, String efficiency, Voltage distribution in a string of suspended insulators, Grading ring, Preventive maintenance

Electrical Design Of Transmission Line: Choice of voltage, Selection of conductor size, Choice of span, No. of circuits, Conductor configuration, Insulation design, Selection of ground wire.

Mechanical Design of Transmission Lines: Supporting structures for overhead lines, Elementary ideas about transmission line construction and erection, Stringing of conductors, Spacing, Sag and Clearance from ground, Sag-tension calculations.

Recommended Text Books / Reference Books:

1. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.
2. C.L. Wadhwa, "Electric Power Systems", Second Edition, Wiley Eastern Limited, 1985.
3. Harder Edwin. I. "Fundamentals of Energy Production", John Wiley and Sons, 1982.
4. Burke James, J. "Power Distribution Engineering; Fundamentals and Applications" Marcel Dekk., 1996.
5. B.R. Gupta, "Generation of Electrical Energy", S. Chand (1998).
6. C.L. Wadhwa C.L., "A Course in Electrical Power", New Age international Pvt. Ltd
7. I. J. Nagrath and D. P. Kothari, "Power System Engineering", Tata McGraw Hill, 1995.
8. O. L. Elgerd, Electrical Energy System Theory - An introduction, Tata McGraw-Hill Publication

**MRSPTU B. TECH. (ELECTRICAL ENGINEERING) SYLLABUS 2018
BATCH ONWARDS**

CONTROL SYSTEMS					
Subject Code:	L T P C				Duration: 60 (Hrs.)
BELES1-502	3 1 0 4				
Course Objectives: To make the students: 1. To understand basic concepts of control systems, such as; mathematical modelling, transfer functions, signal flow graphs etc. 2. To learn basic goals of control systems in terms of transient/steady state time response behaviour and frequency response analysis. 3. To understand concept of stability and application of different analysis methods. 4. To introduce to the concept of state variable analysis.					
Course Outcomes: Students will be able: 1. To do modelling of linear-time-invariant systems using transfer function and state-space representations. 2. To do the stability assessment for linear-time invariant systems. 3. To design simple feedback controllers.					
UNIT-I (15 Hours)					
Introduction: Industrial control examples, Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time-invariant systems, Laplace transform.					
Feedback Control: Open-Loop and closed-loop systems, Benefits of feedback, Block diagram algebra and signal flow graphs.					
UNIT-II (15 Hours)					
Time Response Analysis: Standard test signals, Time response of first and second order systems for standard test inputs, Application of initial and final value theorem, Design specifications for second-order systems based on the time-response, Steady state error and coefficients.					
Concept of Stability: Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique, Construction of Root-loci.					
UNIT-III (15 Hours)					
Frequency Response Analysis: Relationship between time and frequency response, Polar plots, Bode plots, Nyquist stability criterion, Relative stability using Nyquist criterion, Gain and Phase margin, Closed-loop frequency response.					
Introduction to Controller Design: Stability, Steady-state accuracy, Transient accuracy, Disturbance rejection, Methods of controller design in frequency domain, Lead and Lag compensation, Analog and Digital implementation of controllers, Application of Proportional, Integral and Derivative Controllers.					

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UNIT-IV (15 Hours)

State Variable Analysis: Concepts of state variables, State space model, Diagonalization of State Matrix, Solution of state equations, Eigen values and Stability Analysis, Concept of controllability and Observability, Pole-placement by state feedback, Discrete-time systems, Difference Equations, State-space models of linear discrete-time systems, Stability of linear discrete-time systems.

Recommended Text Books / Reference Books:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1999.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, 2011.
4. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.
5. Dorf Richard C. and Bishop Robert H., Modern Control System, Addison-Wesley, Pearson, 2009.
6. B. S. Manke, Linear Control Systems, 2002

MICROCONTROLLERS AND PLC

Subject Code:

L T P C

Duration: 45 (Hrs.)

BELES1-503

3 0 0 3

Course Objectives:

1. To introduce to the architecture of microprocessor and microcontroller.
2. To study 8051 microcontrollers in detail.
3. To interface peripheral devices with microprocessors and microcontrollers.
4. To introduce to PLCs and their applications.

Course Outcomes:

The students will;

1. Know about the architecture, operation and instruction set of 8051 microcontroller.
2. Be able to do programming of 8051 microcontrollers.
3. Be able to Interface 8051 with peripheral devices.
4. Be able to use PLCs.

UNIT-I (11 Hours)

Fundamentals of Microprocessors: Fundamentals of microprocessor architecture, 8-bit Microprocessor and Microcontroller architecture, Difference between microprocessor and microcontroller, Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems.

The 8051 Architecture: PIN diagram of 8051, Internal block diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

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UNIT-II (12 Hours)

Instruction Set and Programming of 8051

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, Bit direct addressing,

8051 Instruction set: Instruction timings, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instructions.

Assembly language programs, Assemblers and compilers, Programming and debugging tools.

UNIT-III (11 Hours)

Memory and I/O Interfacing: Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O such as LED, LCD, keyboard, ADC, DAC, timers, counters, memory devices.

External Communication Interface: Synchronous and asynchronous communication, RS232, SPI, I2C, Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Microcontroller Applications: Stepper motor interfacing, DC motor interfacing, Sensor interfacing, Application of microcontrollers in Arduino.

UNIT-IV (11 Hours)

Introduction to Programmable Logic Controllers

Introduction, Operation of PLC, Difference between PLC and Hardwired system, Difference between PLC and Computer, Relay logic and ladder logic, Ladder commands and examples of PLC ladder diagram realization, PLC timers, PLC counters, Applications of PLC, PLC interfacing with HMI/SCADA system.

Recommended Text Books / Reference Books:

- 1) M. A. Mazidi, The 8051 Microcontroller and Embedded System, Pearson Education (2008).
- 2) Kenneth J Ayola, The 8051 Micro Controller- Architecture, Programming and Application, Penram International Publication
- 3) R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing (India) Pvt. Ltd., 2004.
- 4) D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991.
- 5) B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai and Sons.
- 6) Otter, Job Dan, *Programmable Logic Controller*, P.H. International, Inc, USA
- 7) Dunning Gary, *Introduction to PLCs*, Tata McGraw Hill
- 8) John B Peatman, *Design with Micro Controller*, Tata McGraw Hill
- 9) Udayashankara V. and Mallikarjunaswamy M.S., *8051 Microcontroller Hardware, Software and Applications*, Tata McGraw Hill Education Pvt. Ltd., (2010)

**MRSPTU B. TECH. (ELECTRICAL ENGINEERING) SYLLABUS 2018
BATCH ONWARDS**

POWER SYSTEMS – I LABORATORY				
Subject Code:	L	T	P	C
BELES1-504	0	0	2	1
Course Objectives: To demonstrate the various equipment and concepts related to; 1. Transmission and distribution of power, such as cables, conductors, insulators, supporting structures etc. 2. To visit a power/substation.				
Course Outcomes: 1. Students will have more detailed insight about the need of various equipment used for transmission and distribution of power. 2. They will be able to draw performance characteristics of these equipment. 3. To practically compute parameters and performance of transmission lines and feeders.				
LIST OF EXPERIMENTS				
1. To measure active power, reactive power and power factor of a three phase load by two-wattmeter method and power factor meter and verify through current, voltage and power measurement. 2. To compute the ABCD parameters of a transmission line. 3. To analyze the performance of short and medium length transmission lines and to determine efficiency and voltage regulation. 4. To analyze the performance of long transmission line and to determine its efficiency and voltage regulation and to demonstrate Ferranti effect. 5. To find the earth resistance using three spikes. 6. To study the radial feeder performance (i) fed at one end and (ii) fed at both ends. 7. To study and demonstrate different types of transmission and distribution conductors and models of cables. 8. To measure insulation resistance of a cable.				
OR				
- To measure the capacitance of single-core and three-core cables. 9. To study and demonstrate the methods of fault location in cables. 10. To study different types of supporting structures and insulators for conductors. Also to determine the efficiency of a string of insulators. 11. Optimal capacitor placement on a system having variable reactive power and low voltage profile. 12. Design a transmission system for given power and distance.				
OR				
Design of a small distribution system.				
Note: At least ten experiments should be performed in a semester.				

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CONTROL SYSTEMS LABORATORY				
Subject Code:	L	T	P	C
BELES1-505	0	0	2	1
Course Objectives: 1. To understand the basics concepts of MATLAB software. 2. To introduce variety of control system strategies. 3. To comment about the stability of designed systems. Course Outcomes: 1. To understand the basics of MATLAB software. 2. To understand variety of control system strategies. 3. To acquire skills to understand all types of control components. 4. Ability to analyse the stability of control systems.				
LIST OF EXPERIMENTS 1. Familiarization with MATLAB and its control system toolbox. Familiarization with MATLAB Simulink toolbox. 2. Determination of step response for first order and second order system with unity feedback and their display on CRO. Calculation and verification of time constant, peak overshoot, setting time etc. from the response. 3. Simulation of step response and impulse response for type-0, type-1 and type-2 systems with unity feedback using MATLAB. 4. Determination of Root Locus, Bode-Plot, Nyquist Plot using MATLAB-Control system toolbox for 2nd order system. Determination of different control system performance indices from the plots. 5. Determination of PI, PD, PID controller action of first order simulated process. 6. Experimental determination of approximate transfer function from Bode plot. 7. Evaluation of steady state error, setting time, percentage peak overshoot, gain margin, phase margin, with addition of lead compensator and by compensator in forward path transfer function for unity feedback control system. 8. Determination of control system specifications for variations of system parameters in practical position control system. 9. Design of a second order linear time invariant control system and study of system response with unit step input.				

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10. To study the characteristics of potentiometers and to use 2- potentiometers as an error detector in a control system.
11. To study the Synchro Transmitter-Receiver set and to use it as an error detector.
12. To study the Speed – Torque characteristics of a DC Servo Motor and explore its applications.
13. To obtain the transfer function of a D.C. motor – D.C. Generator set using Transfer Function Trainer.
14. To study the speed control of an A.C. Servo motor using a closed loop and open loop systems.
15. (i) To study the operation of a position sensor and study the conversion of position in to corresponding voltage (ii) To study a PI control action and show its usefulness for minimizing steady state error of time response.

Note: At least twelve experiments should be performed in semester.

MICROCONTROLLER AND PLC				
LABORATORY				
Subject Code:	L	T	P	C
BELES1-506	0	0	2	1
Course Objectives: To make the students: 1. Familiar with microprocessor and microcontroller kits. 2. To write and demonstrate assembly language programmes for arithmetic and logical operations. 3. To interface peripheral devices to microcontrollers and to write programs to control their operation. 4. To demonstrate applications of PLCs.				
Course Outcomes: Students will: 1. Become familiar with the microcontrollers and PLCs. 2. Be able to write assembly language programmes for various types of applications. 3. Become familiar with the use of PLCs in industry.				
LIST OF EXPERIMENTS				
1. Introduction to 8085 Microprocessor kit/simulator and 8051 Microcontroller kit/simulator. 2. Write a program to (i) Add (ii) Subtract (iii) Multiply and (iv) Divide, two 8-bit numbers				

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lying at two memory locations and display the result.

3. Write a program to check a number for being ODD or EVEN and show the result on display.

OR

Write a program to split a byte in two nibbles and show the two nibbles on display.

4. Write a program to arrange TEN numbers stored in memory location in ascending and descending order.
5. Write a program to
- (i) Find a factorial of a given number.
 - (ii) Generate Fibonacci Series
 - (i) Sum up a finite series
6. Study of interrupt structure of 8051 micro-controllers and to write a program to show the use of INT0 and INT1.
7. Write a program of flashing LED connected to port 1 of the micro-controller

OR

Write a program to develop rolling display.

8. Write a program to control a stepper motor in direction, speed and number of steps.
9. Write a program to control the speed of DC motor.
10. Implementation of different gates using PLC.
11. Implementation of DOL and star delta starter using PLC.
12. Implement basic logic operations, motor start and stop operation using
- (i) Timers
 - (ii) Counters
13. Motor forward and reverse direction control using PLC.
14. Make a PLC based system (i) for rack feeder and/or (ii) for conveyor belt and/or (ii) for separating and fetching work pieces.

OR

Implement a PLC based traffic light control.

Note: At least Ten experiments should be performed in a semester.

ELECTRICAL DRIVES

Subject Code:

L T P C

Duration: 45 (Hrs.)

BELED1-511

3 0 0 3

Course Objectives:

1. To review the characteristics of DC motors.
2. To know about the operation of DC drives and their speed control methods using power electronic converters.
3. To know about the various control strategies of induction motors using power electronic control methods.

Course Outcomes:

Students will be able:

1. To draw the characteristics of DC motors and induction motors.

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2. To control the speed of DC motors using power electronic converters.
3. To use power electronic converters for induction motor speed control.

UNIT-I (11 Hours)

DC Motor Characteristics

Review of e.m.f and torque equations of DC machine, review of torque-speed characteristics of separately excited DC motor, Change in torque-speed curve with armature voltage, Load torque-speed characteristics, Operating point, Armature voltage control for varying motor speed, Flux weakening for high speed operation.

Chopper Fed DC Drive

Review of DC chopper and duty ratio control, Chopper fed DC motor for speed control, Steady state operation of a chopper fed drive, Armature current waveform and ripple, Calculation of losses in DC motor and chopper, Efficiency of DC drive, Smooth starting.

UNIT-II (12 Hours)

Multi-Quadrant DC Drive

Review of motoring and generating modes operation of a separately excited DC machine, Four quadrant operation of DC machine; Single-quadrant, Two-quadrant and Four-quadrant choppers; Steady-state operation of multi-quadrant chopper fed DC drive, Regenerative braking.

Closed-loop Control of DC Drive

Control structure of DC drive, Inner current loop and outer speed loop, Dynamic model of DC motor, Dynamic equations and transfer functions, Modeling of chopper as gain with switching delay, Plant transfer function for controller design, Current controller specification and design, Speed controller specification and design.

UNIT-III (11 Hours)

Induction Motor Characteristics: Review of induction motor equivalent circuit and torque-speed characteristic, Variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, Typical torque-speed curves of fan and pump loads, Operating point, Constant flux operation, Flux weakening operation.

Control of Slip Ring Induction Motor

Impact of rotor resistance of the induction motor torque-speed curve, Operation of slip-ring induction motor with external rotor resistance, Starting torque, Power electronic based rotor side control of slip ring motor, Slip power recovery.

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UNIT-IV (11 Hours)

Scalar Control or Constant V/f Control of Induction Motor

Review of three-phase voltage source inverter, Generation of three-phase PWM signals, Sinusoidal modulation, Space vector theory, Conventional space vector modulation, Constant V/f control of induction motor, Steady-state performance analysis based on equivalent circuit, Speed drop with loading, Slip regulation.

Recommended Text Books / Reference Books:

- 1) G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1989.
- 2) R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall, 2001.
- 3) G. K. Dubey, "Fundamentals of Electrical Drives", CRC Press, 2002.
- 4) W. Leonhard, "Control of Electric Drives", Springer Science & Business Media, 2001.

ELECTRICAL MACHINE DESIGN

Subject Code:

L T P C

Duration: 45 (Hrs.)

BELED1-512

3 0 0 3

Course Objectives:

1. Understand the principles of electrical machine design.
2. To know about the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
3. To design transformers and induction motors.
4. To introduce to use of computers in design.

Course Outcomes:

Students will:

1. Know the constructional features.
2. Be able to evaluate performance characteristics of electrical machines.
3. Be able to carry out a basic design of an ac machine.
4. Be able to use software tools to do design calculations.

UNIT-I (11 Hours)

Introduction: Major considerations in electrical machine design, Electrical engineering materials, Space factor, Choice of specific electrical and magnetic loadings, Thermal considerations, Heat flow, Temperature rise, Rating of machines.

UNIT-II (12 Hours)

Transformers:

Sizing of a transformer, Main dimensions, Output kVA for single- and three-phase transformers, Window space factor, Overall dimensions, Operating characteristics,

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Regulation, No load current, Temperature rise in transformers, Design of cooling tank, Methods for cooling of transformers.

UNIT-III (11 Hours)

Induction Motors:

Sizing of an induction motor, Main dimensions, Length of air gap, Rules for selecting rotor slots of squirrel cage machines, Design of rotor bars & slots, Design of end rings, Design of wound rotor, Magnetic leakage calculations, Leakage reactance of poly-phase machines, Magnetizing current, Short circuit current, Circle diagram, Operating characteristics.

UNIT-IV (11 Hours)

Computer aided Design (CAD):

Limitations (assumptions) of traditional design, Need for CAD analysis, Synthesis and hybrid methods, Design optimization methods, Variables, Constraints and Objective function, Problem formulation.

Introduction to FEM based machine design.

Introduction to complex structures of modern machines: Permanent magnet synchronous motor (PMSM), Brushless DC motor (BLDC), Switched reluctance motor (SRM) and Claw-pole machines.

Recommended Text Books / Reference Books:

- 1) A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
- 2) M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.
- 3) S. K. Sen, "Principles of Electrical Machine Design with Computer Programmes", Oxford and IBH Publishing, 2006.
- 4) K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969.
- 5) A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.
- 6) K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
- 7) Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

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ELECTROMAGNETIC WAVES			
Subject Code:	L T P C	Duration: 45 (Hrs.)	
BELED1-513	3 0 0 3		
Course Objectives: 1. Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions. 2. Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media. 3. To analyse radiation by antennas.			
Course Outcomes: Students can: 1. Provide solution to real life plane wave problems for various boundary conditions. 2. Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide. 3. Analyze wave-guides and understand radiation by antennas.			
UNIT-I (15 Hours) Transmission Lines: Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines. Maxwell's Equations: Basic laws of Electromagnetics, Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction, Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.			
UNIT-II (15 Hours) Uniform Plane Waves: Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector. Plane Waves at Media Interface: Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.			
UNIT-III (15 Hours) Waveguides: Parallel plane waveguide, Transverse Electric (TE) mode, Transverse Magnetic (TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.			

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Antennas: Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

Recommended Text Books / Reference Books:

- 1) R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
- 2) D. K. Cheng, "Field and Wave Electromagnetics", Addison-Wesley, 1989.
- 3) M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
- 4) C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.
- 5) C. A. Balanis, "Antenna Theory: Analysis and Design", John Wiley & Sons, 2005.

ELECTRICAL MATERIALS

Subject Code:	L T P C	Duration: 45 (Hrs.)
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BELED1-514	3 0 0 3	
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Course Objectives:

1. Aware about various types of conducting materials and their applications.
2. Aware about various properties of insulating materials and their applications.
3. Aware about various types of magnetic materials and their applications.

Course Outcomes:

1. Analyze the characteristics of different types of materials viz. conductors, insulators, and magnetic materials etc.
2. Select a suitable material for manufacturing electrical equipment.

UNIT-I (15 Hours)

Conducting Materials: Classification of material into conducting, semi conducting and insulating materials, Factors affecting resistance such as alloying and temperature, Classification of conducting material as low resistivity and high resistivity materials, Low resistivity copper alloys and their practical applications, Applications of special metals, High resistivity materials and their applications, Super conductivity.

UNIT-II (15 Hours)

General Properties of Insulating Materials

Electrical Properties: Volume resistivity, Surface resistance, Dielectric loss, Dielectric strength (breakdown voltage), Dielectric constant,

Physical Properties: Hygro-scopicity, Tensile and Compressive strength, Abrasive resistance, Brittleness.

Thermal Properties: Heat resistance, Classification based on permissible temperature rise,

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Effect of overloading on the life of an electrical appliance, Increase in rating with the use of insulating materials having higher thermal stability, Thermal conductivity, Electro-thermal breakdown in solid dielectrics.

Chemical Properties: Solubility, Chemical resistance, Weather-ability, Mechanical properties, Mechanical structure, Tensile structure.

Applications of Insulating Materials

Definition and classification of plastics, Thermosetting materials, Thermo-plastic materials, Natural insulating materials, Properties and their applications, Gaseous materials, Ceramics, properties and applications.

UNIT-III (15 Hours)

Magnetic Materials and Special Materials: Introduction and classification of ferromagnetic materials, Permeability, B-H curve, Magnetic saturation, Hysteresis loop (including) coercive force and residual magnetism, Concept of eddy current and Hysteresis loss, Curie temperature, Magnetostriction effect, Soft Magnetic Materials, Hard magnetic materials, Hall effect and its applications, Thermocouple, Bimetals, Leads, Soldering and Fuses material and their applications.

Recommended Text Books / Reference Books:

- 1) SK Bhattacharya, "Electrical and Electronic Engineering Materials" 1st edition Khanna Publishers, New Delhi, 2006. (Unit 1,2,3)
- 2) A.J. Dekker "Electrical Engineering Materials", PHI, 2006. (Unit 4,5)
- 3) Grover and Jamwal, "Electronic Components and Materials" Dhanpat Rai and Co., New Delhi.
- 4) Sahdev, "Electrical Engineering Materials", Unique International Publications
- 5) C. S. Indulkar & S. Thiruvengadam, "Electrical Engineering Materials", S. Chand & Co. Ltd, New Delhi -55
- 6) S.P. Seth, P.V. Gupta "A course in Electrical Engineering Materials", Dhanpat Rai & Sons.

ECONOMICS FOR ENGINEERS

Subject Code: BHSMC0-019

L T P C
3 0 0 3

Duration: 45 Hrs

Course Objectives

The main aim of this course is:

1. To equip the students of management with time tested tools and techniques of managerial economics to enable them to appreciate its relevance in decision making.
2. To explore the economics of information and network industries and to equip students with an understanding of how economics affect the business strategy of companies in these industries.
3. To develop economic way of thinking in dealing with practical business problems and challenges

Course Outcomes

After completing this course, the students will be able to:

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1. Able to analyze the demand and supply conditions of the market and accordingly assess the position of a company.
2. Understand the basic economic problems faced by the society and make effective decisions.
3. Design competition strategies which includes costing, pricing, product differentiation, and market environment according to the natures of products and the structures of the markets.
4. Analyze the market competitions and design strategies accordingly.

UNIT-I (12 Hrs.)

Micro Economics: Meaning, Nature, Scope and Limitations Basic concepts: Marginal and Incremental Principles, Opportunity Cost, Equilibrium Utility: Cardinal Utility Approach: Diminishing Marginal Utility; Ordinal Utility Approach, Indifference Curve, Properties, Consumer Equilibrium and Marginal Rate of Substitution.

UNIT-II (11 Hrs.)

Demand: Meaning, Determinants, Law of Demand and its Exceptions. Elasticity of Demand: Measurement, Degree of Elasticity. Price, Income and Cross Elasticity of Demand. Revenue: Total Revenue (TR), Average Revenue (AR), Marginal Revenue (MR) and their Relationship.

UNIT-III (12 Hrs.)

Production Function: Meaning, Short-Run Production Function and Law of Variable Proportions, Long Run Production and Laws of Returns. Cost of Production: Concept of Economic and Managerial Costs, Short Run and Long Run Cost Curves. Economies and Diseconomies of Scale

UNIT-IV (10 Hrs.)

Equilibrium of Firm and Industry: Perfect Competition, Monopoly and Discriminating Monopoly. Monopolistic Competition: Characteristics, Individual and Group Equilibrium, Concept of Selling Cost. Oligopoly: Characteristics, Cournot's Model, Kinked Demand Curve, Concepts of Cartel and Price Leadership. Distribution: Marginal Productivity and Modern Theory of Determination.

Recommended Books

1. D. Salvatore, 'Microeconomic Theory', Tata McGraw Hill.
2. R.H. Dholkia and A.N. Oza, 'Microeconomics for Management Students', Oxford University Press.
3. D.N. Dwivedi, 'Managerial Economics', Vikas Publishing
4. P.L. Mehta, 'Managerial Economics', Sultan Chand.

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Total Credits = 21

Semester 6TH		Contact Hours			Max Marks		Total Marks	Credits
Subject Code	Subject Name							
		L	T	P	Int.	Ext.		
BELES1-601	Power Systems – II (Protection)	3	0	0	40	60	100	3
BELES1-602	Electrical Measurements & Instrumentation	3	0	0	40	60	100	3
BELES1-603	Power Systems - II Laboratory	0	0	2	60	40	100	1
BELES1-604	Electrical Measurements & Instrumentation Lab	0	0	2	60	40	100	1
BELES1-605	Electrical Design & Estimation Lab	0	0	2	60	40	100	1
Departmental Electives – II	(Select any one from the following list)	3	0	0	40	60	100	3
BELED1-611	Industrial Electrical Systems							
BELED1-612	Non-Linear & Digital Control Systems							
BELED1-613	Computer Architecture							
BELED1-614	Computational Electromagnetics							
Departmental Electives – III	(Select any one from the following list)	3	0	0	40	60	100	3
BELED1-621	Wind & Solar Energy Systems							
BELED1-622	HVDC Transmission Systems							
BELED1-623	EHVAC Transmission Systems							
BELED1-624	FACTS Devices in Transmission & Distribution Networks							
XXXXX	Open-Elective*	3	0	0	40	60	100	3
BELES1-606	Introduction to Industrial Management	3	0	0	40	60	100	3
Total		-	-	-	420	480	900	21

*Open Electives (OE) can also be taken from existing lists of Open Elective-I, Open Elective-II and Open Elective-III subject lists.

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POWER SYSTEMS – II (Protection)			
Subject Code:	L T P C	Duration: 45(Hrs.)	
BELES1-601	3 0 0 3		
Course Objectives: 1. To provide knowledge about principle and components of protective system. 2. To impart knowledge about basics of Substation, Isolator and Fuses. 3. To provide knowledge about operating principle, types of relays and circuit breakers. 4. To provide knowledge about protection of Feeder, Bus bar, Generator and Transformer			
Course Outcomes: Students will be able to: 1. Explain causes and effects of faults, components used for power system protection such as; isolators and fuses, relays, circuit breakers etc. 2. Classify types of relays and circuit breakers and explain their working principles and operation. 3. Protect transmission lines, feeders, bus bars, generator and transformer. 4. Develop concepts about the basic principles of static and digital protection.			
UNIT-I (11 Hours)			
Introduction to Components of Protection System: Need for Protective System, Nature and causes of faults, Types and effects of faults, Zones of protection, Primary and backup protection, Essential qualities of protection, Basic principle of protection system, Components and classification of protective system.			
Substation: Types, Classification, Main Equipment, Layout, Bus-bar Arrangement of Substation, Functions, Operation, Types and rating of Isolators, Characteristics, Types and rating of fuses.			
UNIT-II (12 Hours)			
Circuit Breakers: Need for Circuit Breakers, Circuit Breaker Ratings, Arc Initiation and their Interruption Methods, Arc Quenching Theories, Re-striking voltage, Recovery Voltage, RRRV, Oil Circuit Breaker, Minimum Oil Circuit Breaker, Air Circuit Breaker, Air Blast Circuit Breaker, Vacuum Circuit breaker and SF ₆ circuit breaker.			
Protective Relays: Introduction, Classification, Constructional features, and Characteristics of Electromagnetic, Induction, Over-current relays, Directional over current relay, Distance relays; Impedance relay, Reactance relay and Mho relay, Differential Relays. Under voltage relay, Over voltage relay, Trans-lay, Under-frequency relay, Over-frequency relay, Rate of change of frequency (df/dt) relays, Reverse-power relay, Negative sequence relay.			

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UNIT-III (11 Hours)

Transmission Line, Feeder and Bus Bar Protection:

Over current protection by time graded system, Current graded and Time- current graded system, Protection of parallel feeder, Protection of ring mains feeder, Over current earth fault protection.

Distance Protection of transmission lines, Comparison among distance relays, Differential and percentage differential protection, Pilot relaying protection of feeder, Differential protection of bus bars.

Overvoltages on transmission lines such as switching overvoltages and lightning overvoltages, Protection of transmission lines against lightning, Protection of power system apparatus against surges.

UNIT-IV (11 Hours)

Transformer Protection:

Over current protection, Percentage differential protection, Incipient faults in transformers, Inter-turn fault, Protection against over fluxing.

Generator Protection:

Various faults and abnormal operating conditions, Protection against unbalanced loading, Over-speeding, Loss of excitation, Loss of prime mover.

Introduction to Advance Protection Systems:

Carrier aided protection of transmission lines, Static comparators as relays, Structure and Operation of Digital protection system, Advantages of digital techniques in power system protection.

Recommended Text Books / Reference Books:

1. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.
2. Burke James, J. "Power Distribution Engineering; Fundamentals and Applications" Marcel Dekk., 1996.
3. C.L. Wadhwa, A Course in Electrical Power, New Age international Pvt. Ltd
4. Badri Ram and D.N. Vishwakarma, Power system Protection and Switchgear, Tata McGraw Hill, 2001
5. M.V. Deshpande, Switchgears and Protection, Tata McGraw Hill
6. Ashfaq Hussain, Electrical Power system, 3rd edition, CBS Publishers & Distributors Pvt. Ltd. New Delhi, 2007.
7. S. S. Rao, Switchgear Protection and Power System, Khanna Publishers, Delhi, 10th Edition, 1992
8. Dahiya and Attri, Substation Engineering, Khanna Publishers

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ELECTRICAL MEASUREMENTS & INSTRUMENTATION					
Subject Code:	L T P C			Duration: 45 (Hrs.)	
BELES1-602	3 0 0 3				
Course Objectives: 1. To make the students aware about the basics of measurements and instrumentation systems. 2. To impart knowledge about different instruments for electrical measurements. 3. To introduce to basic concepts of different types of sensors and transducers.					
Course Outcomes: Students will be able: 1. To explain the constructional features, characteristics and operation of various measurement devices and transducers. 2. To measure R, L and C using DC and AC bridges. 3. To use CRO and instrument transformers for measurement and instrumentation purposes. 4. To select transducers for different applications.					
UNIT-I (12 Hours)					
Measurment Systems: Introduction, Necessity of measurements, Block diagram of measurement system, Instrument characteristics such as True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Repeatability and sensitivity, Different types of errors in measurement.					
Measuring Instruments: Principle of operation and constructional features of D'Arsonval galvanometer, Permanent magnet moving coil (PMMC), Moving Iron instruments (Repulsion and Attraction type), Electrodynamic type instruments, Measurement of current, voltage, power and power factor by using these instruments, Use of Shunts, Multipliers and Potential dividers, Energy meter, Digital Multi-meter, Clamp-on meters.					
UNIT-II (11 Hours)					
Measurement of Resistance: Low, Medium and High resistance measurement using Kelvin Double Bridge, Ammeter-Voltmeter method, Wheat Stone Bridge, Megohm bridge, Megger.					
Measurement of Inductance and Capacitance: Maxwell Inductance, Hay's, Anderson and Schering Bridges, Measurement of frequency by Wein bridge method.					

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UNIT-III (11 Hours)

Oscilloscope:

Basic principle and construction of Analog CRO, Sweep modes, Applications in measurement of voltage, frequency (Lissajous pattern), Introduction to Dual Trace Oscilloscope, Digital Storage Oscilloscope, Sampling oscilloscope, Comparison between analog and digital oscilloscope.

Instrument Transformers:

Theory and construction of current and potential transformers, Ratio and phase angle errors and their minimization, Characteristics of current transformers(CT) and potential transformers(PT) and their Testing.

UNIT-IV (11 Hours)

Transducers:

Transducer, Difference between sensor and transducer, Transducer characteristics, Classifications and Types, Basic requirements of Transducer/Sensors, Displacement Transducers: LVDT, RVDT and Piezoelectric, Resistance Thermometer, Thermistors, Thermocouples, Strain Gauge, Applications of Transducers.

Recommended Text Books / Reference Books:

1. Helfrick A.D. and Cooper W.D., “Modern *Electronic Instrumentation and Measurement Techniques*”, PHI, 1990.
2. A.K. Sawhney, Puneet Sawhney, “A course in Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai & Sons, 2011.
3. Jones and Chin, ‘Electronic Instruments and Measurement’, 2010.
4. J. Toppin, ‘Theory of Errors’, Wessely Publishing, 2000.
5. Bell David A., *Electronics Instrumentation and Measurements*, Prentice Hall, India
6. Golding Edward William and Widdis Frederick Charles, *Electrical Measurements and Measuring instruments*, Wheelers India
7. Murthy D. V. S., *Transducers and Instrumentation*, Prentice-Hall, India

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POWER SYSTEMS – II LABORATORY				
Subject Code:	L	T	P	C
BELES1-603	0	0	2	1
Course Objectives: 1. Understand operation of relays and circuit breakers. 2. To demonstrate the characteristics of different types of relays.				
Course Outcomes: Students will be able: 1. To demonstrate operation of relays and circuit breakers. 2. To analyze various protection schemes in power system. 3. To plot characteristics of various types of relays, circuit breakers and fuses.				
LIST OF EXPERIMENTS				
1. To study the characteristics of over current protection. 2. To study the characteristics of earth fault protection. 3. To draw the operating characteristics of fuse (HRC or open type) and bimetal mini circuit breakers. 4. To study air circuit breakers, oil circuit breakers, vacuum circuit breakers and SF₆ circuit breakers and demonstrate at least two of them. 5. To study over current static relay. 6. To study the performance of under voltage relay and over voltage relay. 7. To study the characteristics of Distance (Impedance, Reactance and Mho) Relay. 8. To demonstrate the operation of Buchholz's relay. 9. To find the breakdown strength of transformer oil. 10. To study the different types of faults on transmission line demonstration panel/model. 11. Short circuit analysis and calculations of circuit breaker ratings for a power system network.				
OR				
Design of protection system for a substation. 12. To obtain relay co-ordination on a power system. 13. Visit to a power generation station/substation.				
Note: At least ten experiments should be performed in a semester.				

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ELECTRICAL MEASUREMENTS & INSTRUMENTATION LAB				
Subject Code:	L	T	P	C
BELES1-604	0	0	2	1
Course Objectives: 1. To demonstrate the constructional features of measuring instruments. 2. To demonstrate the applications of measuring instruments. 3. To draw the characteristics and use of various types of transducers.				
Course Outcomes: Students will be able: 1. To apply the basic measurement techniques and use measuring instruments. 2. To measure various electrical quantities using various types of meters. 3. To practically use current and potential transformers, CRO and DSO.				
List of Experiments 1. To demonstrate the constructional features of various types of indicating measuring instruments, such as PMMC type, Moving iron type, Electrodynamo type etc. 2. Current Measurement using Clamp-on meter and Hall Sensor. 3. To measure high value of DC current and voltage using shunt and Multiplier. 4. To measure the active power in 3-phase balanced and unbalanced load by two wattmeter method and observe the effect of power factor variation on wattmeter reading. 5. To study and calibrate Energy Meter. 6. To measurement of low resistance using Wheat stone bridge and Kelvin's double bridge. 7. Measurement of High resistance and Insulation resistance using Megger. 8. Measurement of self-inductance by using any bridge technique such as Anderson's bridge as well as LCR meter. 9. Measurement of capacitance by using any bridge technique such as Schering bridge as well as LCR meter. 10. Measurement of frequency using Wein's Bridge. OR Determination of frequency and phase angle using CRO. 11. Use a DSO to capture transients like a step change in R-L-C circuit. OR Download one-cycle data of a periodic waveform from a DSO and use values to compute the RMS value. 12. To study the connections and use of a potential transformer (PT) and to find out ratio error. 13. To study the connections and use of a current transformer (CT) and to find out ratio error. 14. Measurement of displacement using LVDT and RVDT. 15. Study the characteristics of (i) Resistance Temperature Detector (RTD) and (ii) Thermistor and measurement of temperature using them. 16. Study the characteristics of a strain gauge sensor and its application in a measuring unit. Note: At least 12 experiments must be performed in a semester.				

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ELECTRICAL DESIGN & ESTIMATION LAB				
Subject Code:	L	T	P	C
BELES1-605	0	0	2	1
Course Objectives: 1. To know about the layout of wiring circuits of electrical installations of a residential building or/and an educational institute or/and an industry. 2. To enable the students to prepare the schedule of materials with specifications and estimates for different types of electrical installations. 3. To know about wiring arrangements of motor control circuits and to do an energy audit of a small utility.				
Course Outcomes: Students will be able: 1. To estimate the cost of various types of electrical installations. 2. To identify design goals and analyze possible approaches to meet given specifications with realistic engineering constraints. 3. To use modern engineering software tools. 4. To work amicably as a member of an engineering design team.				
List of Experiments 1. To study the Indian Electricity Act. 2. To estimate the cost of overhead service connection and an underground service connection. 3. To estimate (i) the load and cost of any five electrical appliances and (ii) their cost of repair and maintenance. 4. To carry out the schematic wiring diagram of a residential building/educational institute/industry. 5. To study design parameters of electrical panelboards. 6. To draw wiring diagrams of motor control circuits for the starting of induction and synchronous motors. 7. To study and design the earthing requirements for different types of installations and also to estimate the cost of earthing. 8. To carry out an electrical energy audit of a laboratory/office/workshop. 9. Protection of buildings and allied structures against lightning. 10. To design and estimate the cost of illumination of a Residential building/laboratory/drawing hall. 11. Lighting design: Different entities of illuminating systems; Exterior lighting- flood, street,				

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aviation and transport lighting.

OR

Lighting design for displays and signaling- neon signs, LED-LCD displays beacons and lighting for surveillance.

12. Introduction to and hands on working experience on any available programming and/or simulation platform(s), such as:

- (i) C/C++, FORTRAN, MATLAB, SIMULINK etc.
- (ii) ETAP (analytical engineering software)
- (iii) Different types of Electrical design softwares (CAD) for drawing of Electrical diagrams, schematics, control circuit diagrams etc.

Note: At least ten experiments should be performed in the semester.

Recommended Text Books / Reference Books:

- 1. Raina K.B. and Bhattacharya S.K., "Electrical Design, Estimating and Costing", Tata McGraw Hill, New Delhi.
- 2. Gupta J.B., "A course in Electrical Installation, Estimating and Costing", SK Kataria and Sons, N.Delhi
- 3. Sharma B.R. and Rai H.M., "Electrical Estimating and Costing".
- 4. Uppal S.L., "Electrical Wiring, Estimating and Costing".
- 5. Singh Surjeet, "Estimating and Costing", Dhanpat Rai and Co., New Delhi

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INDUSTRIAL ELECTRICAL SYSTEMS			
Subject Code:	L	T	P C
BELED1-611	3	0	0 3
Course Objectives: To make the students: 1. Familiar with the electrical wiring systems for residential, commercial and industrial consumers. 2. To learn about various components of industrial electrical systems. 3. To introduce to industrial automation. Course Outcomes: Students will be able: 1. To represent the electrical wiring systems for residential, commercial and industrial consumers with standard symbols and drawings, SLD. 2. To explain various components of industrial electrical systems. 3. To analyze and select the proper size of various electrical system components.			
UNIT-I (11 Hours)			
Electrical System Components: LT system wiring components, Selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components; Fuse, MCB, MCCB, ELCB, Inverse current characteristics, Symbols, Single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and electrical safety practices.			
UNIT-II (12 Hours)			
Residential and Commercial Electrical Systems: Types of residential and commercial wiring systems, General rules and guidelines for installation, Load calculation and sizing of wire, Rating of main switch, distribution board and protection devices, Earthing system calculations, Requirements of commercial installation, Deciding lighting scheme and number of lamps, Earthing of commercial installation, Selection and sizing of components.			
Illumination Systems: Understanding various terms regarding Light, Lumen, Intensity, Candle power, Lamp efficiency, Specific consumption, Glare, Space to height ratio, Waste light factor, Depreciation factor, various Illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, Energy saving in illumination systems, Design of a lighting scheme for a residential and commercial premises, Flood lighting.			
UNIT-III (11 Hours)			
Industrial Electrical Systems – I: HT connection, Industrial substation, Transformer selection, Industrial loads, Motors, Starting of motors, SLD, Cable and Switchgear selection, Lightning protection, Earthing design, Power factor correction; kVAR calculations, type of Compensation, Introduction to PCC, MCC panels, Specifications of LT Breakers, MCB and other LT panel components.			

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UNIT-IV (11 Hours)

Industrial Electrical Systems – II: DG systems, UPS system, Electrical systems for the elevators, Battery banks, Sizing the DG, UPS and battery banks, Selection of UPS and batterybanks.

Industrial Electrical System Automation: Study of basic PLC, Role in automation, Advantages of process automation, PLC based control system design, Panel metering and introduction to SCADA system for distribution automation.

Recommended Text Books / Reference Books:

1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
3. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.
4. Web site for ISStandards.
5. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

NON-LINEAR & DIGITAL CONTROL SYSTEMS

Subject Code: BELED1-612	L T P C 3 0 0 3	Duration: 45 (Hrs.)
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Course Objectives:

1. To introduce to discrete system analysis.
2. To introduce to stability aspects of discrete time systems.
3. To introduce to design of digital control and discrete output feedback control.

Course Outcomes:

Students can:

1. Represent discrete LTI systems.
2. Analyse stability of open loop and closed loop discrete-time systems.
3. Design and analyse digital controllers.
4. Design state feedback and output feedback controllers.

UNIT-I (10 Hours)

Discrete Representation of Continuous Systems:

Basics of digital control systems, Discrete representation of continuous systems, Sample and hold circuit, Mathematical Modeling of sample and hold circuit, Sampling and Quantization, Choice of sampling frequency, ZOH equivalent.

UNIT-II (12 Hours)

Discrete System Analysis:

Z-Transform and Inverse Z Transform for analyzing discrete time systems, Pulse Transfer function, Pulse transfer function of closed loop systems, Mapping from S-plane to Z plane,

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Solution of Discrete time systems, Time response of discrete time system.

Stability of Discrete Time System:

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead-beat response design.

UNIT-III (12 Hours)

State Space Approach for Discrete Time Systems:

State space models of discrete systems, State space analysis, Lyapunov Stability, Controllability, Reach-ability, Reconstructibility and observability analysis, Effect of pole zero cancellation on the controllability & observability.

Design of Digital Control System:

Design of Discrete PID Controller, Design of discrete state feedback controller, Design of set point tracker, Design of discrete observer for LTI System, Design of discrete compensator.

UNIT-IV (11 Hours)

Discrete Output Feedback Control:

Design of discrete output feedback control, Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

Introduction to Optimal Control and Non-linear Control:

Performance indices, Regulator problem, Tracking problem, Nonlinear system, Basic concepts and analysis.

Recommended Text Books / Reference Books:

1. K.Ogata, "Digital Control Engineering", Prentice Hall, Englewood Cliffs, 1995.
2. K.Ogata, "Modern Control Engineering", Prentice Hall, 1991.
3. M.Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
4. B.C.Kuo, "Digital Control System", Holt, Rinehart and Winston, 1980.
5. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
6. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009
7. G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems", Addison-Wesley, 1998.

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BATCH ONWARDS**

COMPUTER ARCHITECTURE				
Subject Code:	L	T	P	C
BELED1-613	3	0	0	3
Course Objectives: 1. To develop the concept of computer architecture and its operation. 2. To understand the concepts of microprocessors, their principles and practices. 3. To know about memory organisation. Course Outcomes: 1. Organize a modern computer system and be able to relate it to real examples. 2. Write efficient programs in assembly language of the 8086 family of microprocessors. 3. Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.				
UNIT-I (11 Hours)				
Introduction to Computer Organization: Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic, Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.				
UNIT-II (12 Hours)				
Memory Organization: System memory, Cache memory, Types and organization, Virtual memory and its implementation, Memory management unit, Magnetic hard disks, Optical disks. Input – output Organization: Accessing I/O devices, Direct memory access (DMA) and its controller, Interrupts and interrupt controllers, Arbitration, Multilevel bus architecture, Interface circuits, Parallel and serial port, Features of PCI and PCI express bus.				
UNIT-III (11 Hours)				
16 and 32 Microprocessors: 80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86				
UNIT-IV (11 Hours)				
Pipelining: Introduction to pipelining, Instruction level pipelining (ILP), Compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch prediction, Influence on instruction set. Different Architectures: VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming.				
Recommended Text Books / Reference Books: 1. V. Carl, G. Zvonko and S. G. Zaky, “Computer organization”, McGraw Hill, 1978.				

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BATCH ONWARDS**

2. B. Brey and C. R. Sarma, "The Intel microprocessors", Pearson Education, 2000.
3. J. L. Hennessy and D. A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufman, 2011.
4. W. Stallings, "Computer organization", PHI, 1987.
5. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice Hall, 2004.
6. Y. C. Lieu and G. A. Gibson, "Microcomputer Systems: The 8086/8088 Family", Prentice Hall India, 1986.
7. J. Uffenbeck, "The 8086/8088 Design, Programming, Interfacing", Prentice Hall, 1987.
8. B. Govindarajalu, "IBM PC and Clones", Tata McGraw Hill, 1991.
9. P. Able, "8086 Assembly Language Programming", Prentice Hall India.

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COMPUTATIONAL ELECTROMAGNETICS				
Subject Code: BELED1-614	L 3	T 0	P 0	C 3
				Duration: 45 (Hrs.)
Course Objectives: 1. To introduce to the basic concepts of electromagnetics and analytical methods. 2. To understand computational techniques for computing fields. Course Outcomes: 1. Explain the basic concepts of electromagnetics. 2. Use computational techniques for electromagnetic fields. 3. Apply the techniques to simple real-life problems.				
UNIT-I (15 Hours)				
Introduction: Conventional design methodology, Computer aided design aspects, Advantages, Review of basic fundamentals of Electrostatics and Electromagnetics, Development of Helmholtz equation, Energy transformer vectors, Poynting and Slepian, Magnetic diffusion-transients and time-harmonics.				
Analytical Methods: Analytical methods of solving field equations, method of separation of variables, Roth's method, Integral methods, Green's function, Method of images.				
UNIT-II (15 Hours)				
Finite Difference Method (FDM): Finite difference schemes, Treatment of irregular boundaries, Accuracy and stability of FD solutions, Finite-difference time-domain (FDTD) method, Uniqueness and convergence.				
Finite Element Method (FEM): Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.				
UNIT-III (15 Hours)				
Special Topics: Background of experimental methods, Electrolytic tank, R-C network solution, Field plotting (graphical method), Hybrid methods, Coupled circuit, Field computations, Electromagnetic - thermal and electromagnetic - structural coupled computations, Solution of equations, Method of moments, Poisson's fields.				
Applications: Low frequency electrical devices, Static/ time-harmonic / transient problems in transformers, Rotating machines, Actuators, CAD packages.				
Text/Reference Books 1. P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press, 1996. 2. M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press, 2001.				

**MRSPTU B. TECH. (ELECTRICAL ENGINEERING) SYLLABUS 2018
BATCH ONWARDS**

WIND & SOLAR ENERGY SYSTEMS				
Subject Code:	L	T	P	C
BELED1-621	3	0	0	3
Course Objectives: 1. To understand the energy scenario and the consequent growth of the power generation from renewable energysources. 2. To develop the understanding about the issues related to the grid-integration of solar and wind energysystems. Course Outcomes: Students will be enabled: 1. To explain the basics of wind power powergeneration. 2. To elaborate the basics of solar power powergeneration. 3. To intrepret the network integration issuesand the power electronic interfaces for wind and solargeneration.				
UNIT-I (15 Hours)				
Physics of Wind Power: History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distributionfunctions.				
Wind Generator Topologies: Review of modern wind turbine technologies, Fixed and variable speed wind turbines, Induction generators, Doubly-Fed induction generators and their characteristics, Permanent- magnet synchronous generators, Power electronics converters, Generator-converter configurations, Converter control.				
UNIT-II (15 Hours)				
The Solar Resource: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.				
Solar Photovoltaic: Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms, Converter Control.				
UNIT-III (15 Hours)				
Network Integration Issues: Overview of grid code technical requirements, Fault ride-through for wind farms, Real and reactive power regulation, Voltage and frequency operating limits, Solar PV and wind farm behavior during grid disturbances, Power quality issues, Power system interconnection experiences in the world, Hybrid and isolated operations of solar PV and wind systems.				

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Solar Thermal Power Generation:

Technologies, Parabolic trough, Central receivers, Parabolic dish, Fresnel, Solar pond, Elementary analysis.

Text / References:

1. T.Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. S.P.Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
5. G.N.Tiwari and M.K.Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

**MRSPTU B. TECH. (ELECTRICAL ENGINEERING) SYLLABUS 2018
BATCH ONWARDS**

HVDC TRANSMISSION SYSTEMS			
Subject Code:	L T P C	Duration: 45 (Hrs.)	
BELED1-622	3 0 0 3		
Course Objectives: 1. To know about the components and types of HVDC systems. 2. To know the role of power electronic converters in HVDC transmission. 3. To know about the use of HVDC transmission systems for power system stability.			
Course Outcomes: Students will be able: 1. To know the advantages of DC transmission over AC transmission. 2. To explain the operation of Line Commutated Converters and Voltage Source converters. 3. To apply control strategies used for HVDC transmission system. 4. To improve power system stability using HVDC system.			
UNIT-I (12 Hours) DC Transmission Technology: Comparison of AC and DC transmission; Economics, Technical performance and Reliability, Application of DC transmission, Types of HVDC systems, Components of a HVDC system, Line commutated converter, Voltage source converter based systems. Analysis of Line Commutated Converters: Line commutated converters (LCCs), Six pulse converter, Analysis neglecting commutation overlap, Harmonics, Twelve pulse converters, Inverter operation, Effect of commutation overlap, Expressions for average DC voltage, AC current and reactive power absorbed by the converters, Effect of commutation failure, Misfire and current extinction in LCC links.			
UNIT-II (12 Hours) Voltage Source Converters (VSCs); Two and Three-level VSCs, PWM schemes; Selective harmonic elimination, Sinusoidal pulse width modulation, Analysis of six pulse converter, Equations in the rotating frame, Real and reactive power control using a VSC. Control of HVDC Converters: Principles of Link Control in a LCC HVDC system, Control hierarchy, Firing Angle Controls, Phase-Locked Loop, Current and extinction angle control, Starting and stopping of a link, Higher level controllers; Power control, Frequency control, Stability controllers, Reactive power control, Principles of link control in a VSC HVDC system, Power flow and DC voltage control, Reactive power control/AC voltage regulation.			
UNIT-III (10 Hours) Components of HVDC Systems: Smoothing reactors, Reactive power sources and Filters in LCC HVDC systems DC line: Corona Effects, Insulators, Transient over-voltages, DC line faults in LCC systems, DC line faults in VSC systems, DC breakers, Mono-polar operation, Ground electrodes.			

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UNIT-IV (11 Hours)

Stability Enhancement using HVDC Control: Basic Concepts: Power system angular, voltage and frequency stability, Power modulation, basic principles, Synchronous and asynchronous links, Voltage stability problem in AC/DC systems.

MTDC Links: Multi-Terminal and Multi-Infeed systems, Series and parallel MTDC systems using LCCs, MTDC systems using VSCs, Modern trends in HVDC technology, Introduction to modular multi-level converters.

Recommended Text Books / Reference Books:

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011.
2. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1983.
3. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience, 1971.

EHVAC TRANSMISSION SYSTEMS

Subject Code:

L T P C

Duration: 45 (Hrs.)

BELED1-623

3 0 0 3

Course Objectives:

1. To familiarize the students with the need and advantages associated with EHVAC Transmission.
2. To acquaint the students with the reactive parameters of lines and methods of voltage control.
3. To make them aware about voltage gradients of conductors and effects of corona.

Course Outcomes:

Students will be enabled:

1. To explain the advantages of EHVAC Transmission and problems associated with it.
2. To examine the reactive parameters of lines and use methods of voltage control.
3. To compute the voltage gradients of conductors and explain the associated bad effects of corona.

UNIT-I (11 Hours)

Preliminaries:

Necessity of extra high voltage (EHVAC) transmission, Advantages and Problems, Power handling capacity and Line losses, Mechanical considerations, Resistance of conductors, Properties of bundled conductors, Bundle spacing and bundle radius, Examples.

Line and Ground Reactive Parameters:

Line inductance and capacitance, Sequence inductances and capacitances, Modes of propagation, Ground return, Examples.

UNIT-II (12 Hours)

Travelling Wave Theory:

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Traveling wave expression and solution, Source of excitation, Terminal conditions, Open circuited and Short-circuited end reflection and refraction coefficients, Lumped parameters of distributed lines, Generalized constants, No load voltage conditions and Charging current.

Voltage Control:

Power circle diagram and its use, Voltage control using synchronous condensers, Cascade connection of shunt and series compensation, Sub synchronous resonance in series capacitor, Compensated lines, Static VAR compensating system.

UNIT – III (11 Hours)

Voltage Gradients of Conductors:

Electrostatics, field of sphere gap, field of line charges and properties, Charge, Potential relations for multi-conductors, Surface voltage gradient on conductors, Distribution of voltage gradient on sub conductors of bundle, Electrostatic field, Calculation of electrostatic field of EHV/AC lines, Effect on humans, animals and plants, Electrostatic induction in un-energized circuit of double-circuit line, Electromagnetic interference, No load voltage conditions and charging current.

UNIT-IV (11 Hours)

Corona Effects:

Power loss and audible noise (AN), Corona loss formulae, Charge voltage diagram, Generation, Characteristics, Limits and Measurements of AN, Relation between 1- phase and 3-phase AN levels, Radio interference (RI), Corona pulses: generation, properties, limits, frequency spectrum, Modes of propagation, Excitation function, measurement of RI, RIV and Excitation functions.

Recommended Text Books / Reference Books:

- 1.R.D. Begamudre, 'EHVAC Transmission Engineering', New Academic Science, 4th Edn., **2011**.
- 2.S. Rao, 'EHVAC and HVDC Transmission and Distribution Engineering', 3rd Edn., Khanna Publishers, **2008**.

**MRSPTU B. TECH. (ELECTRICAL ENGINEERING) SYLLABUS 2018
BATCH ONWARDS**

FACTS DEVICES IN TRANSMISSION & DISTRIBUTION NETWORKS			
Subject Code:	L T P C	Duration: 45 (Hrs.)	
BELED1-624	3 0 0 3		
Course Objectives: 1. To know about the need of shunt and series reactive power compensation. 2. To become familiar with the working principles of FACTS devices, their operating characteristics, and applications. 3. To understand the basic concepts of power quality.			
Course Outcomes: 1. To analyze the characteristics of AC transmission. 2. To explain the effect of shunt and series reactive power compensation. 3. To apply FACTS devices to control power flow and to improve power quality.			
UNIT-I (11 Hours)			
Transmission Lines and Series/Shunt Reactive Power Compensation: Basics of AC transmission, Analysis of uncompensated AC transmission lines, Passive reactive power compensation, Shunt and series compensation at the mid-point of an AC line, Comparison of series and shunt compensation.			
Thyristor-based Flexible AC Transmission Controllers (FACTS): Description and characteristics of Thyristor-based FACTS devices, Static VAR compensator (SVC), Thyristor controlled series capacitor (TCSC), Thyristor controlled braking resistor and Single pole single throw (SPST) switch, Configurations/Modes of operation, Harmonics and control of SVC and TCSC, Fault current limiter.			
UNIT-II (11 Hours)			
Voltage Source Converter based (FACTS) Controllers: Voltage source converters (VSC), Six pulse VSC, Multi-pulse and Multi-level converters, Pulse-width modulation for VSCs, Selective harmonic elimination, Sinusoidal PWM and Space vector modulation, STATCOM: Principle of operation, Reactive power control: Type I and Type II controllers, Static synchronous series compensator (SSSC) and Unified power flow controller (UPFC): Principle of Operation and Control, Working principle of Interphase power flow controller. Other Devices: GTO controlled series compensator, Fault current limiter.			
UNIT-III (12 Hours)			
Application of FACTS: Application of FACTS devices for power-flow control and stability improvement, Simulation example of power swing damping in a single-machine infinite bus system using a TCSC, Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.			
Power Quality Problems in Distribution Systems:			

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Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations, Flicker and its measurement, Tolerance of Equipment, CBEMA curve.

UNIT-IV (11 Hours)

DSTATCOM (Distribution Static Compensator):

Reactive Power Compensation, Mitigation of harmonics and unbalance in distribution systems using DSTATCOM and shunt active filters, Synchronous reference frame, Extraction of reference currents, Current control techniques for DSTATCOM.

Dynamic Voltage Restorer and Unified Power Quality Conditioner:

Voltage sag and swell mitigation: Dynamic Voltage Restorer; Working principle and control strategies, Series active filtering, Unified power quality conditioner (UPQC): Working principle, capabilities and control strategies.

Recommended Text Books / Reference Books:

1. N. G. Hingorani and L. Gyugyi, “ Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.
2. K. R. Padiyar, “ FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.
3. T. J. E. Miller, “Reactive Power Control in Electric Systems”, John Wiley and Sons, New York, 1983.
4. R. C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education, 2012.
5. G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1991

MRSPTU B. TECH. (ELECTRICAL ENGINEERING) SYLLABUS 2018 BATCH ONWARDS

INTRODUCTION TO INDUSTRIAL MANAGEMENT

Subject Code: BELES1-606

L T P C

Duration: 45 Hrs

3 0 0 3

Course Objectives

The aim of this course is:

1. To introduce the concepts of Industrial Management
2. To provide knowledge about various Costs and Inventory Management
3. To highlight the latest trend in Industrial Management

Course Outcome

After completing this course, the students will be able to:

1. Understand the theories and principles of modern management
2. Apply the concepts to the management of organizations in private and public sector
3. Plot and analyze inventory control models and techniques.
4. Understand JIT, MRP and Six Sigma

UNIT-I (10 Hrs.)

Concepts of Industrial Management: Introduction: Concept and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership. Functions of Management, Evolution of Management Thought : Taylor's Scientific Management, Fayol's, Principles of Management, Douglas Mc-Gregor's Theory X and Theory Y, Mayo's Hawthorne, Experiments, Herzberg's Two Factor Theory of Motivation, Maslow's Hierarchy of Human Needs

Introduction to Human resources management: Nature of HRM, functions and importance of HRM.

UNIT-II (10 Hrs.)

Designing Organizational Structures: Concept, Importance and characteristics of organization, Types of organization - Project, matrix and informal organization. Span of control, Delegation of authority.

Work Study: Introduction, Definition, Objectives, Steps in Work Study, Method Study: Definition, Objectives, Steps of Method Study,

Work Measurement: Purpose, Types of study: Stop Watch Methods-Steps, allowances, Standard Time Calculations, Work Sampling, Production Planning and Control

UNIT-III (11 Hrs.)

Cost Analysis: Cost classification: Prime cost, Overhead cost, Selling and Distribution Cost, Fixed cost, Variable cost, Implicit cost, Explicit cost, Replacement cost, Opportunity cost, Marginal cost

Inventory Control: Inventory, Cost, Models of inventory control: EOQ, ABC, VED

UNIT-IV (14 Hrs.)

Quality Control: Statistical Quality Control, Control charts for variables and attributes, Acceptance Sampling- Single sampling- Double sampling plans,

Recent Trends in Industrial Management—Material Requirement Planning (MRP), Enterprise Resource Planning (ERP), Just in Time (JIT), Six Sigma-Concept and benefits.

Recommended Books

1. O.P Khanna, Industrial Engineering.
2. M.S. Saiyada, 'Minappa and Personnel Managements' Tata Mc Graw Hill
3. C.B. Mamoria, 'Personnel Management', Himalaya Publications
4. Ravi Shankar, 'Industrial Engineering', Galgotia

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Total Credits = 20

Semester 7 TH		Contact Hours			Max Marks		Total Marks	Credits
Subject Code	Subject Name							
		L	T	P	Int.	Ext.		
BELES1-701	Power System Analysis	3	0	0	40	60	100	3
BELES1-702	Introduction to Industry 4.0	2	0	0	40	60	100	2
BELES1-703	Power System Analysis Lab	0	0	2	60	40	100	1
BELES1-704	Minor Project	0	0	4	60	40	100	2
BELES1-705	Summer Internship (6-Week)	0	0	--	60	40	100	3
Departmental Elective - IV (Select any One)		3	0	0	40	60	100	3
BELED1-711	High Voltage Engineering							
BELED1-712	Electrical & Hybrid Vehicles							
BELED1-713	Introduction to Digital Protection							
BELED1-714	Digital Signal Processing							
XXXXX	Open-Elective*	3	0	0	40	60	100	3
BHSMC0-024	Project Management & Entrepreneurship	3	0	0	40	60	100	3
Total		-	-	-	380	420	800	20

*Open Electives (OE) can also be taken from existing lists of Open Elective-I, Open Elective-II and Open Elective-III subject lists.

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POWER SYSTEM ANALYSIS			
Subject Code:	L T P C	Duration: 45 (Hrs.)	
BELES1-701	3 0 0 3		
Course Objectives:			
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breakers, Algorithm for short circuit studies, Formulation of bus impedance matrix.

Symmetrical Components:

Symmetrical component transformation, Sequence impedances and networks of; Transmission lines, Synchronous machine and Transformers, Construction of sequence networks of a power system.

Unsymmetrical Fault Analysis:

Analysis of unsymmetrical LG (line to ground) fault, LL (line to line) fault, LLG (double line to ground) fault using symmetrical components, Symmetrical and unsymmetrical fault analysis using Bus Impedance Matrix with algorithm and flow chart.

UNIT-IV (11 Hours)

Power System Stability:

Steady state stability, Dynamics of a synchronous machine, Power angle equation, Transient stability, Equal area criterion and its application to study the effect on transient stability of; Sudden change in mechanical input, Effect of clearing time on stability, Sudden loss of one of parallel lines, Sudden short circuit on one of parallel lines, Numerical solution of swing equation, Factors effecting transient stability.

Recommended Text Books / Reference Books:

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
2. D.P. Kothari & J.S. Dhillon, Power System Optimization, Prentice-Hall of India
3. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
4. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999
5. J. Arrillaga and C. P. Arnold, Computer Aided Power System, John Wiley and Sons, 1994.
6. Stagg Glenn W. and Ei-Abiad Ahmed H., Computer Methods in Power System Analysis, Tata McGraw Hill
7. Kusic G.L., Computer Aided Power System analysis, Prentice Hall, India
8. Nagsarkar T.K. and Sukhija M.S., Power System Analysis, Oxford University Press, 2016.

MRSPTU B. TECH. (ELECTRICAL ENGINEERING) SYLLABUS 2018 BATCH ONWARDS

INTRODUCTION TO INDUSTRY 4.0			
Subject Code:	L T P C	Duration: 30 (Hrs.)	
BELES1-702	2 0 0 2		
Course Objectives: 1. To train the students to cope up with the upcoming demand of the industry. 2. To introduce the students to the emerging areas of importance like Internet of Things (IoT), Cloud, Big Data, Robotics, Block Chain, Artificial Intelligence (AI), Machine Learning etc.			
Course Outcomes: 1. Understanding about the emerging demands of the industry. 2. To develop an insight about the better human-machine interface.			
UNIT-I (07 Hours)			
Various Industry Revolutions: Define Data, Meaning of going digital, Difference between Digitisation & Digitalisation, Interdependence of technologies in the digital world, Role of Digital, Digitisation and Digitalisation in our lives. Internet of Things (IoT): Definition and working of IoT, Integration of different components of IoT, Impact of IoT on Industries, Machine to Machine communication(M2M), Limitations of IoT.			
UNIT-II (08 Hours)			
Cloud: Definition of cloud computing, Laas, PaaS, SaaS & Bpaas, Importance of cloud, Advantages and disadvantages of cloud, Meaning of a Cloud-based Open IoT Operating System (PaaS). Big Data: Difference between data and bigdata, Characteristic of bigdata; Volume, Velocity, Variety, Veracity and Value. Data Analysis: Descriptive analysis, Predictive analysis, Prescriptive analysis Blockchain: Mechanism of Cryptocurrency, Working of blockchain technology, Mining and miner.			
UNIT-III (08 Hours)			
Artificial Intelligence (AI): Tasks of AI: visual perception, speech recognition, decision making, translation between languages, Subfields of Artificial Intelligence, such as; Machine Learning, Neural Network, Deep Learning, Cognitive Computing, Computer vision, Natural Language Processing, Benefits of Artificial Intelligence in Industries.			

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Machine Learning (ML):

Relationship between ML and AI, Importance of ML for individuals and companies, **Use of ML for**; Interpretation of past customer behaviour, Simplification of product marketing, Accurate sales forecasting, Accurate medical prediction and diagnosis, Simplification in documentation and data entry, Improvement in precision of financial rules and models, Detection of Spam, Increasing the efficiency of predictive maintenance in manufacturing industry, Better customers segmentation and accurate lifetime value prediction, Recommendation of the right product.

Machine Learning Algorithms Categories: Supervised, Unsupervised and Reinforcement

UNIT-IV (07 Hours)

Plant Integration:

Standardization; Open network Interface, M2M communication, Combination of individual machines in to asynchronized production line, Manage of dark data i.e. Complex data Management.

Virtual Commissioning/Digital Twin:

End-to-end engineering, Mechanical design to electrical layout and automation, Detecting mechanical problems/ software errors at an early stage?

Industrial Edge:

Local and cloud computing/on-premise and off-premise, Industrial Edge and its Benefits to Industry

Recommended Text Books / Reference Books:

1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress Publishers, June 2016.
2. Sudip Misra, "Introduction to Industry 4.0 and Industrial Internet of Things" SWAYAM Course.
3. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, "Industrial Internet of Things: Cybermanufacturing Systems", Springer.
4. Research papers

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POWER SYSTEM ANALYSIS LAB				
Subject Code:	L	T	P	C
BELES1-703	0	0	2	1
Course Objectives: To enable the students: 1. To develop and execute software programs to formulate bus matrices. 2. To develop software programs or use dedicated programming tools for execution of load flow analysis. 3. To develop or use software programs for fault analysis.				
Course Outcomes: 1. Ability to develop software programs for bus matrices. 2. Capability to develop or use software programs for load flow analysis. 3. Ability to compute fault currents.				
List of Experiments 1. Introduction to software tools for power system studies like MiPower, ETAPetc. and/or some high level programming language such asMATLAB, C++ etc. 2. To develop a program for formation of bus admittance matrix. 3. To develop a program for approximate load flow analysis. 4. To develop a program for load flow analysis by Gauss Seidal method. 5. To develop a program for load flow analysis by Newton Raphson method. 6. To develop a program for formation of bus impedance matrix using building algorithm. 7. To calculate short circuit current and circuit breaker ratings for a power system network. 8. Fault analysis for line-to-line (L-L) fault, Line-to-Ground (L-G)fault etc. 9. To find synchronous reactances (Transient, sub-transient) during faultanalysis. 10. To develop a program for economic load dispatch of power systems. 11. Power system stability studies on a single machine system.				
Note: Atleast eight experiments must be performed from the given list.				

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MINOR PROJECT				
Subject Code:	L	T	P	C
BELES1-704	0	0	4	2
Course Objective: To enable the students to take up investigative study (theoretical and /or practical) in the broad field of Electrical Engineering.				
Course Outcomes: 1. Student will be able to apply the theoretical and practical knowledge gained so far, by taking up the study in the form of a project work. 2. This study is expected to provide a good initiation for the students in R&D work.				
The aim of the Minor Projects to enable the student to take up an investigative study in the broad field of Electrical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. The assignment to normally include: 1. Survey and study of published literature on the assigned topic; 2. Working out a preliminary Approach to the Problem relating to the assigned topic; 3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility; 4. Preparing a Written Report on the Study conducted for presentation to the Department; 5. Final Seminar, as oral Presentation before a departmental committee.				

HIGH VOLTAGE ENGINEERING				
Subject Code:	L	T	P	C
BELED1-711	3	0	0	3
Course Objectives: 1. To understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials. 2. To know about generation and measurement of D. C., A.C., & Impulse voltages. 3. To know about causes of over-voltages and protection against them. 4. To make familiar with high voltage testing of electrical apparatus.				
Course Outcomes: 1. Knowledge of generation and measurement of D. C., A.C., & Impulse voltages. 2. Knowledge of tests on H. V. equipment and on insulating materials, as per the standards. 3. Knowledge of how over-voltages arise in a power system, and protection against these				

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over-voltages.

UNIT-I (14 Hours)

Breakdown in Gases: Ionization and de-ionization processes, Types of discharge, Gases as insulating materials, Breakdown in uniform gap, Non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

Breakdown in Liquid and Solid Insulating Materials: Breakdown in pure and commercial liquids, Solid dielectrics, Composite dielectrics, Intrinsic breakdown, Electromechanical breakdown, Thermal breakdown, Partial discharge, Applications of insulating materials.

UNIT-II (16 Hours)

Generation of High Voltages: Generation of high voltages, generation of high D. C. and A.C. voltages, Generation of impulse voltages, Generation of impulse currents, Tripping and control of impulse generators.

Measurements of High Voltages and Currents: Peak voltage, Impulse voltage and high direct current measurement method, Cathode ray Oscillo graphs for impulse voltage and current measurement, Measurement of dielectric constant and loss factor, Partial discharge measurements.

Lightning and Switching Over-voltages: Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges, Switching over- voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

UNIT-III (15 Hours)

High Voltage Testing of Electrical Apparatus and High Voltage Laboratories: Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, Testing of isolators and circuit breakers, Testing of cables, Power transformers and some high voltage equipment, High voltage laboratory layout, Indoor and outdoor laboratories, Testing facility requirements, Safety precautions in H. V. Labs.

Recommended Text Books / Reference Books:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C.L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
4. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
5. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.
6. Various IS standards for HV Laboratory Techniques and Testing

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ELECTRICAL & HYBRID VEHICLES					
Subject Code:	L	T	P	C	Duration: 45 (Hrs.)
BELED1-712	3	0	0	3	
Course Objectives: 1. To study about concept of hybrid electric vehicles, their configurations and control. 2. To know about different possible ways of energy storage. 3. To understand different strategies related to energy management in hybrid and electric drive systems.					
Course Outcomes: Students will be able to: 1. Develop mathematical models to describe vehicle performance. 2. Analyse fuel efficiency of hybrid and electric drive trains. 3. Control various types of drives. 4. Analyse different types of energy storage systems. 5. Select the size of a drive system and Implement energy management strategies.					
UNIT-I (11 Hours)					
Conventional Vehicles: Basics of vehicle performance, Vehicle power source characterization, Transmission characteristics, Mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies.					
UNIT-II (11 Hours)					
Hybrid Electric Drive-Trains: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis. Electric Drive Trains: Basic concept of electric traction, Introduction to various electric drive- train topologies, Power flow control in electric drive-train topologies, Fuel efficiency analysis. Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles.					
UNIT-III (12 Hours)					
Configuration and Control of Various Types of Drives: DC motor drives, Induction motor drives, Permanent magnet motor drives, Switch reluctance motor drives, Drive system efficiency. Energy Storage: Introduction to energy storage requirements in hybrid and electric vehicles, Battery based energy storage and its analysis, Fuel cell based energy storage and its analysis, Super capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.					

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UNIT-IV (11 Hours)

Sizing the Drive System: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, Sizing the power electronics, Selecting the energy storage technology, Communications, Supporting subsystems.

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, Classification and comparison of different energy management strategies, Implementation issues of energy management strategies.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Recommended Text Books / Reference Books:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
4. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

INTRODUCTION TO DIGITAL PROTECTION

Subject Code:	L	T	P	C	Duration: 45 (Hrs.)
BELED1-713	3	0	0	3	

Course Objectives:

1. To know about the evolution of static relays and numerical relays.
2. To know about the basic principle and the interfacing elements required for the digital protection.

Course Outcomes:

Students will be able:

1. To classify relays, such as; electromechanical, static and numerical relays and describe their merits and de-merits.
2. To explain the need of numerical relaying algorithms.
3. To explain the basic block diagram of a digital protection system.
4. To interface elements with microprocessor to develop digital relays.

UNIT-I (11 Hours)

Introduction: Need for protective systems, Evolution of protective relays, Essential qualities of protection, Classification of protective relays, Electromechanical relays, Static relays, Numerical relays, Comparison between Electromechanical relays and Numerical relays.

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Static Relays: Merits and demerits, use of Amplitude and phase comparators in static relays, Types of amplitude comparators such as; circulating current type Rectifier bridge comparators, Phase splitting type comparators, Sampling comparators, Types of phase comparators such as; Vector product phase comparators, Coincidence phase comparators.

UNIT-II (11 Hours)

Numerical Protection: Introduction to numerical relay, its generalized Block diagram, Advantages and Disadvantages of numerical relays, components of Data acquisition system such as; Signal conditioner, Aliasing, Sampling, Analog interface.

Numerical Relaying Algorithms: Mann-Morrison technique, Differential equation technique, Fourier representation of signals, Discrete Fourier transform (DFT) technique, Extraction of fundamental frequency components, Computation of the apparent impedance.

UNIT-III (12 Hours)

Interfacing Elements of Microprocessor-Based Relays: Introduction, IC elements and circuits for interfaces; Operational amplifier, Zero-crossing detector, Phase shifter, Current to voltage converter, Summing amplifier, Differential amplifier, Precision rectifier, Active low-pass filter, Bipolar to unipolar converter.

A/D converter (ADC 0800, ADC 0808), Analog multiplexer (AM 3705), Sample & Hold (S/H) circuit (LF 398), Interfacing of ADC 0800, AM 3705 and LF 398 to microprocessor 8085.

UNIT-IV (11 Hours)

Microprocessor-Based Numerical Relays: Digital relay as a unit consisting of hardware and software, Block schematic diagram of Over current relay, Program flowchart and Program, Block schematic diagram of Impedance relay, Program flowchart and Program, Block schematic diagram of generalized interface for Distance relays and its generalized program flowchart.

Recommended Text Books / Reference Books:

1. Badri Ram and Vishwakarma D.N., Power system Protection and Switchgear, Tata McGraw Hill
- A. T. Johns and S. K. Salman, "Digital Protection of Power Systems", IET Press
2. S.R. Bhide, 'Digital Power System Protection', PHI Learning Pvt. Ltd., 2014.
3. T.S. Madhava Rao, 'Power System Protection: Static Relays: with Microprocessor Applications', 2017.
4. G. Phadke & J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
5. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.

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DIGITAL SIGNAL PROCESSING					
Subject Code:	L T P C			Duration: 45 (Hrs.)	
BELED1-714	3 0 0 3				
Course Objectives:					
1. To familiarize the students with the basics of signal processing for analysis of discrete signals.					
2. To acquaint the students with the application of different tools required for the analysis of discrete signals.					
3. Application of digital signals to real-life problems.					
Course Outcomes:					
Students will be able:					
1. To represent signals mathematically in discrete-time, and in the frequency domain and analyse them using Z-transform.					
2. To implement Discrete Time Systems using the Discrete-Fourier Transform (DFT) and the FFT algorithms.					
3. To design digital filters for various applications.					
4. To apply digital signal processing for the analysis of real-life signals.					
UNIT-I (12 Hours)					
Discrete-Time Signals and Systems: Discrete time signals and systems, Sequences; Representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.					
Z-transform: Z-transform, Region of Convergence, Analysis of Linear shift invariant systems using Z- transforms, Properties of Z-transform for causal signals, Interpretation of stability in Z-domain, Inverse Z-transforms, Introduction to bilateral Z-transforms.					
UNIT-II (10 Hours)					
Discrete Fourier Transform: Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.					
UNIT-III (12 Hours)					
Digital Filter Structure: Describing equation, Structures for FIR systems and structure for IIR Systems, Representation of structures using signal flow graph.					
Design of Digital filters: Design of FIR digital filters, Window method, Park-McClellan's method, Design of IIR digital filters: Butterworth, Chebyshev and Elliptic approximations, Low-pass, Band-pass, Band-stop and High-pass filters, Effect of finite register length in FIR filter design, Finite Word-length Effects, Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.					

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UNIT-IV (11 Hours)

Applications of Digital Signal Processing: Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Hardware Architecture of DSP Processor: Introduction, Desirable features of DSP processors, Types of architectures, Internal architecture of ADSP-21xx family, Features of ADSP-21xx family processors.

Recommended Text Books / Reference Books:

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schaffer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.
5. J.R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.

PROJECT MANAGEMENT & ENTREPRENEURSHIP

Subject Code: BHSMC0-024

L T P C
3 0 0 3

Contact Hrs. 45 (Hrs.)

Course Objectives:

The aim of this course is:

1. To provide the conceptual clarity about project organization and feasibility analyses
2. To develop the entrepreneurial intent among students
3. To build the necessary competencies and motivation for a career in Entrepreneurship.
4. To provide insights about network analysis tools for cost and time estimation.

Course Outcomes:

After completing this course, the students will be able to:

1. Understand project characteristics and various stages of a project.
2. Analyze the learning and understand techniques for Project planning, scheduling and Execution Control.
3. Know the parameters to assess opportunities and constraints for new business ideas.
4. Understand the systematic process to select and screen a business idea
5. Understand various funding opportunities available for start-up and new ventures

UNIT-I (10 Hrs.)

Project Management: Concepts Attributes of a Project, Project Life Cycle, The Project Management Process, Benefits of Project Management, Needs Identification, Project Selection, Impact of Delays in Project Completions, Roles and Responsibilities of Project Manager.

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Relationship between Project Management and Line management, Ethical issues in Project Management

UNIT-II (13 Hrs.)

Project Planning and Scheduling

Project Planning: Introduction, Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)

PERT and CPM: Introduction, Development of Project Network, Time Estimation, Determination of the Critical Path, PERT Model, Measures of variability, CPM Model, Network Cost System

Project Implementation - Stages - Bottlenecks in project implementation

UNIT-III (12 Hrs.)

Foundations of Entrepreneurship: Concept, Need, Definition & Role of Entrepreneurship, Definition, Characteristics & Scope of Entrepreneur, Reasons for The Failure of Entrepreneurial Ventures,

Business Opportunity Identification: Business ideas, methods of generating ideas, and opportunity recognition

Preparing a Business Plan: Meaning and significance of a business plan, components of a business plan, and feasibility study

UNIT-IV (10 Hrs.)

Institutional support to Entrepreneurship: Role of Central Government and State Government in Promoting Entrepreneurship, Role of Directorate of Industries, District Industries, Centers (DICs), Industrial Development Corporation (IDC), State Financial corporation (SFCs), Commercial banks Small Scale Industries Development Corporations (SSIDCs), National Small Industries Corporation (NSIC), Small Industries Development Bank of India (SIDBI),

Introduction to various Incentives, Subsidies and Grants - Export Oriented Units - Fiscal and Tax concessions available. Women Entrepreneurs Reasons for low / no women Entrepreneurs their Role, Problems and Prospects

Recommended Books

1. N.P.Srinivasan & G.P.Gupta, 'Entrepreneurial Development', Sultanchand & Sons.
2. Angadi, Cheema, Das, 'Entrepreneurship, Growth, and Economic Integration', Himalaya Publication.
3. Rizwana and Janakiran, 'Entrepreneurship Development', Excel Books.
4. Kanda, 'Project Management – A Life Cycle Approach', PHI.
5. Gido, 'Project Management', Cengage COURSEs.
6. Vasant Desai, 'Project Management' Himalaya Publications.
7. Maylor, 'Project Management', Pearson Education.
8. Prasanna Chandra, 'Projects, Preparation, Appraisal Budgeting & Implementation', Tata McGraw Hills.

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Total Credits = 16

Semester 8 TH		Contact Hours			Max Marks		Total Marks	Credits
Subject Code	Subject Name							
		L	T	P	Int.	Ext.		
BELES1-801	Generation & Economics of Electric Power	3	0	0	40	60	100	3
BELES1-802	Major Project	0	0	8	60	40	100	4
Departmental Elective - V (Select any One)		3	0	0	40	60	100	3
BELED1-811	Electrical Energy Conservation & Auditing							
BELED1-812	Power System Dynamics & Control							
BELED1-813	Control Systems Design							
BELED1-814	Advanced Electric Drives							
BELED1-815	Restructuring of Power Industry							
XXXXX	Open-Elective*	3	0	0	40	60	100	3
XXXXX	Open-Elective *	3	0	0	40	60	100	3
Total		-	-	-	220	280	500	16

*Open Electives (OE) can also be taken from existing lists of Open Elective-I, Open Elective-II and Open Elective-III subject lists.

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GENERATION & ECONOMICS OF ELECTRIC POWER					
Subject Code:	L T P C			Duration: 45 (Hrs.)	
BELES1- 801	3 0 0 3				
Course Objectives: 1. To familiarize the students with different types of loads and load curves. 2. To apprise them with different types of costs involved in power plant and tariffs imposed on the electricity consumers. 3. To impart knowledge about selection and economic operation of steam plants. 4. To impart knowledge about hydrothermal coordination.					
Course Outcomes: 1. Students will be able to differentiate among types of loads and related terminology. 2. They will be able to estimate various costs involved in the power plants and tariffs imposed on different categories of consumers. 3. They can select the size and location of a power plant. 4. They will be enabled to co-operate hydro and steam power plants.					
UNIT-I (12 Hours)					
Introduction: Electrical energy sources, Organization of power sector in India, Single line diagram of thermal, hydro and nuclear power stations, Classification of power plants in base load and peak load plants.					
Loads and Load curves: Fixed voltage loads, Resistive loads, Inductive motor loads, Mechanical load, effect of supply Voltage and Frequency on load, Maximum demand, Group diversity factor, Peak diversity factor,					
Classification of loads: Domestic, Industrial, Commercial, Urban, Traction, Municipal, Irrigation, Chronological load curves, Load-duration curve, Mass curves, Energy-load curve, Demand factor, Load factor, Capacity factor, Utilization factor, Base load, Peak load, Load forecasting and its types.					
UNIT-II (12 Hours)					
Power Plant Economics: Cost of electrical energy, Capital cost of plants, Annual fixed, operating and Annual plant cost, Generation cost, Effect of load factor on unit cost of energy, Depreciation and its types.					
Tariffs: Objectives of tariff, Types of tariff, General tariff form, Flat meter rate, Block meter rate, Two part, Maximum or Flat demand, Power factor tariff, Three part tariff, Wright demand rate.					
Availability Based Tariff (ABT): Introduction to ABT and its necessity, Various components of ABT, Unscheduled interchange rate, Implementation of ABT in India.					
Power Factor Improvement: Causes and effect of low power factor, Improvement of power factor using capacitors and synchronous condenser, Determination of economic power factor.					
UNIT-III (10 Hours)					
Selection of Plant: Plant location considerations, Plant size, Number and size of units in					

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plants, Selection of plant based on; Annual cost, Rate of return, Present worth and Capitalized cost methods, Operating and Spinning Reserve.

Economic Operation of Steam Plants: Introduction, Methods of loading turbo-generators, Input-output curve, Heat rate, Incremental cost, Economic loading neglecting transmission losses, Method of Lagrangian multiplier, Economic loading including transmission losses, Co-ordination equations, Iterative procedure to solve co-ordination equations.

UNIT-IV (11 Hours)

Hydro-Thermal Co-ordination: Introduction, Advantages of combined operation, Base load and Peak load operation, Combined working of Run-off River plant and steam plant, reservoir hydro plants and thermal plants, Long-term operational aspects, Short term Hydro-Thermal coordination, Coordination Equations, Scheduling methods and its applications.

Cogeneration: Definition and scope, Topping and Bottoming cycles, Benefits, Cogeneration technologies, Industries suitable for cogeneration.

Captive Power Generation: Introduction, Advantages and Constraints, Types of captive power plants, Financing of captive power plants, Energy banking and energy wheeling, Future prospects in India.

Recommended Text Books / Reference Books:

1. Deshpande M.V., "Power Plant Engineering", Tata McGraw Hill (2004).
2. EI-Wakit M.M., "Power Plant Engineering", McGraw Hill, USA, 2010
3. Kothari D.P. and Nagrath I.J., "Power System Engineering", Tata McGraw Hill, 2008.
4. Arora S.C. and Dom Kundwar S., "A course in Power Plant Engineering", Dhanpat Rai, Sixth Revised Edition 2011-12.
5. Nag, P.K., "Power Plant Engineering", Tata McGraw Hill, 2014.
6. Gupta B.R., "Generation of Electrical Energy", S. Chand 2017.
7. Rajput R.K., "Power Plant Engineering", Luxmi Publications
8. Sharma P.C., "Power Plant Engineering", Kataria and Sons
9. Skrotzki B.G.A. and Vapot W.A., "Power Station Engineering and Economy", Tata McGraw-Hill
10. Nagrath I.J. and Kothari D.P., "Power System Analysis" Tata McGraw-Hill Publication

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MAJOR PROJECT				
Subject Code:	L	T	P	C
BELES1-802	0	0	8	4
Course Objective: To enable the students to extend further the investigative study (theoretical and /or practical)(taken up under Minor Project in the previous semester or a new study), so as to explore their knowledge and technical skills in a more comprehensive way by working in a group as a team.				
Course Outcomes: 1. Student will be trained to apply the theoretical knowledge and practical experience gained so far, by conducting the study in the form of a project work. 2. Students will get a good training in R&D work and technical leadership.				
The object of Major Project and Dissertation is to enable the student to either extend further the investigative study taken up under Minor Project or take up a new study either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. The assignment to normally include: 1. In depth study of the topic assigned in the light of the Report prepared under Minor Project or on a new topic (if it is not possible to extend the study of minor project). 2. Review and finalization of the Approach to the Problem related to the assigned topic; 3. Preparing an Action Plan for conducting the investigation, including team work; 4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed; 5. Final development of product/process, testing, results, conclusions and future directions; 6. Preparing a Dissertation in the standard format for being evaluated by the Department. 7. Final Seminar Presentation before a Departmental Committee.				

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ELECTRICAL ENERGY CONSERVATION & AUDITING					
Subject Code:	L	T	P	C	Duration: 45 (Hrs.)
BELED1- 811	3	0	0	3	
Course Objectives: 1. To understand the importance of energy management and Audit. 2. To study various types of energy dissipating systems such as electrical, compressed air system, HVAC and refrigeration systems. 3. To understand energy audit processes of these systems used in the industry.					
Course Outcomes: Students will be able: 1. To do management and audit of energy. 2. To calculate different types of losses and hence evaluate and improve energy efficiency of electrical systems. 3. To evaluate performance and efficiency of HVAC systems, fans, blowers, pumps, compressed air systems and cooling towers.					
UNIT-I (15 Hours) Energy Scenario: Commercial and non-commercial energy, Primary energy resources, Commercial energy production, Final energy consumption, Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy and environment, Energy security, Energy conservation and its importance, Restructuring of the energy supply sector, Energy strategy for the future, Air pollution, Climate change, Energy Conservation Act-2001 and its features. Energy Management & Audit: Definition, Energy audit, Need, Types of energy audit, Energy management (audit) approach, Energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel & energy substitution, Energy audit instruments. Material and energy balance, Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams.					
UNIT-II (15 Hours) Energy Efficiency in Electrical Systems: Electrical system, Electricity tariffs, 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.					

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Distribution and transformer losses.

Electric Motors: Types, Losses in induction motors, Motor efficiency, Factors affecting motor performance, Rewinding and motor replacement issues, Energy saving opportunities with energy efficient motors.

Energy Efficient Technologies in Electrical Systems: Maximum demand controllers, 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, Energy saving potential of each technology.

UNIT-III (15 Hours)

Energy Efficiency in Industrial Systems:

Compressed Air System: Types of air compressors, Compressor efficiency, Efficient compressor operation, Compressed air system components, Capacity assessment, Leakage test, Factors affecting the performance and efficiency.

Saving Opportunities in HVAC, Fans and Blowers: Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities.

Pumps and Pumping System: Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities.

Cooling Tower: Types and performance evaluation, Efficient system operation, Flow control strategies and energy saving opportunities, Assessment of cooling towers.

Recommended Text Books / Reference Books:

1. Abbi Y.P. and Jain S., Handbook on Energy Audit and Environment Management, T E R I Press, 2006.
2. Doti Steve, PE, CEM, Commercial Energy Auditing Reference Handbook, CRC Press, Taylor & Francis Group, 2010.
3. Desai Sonal, Handbook of Energy Audit, McGraw Hill Education, New Delhi, 2017.
4. Al-Shemeri Tarik, Energy Audits, A workbook for Energy Management in Buildings, John Wiley & Sons, 2011.
5. Capehart, Turner and Kennedy, Guide to Energy Management, CRC Press, Taylor & Francis Group, 2008.
6. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
7. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
8. S.C.Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.

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POWER SYSTEM DYNAMICS & CONTROL					
Subject Code:	L	T	P	C	Duration: 45 (Hrs.)
BELED1- 812	3	0	0	3	
Course Objectives: 1. To understand the problem of power system stability, its impact, analysis and methods to control it. 2. To model synchronous machine, its associated controllers, and other power system components for the study of stability. 3. To know about different types of stability measures.					
Course Outcomes: Students will be able: 1. To evaluate the impact of stability on the operation and control of power system. 2. To analyse linear dynamical systems and can apply numerical integration methods. 3. To model different power system components for the study of stability. 4. To use methods to improve stability.					
UNIT-I (15 Hours)					
Introduction to Power System Operations: Introduction to power system stability, Power system operations and control, Stability problems in Power System, Impact on power system operations and control. Analysis of Linear Dynamical System and Numerical Methods: Analysis of dynamical System, Concept of equilibrium, Small and large disturbance stability, Modal analysis of linear system, Analysis using numerical integration techniques, Issues in modeling, Slow and fast transients, Stiff system.					
UNIT-II (15 Hours)					
Modeling of Synchronous Machines and Associated Controllers: Modeling of synchronous machine, Physical characteristics, Rotor position dependent model, D-Q transformation, Model with standard parameters, Steady state analysis of synchronous machine, Short circuit transient analysis of a synchronous machine, Synchronization of synchronous machine to an infinite bus, Modeling of excitation and prime mover systems, Physical characteristics and models, Excitation system control, Automatic voltage regulator, Prime mover control systems, Speed governors. Modeling of Other Power System Components: Transmission line physical characteristics, Transmission line modeling, Load models, Induction machine model, Frequency and voltage dependence of loads, Other Sub-systems, HVDC and FACTS controllers, Wind energy systems.					

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UNIT-III (15 Hours)

Stability Analysis: Angular stability analysis in single machine infinite bus system, Angular stability in multi-machine systems, Intra-plant, Local and Inter-area modes, Frequency Stability, Centre of inertia motion, Load sharing, Governor droop, Single machine load bus system, Voltage stability, Torsional oscillations and the SSR phenomenon, Stability analysis tools, Transient stability programs, Small signal analysis programs.

Enhancing System Stability: Planning measures, Power system stabilizers, Operational measures, Preventive control, Emergency control.

Recommended Text Books / Reference Books:

1. K.R. Padiyar, "Power System Dynamics, Stability and Control", B. S. Publications, 2002.
2. P.Kundur, "Power System Stability and Control", McGraw Hill, 1995.
3. P.Sauer and M.A.Pai, "Power System Dynamics and Stability", Prentice Hall, 1997.

CONTROL SYSTEMS DESIGN

Subject Code:	L	T	P	C	Duration: 45 (Hrs.)
BELED1- 813	3	0	0	3	

Course Objectives:

1. To understand various design specifications.
2. To learn to design controllers to satisfy the desired design specifications.
3. To design controllers using the state-space approach.

Course Outcomes:

Students will be able to:

1. Design classical control systems in time domain.
2. Design classical control systems in frequency domain.
3. Design controller structures (P, PI, PID, compensators).
4. Examine the controllability & observability and can design controllers using state-space approach.

UNIT-I (15 Hours)

Design Specifications:

Introduction to design problem and philosophy, Introduction to time domain and frequency domain design specifications and their physical relevance, Effect of gain on transient and steady state response, Effect of addition of pole on system performance, Effect of addition of zero on system response.

Design of Classical Control System in Time Domain:

Introduction to compensator, Design of Lag, lead, and lag-lead compensator in time domain, Feedback and Feed forward compensator design, Feedback compensation, Realization of compensators.

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UNIT-II (15 Hours)

Design of Classical Control System in Frequency Domain:

Compensator design in frequency domain to improve steady state and transient response, Feedback and Feed forward compensator design using Bode diagram.

Design of PID controllers:

Design of Proportional (P), Proportional-Integral (PI), Proportional-Derivative (PD) and PID controllers in time domain and frequency domain for first, second and third order systems, Control loop with auxiliary feedback, Feed forward control.

UNIT-III (15 Hours)

Control System Design in State Space:

Review of state space representation, Concept of controllability & observability, Effect of pole zero cancellation on the controllability & observability of the system, Pole placement design through state feedback, Ackerman's Formula for feedback gain design, Design of Observer, Reduced order observer, Separation Principle.

Effect of Nonlinearities on System Performance:

Types of non-linearities, Effect of non-linearities on system performance, Singular points, Phase plot analysis.

Recommended Text Books / Reference Books:

1. N. Nise, "Control System Engineering", John Wiley, 2000.
2. I. J. Nagrath and M. Gopal, "Control System Engineering", Wiley, 2000.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
4. K. Ogata, "Modern Control Engineering", Prentice Hall, 2010.
5. B. C. Kuo, "Automatic Control system", Prentice Hall, 1995.
6. J. J. D'Azzo and C. H. Houpis, "Linear Control System Analysis and Design (conventional and modern)", McGraw Hill, 1995.
7. R. T. Stefani and G. H. Hostetter, "Design of Feedback Control Systems", Saunders College Pub, 1994.

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ADVANCED ELECTRIC DRIVES					
Subject Code:	L	T	P	C	Duration: 45 (Hrs.)
BELED1- 814	3	0	0	3	
Course Objectives: 1. To understand the operation of power electronic converters and their control strategies. 2. To understand the different control strategies used for AC motor drives. 3. To understand the control strategies using digital signal processors.					
Course Outcomes: Students will be able to: Understanding about the control of power converters and their control methods. 1. Control power converters for controlling AC drives. 2. Apply the various control techniques for induction motor drives and synchronous motor drives. 3. Control motion using digital signal processors.					
UNIT-I (15 Hours)					
Power Converters for AC Drives: Pulse width modulation (PWM) control of inverter, Selected harmonic elimination, Space vector modulation (SVM), Current control of VSI, Three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, Current source inverters (CSI) with self-commutated devices, Control of CSI, H bridge as a four quadrant (4-Q) drive.					
UNIT-II (15 Hours)					
Induction Motor Drives: Different transformations and reference frame theory, Modeling of induction machines, Voltage fed inverter control-v/f control, Vector control, Direct torque and flux control (DTC). Synchronous Motor Drives: Modeling of synchronous machines, Open loop v/f control, Vector control, Direct torque control, CSI fed synchronous motor drives.					
UNIT-III (15 Hours)					
Permanent Magnet (PM) Motor Drives: Introduction to various PM motors, BLDC (Brushless DC) motor and PMSM (Permanent magnet synchronous motor) drive configuration, Comparison, Block diagrams, Speed and torque control in BLDC and PMSM. Switched Reluctance Motor (SRM) Drives: Evolution of switched reluctance motors, various Topologies for SRM drives, Their comparison, Closed loop speed control and torque control of SRM. DSP based Motion Control: Use of DSPs in motion control, various DSPs available, Realization of some basic blocks in DSP for implementation of DSP based motion control.					

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Recommended Text Books / Reference Books:

1. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.
3. H.A.Taliyat and S.G.Campbell, "DSP based Electromechanical Motion Control", CRC press, 2003.
4. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press, 2009.

RESTRUCTURING OF POWER INDUSTRY					
Subject Code:	L	T	P	C	Duration: 45 (Hrs.)
BELED1- 815	3	0	0	3	
Course Objectives: 1. To understand about the restructuring of the electricity market. 2. To understand about transmission network congestion management and its pricing. 3. To know about ancillary service management.					
Course Outcomes: 1. Students will be enabled to Identify the need of restructuring and deregulation of power industry. 2. They will be able to manage congestion of transmission network. 3. They will be able to estimate pricing of transmission network. 4. Define and describe the Technical and Non-technical issues in restructured power industry.					
UNIT-I (15 Hours)					
Introduction to Restructuring of Power Industry: Introduction, Reasons for restructuring/ deregulation of <u>power industry</u> , Understanding the restructuring process, Reasons and objectives of deregulation of <u>various</u> power systems across the world.					
Trading Arrangement: Pool model, Pool and bilateral trades, Multi-lateral trades model					
UNIT-II (15 Hours)					
Transmission Congestion Management: Transmission congestion management, Classification of congestion management mechanisms, Calculation of available transfer capability (ATC), Non-market methods of congestion management, Nodal pricing: OPF based congestion management, Inter-zonal congestion management, Price area congestion management, Comparison and conclusion.					
Pricing of Transmission Network: Pricing of transmission network usage, Principles of transmission pricing, Classification of transmission pricing, Rolled in transmission pricing methods, Marginal transmission pricing methods.					
UNIT-III (15 Hours)					
Locational Marginal Prices (LMPs): Locational marginal pricing fundamentals, LMP					

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formulations and implementation, Locational marginal pricing formulation and implementation using AC optimal power flow (ACOPF), Locational Pricing using DC optimal power flow (DCOPF).

Ancillary Service Management: Ancillary services, Types of ancillary services, Load generation balancing related services, Voltage control and Reactive power support service, Black start capability service.

Recommended Text Books / Reference Books:

1. Loi Lei Lai, Power System Restructuring and Deregulation, John Wiley & Sons Ltd. 2001
2. National Digital Library of India
3. A.R. Abhyankar and S. A. Khaparde, Restructured Power Systems, Alpha Science International Ltd. 2016.
4. M Shahidehpour, M Alomoush, Restructured electrical power systems: Operation: Trading, and volatility, Marcel Dekker Inc. New York 2017