# Course Structure & Syllabus

# of

# B. Tech. Programme

# in

# Electrical and Electronics Engineering

# Academic Year – 2019-20


## VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, ODISHA

## Burla, Sambalpur-768018, Odisha

## www.vssut.ac.in

# VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA, ODISHA

## DEPARTMENT OF ELECTRICAL& ELECTRONICS ENGINEERING

### VISION OF THE DEPARTMENT

The graduates in Electrical & Electronics Engineering program of VSSUT Burla strives to be recognized globally for imparting outstanding technical education and research leading to well qualified truly world class leaders and to unleash technological innovations to serve the global society with an ultimate aim to improve the quality of life.

### MISSION OF THE DEPARTMENT

The graduates in Electrical & Electronics Engineering program of VSSUT Burla strives to create world class Electrical & Electronics Engineers by

| | |
|---|---|
| **M1** | Imparting quality education to its students and enhancing their skills |
| **M2** | Encouraging innovative research and consultancy by establishing the state-of-the-art research facilities through which the faculty members and engineers from the nearby industries can actively utilize the established the research laboratories |
| **M3** | Expanding curricula as appropriate to include broader prospective. |
| **M4** | Establishing linkages with world class R&D organizations and leading educational institutions in Indian and abroad for excelling in teaching, research and consultancy |
| **M5** | Developing simple and appropriate technologies for rural areas and eventually contributing to sustainable development of the society |

## PROGRAM EDUCATIONAL OBJECTIVES

The educational objectives of UG program in Electrical and Electronics Engineering (EEE) of VSSUT, Burla are:

| | |
|---|---|
| **PEO1** | To have sound knowledge of basic principles of electrical& electronics engineering, exposure to experimental setups including requisite knowledge in mathematics, sciences and basic engineering. |
| **PEO2** | To augment the workforce in areas of electrical power and electronics systems, electrical and electronic component manufacturing industries, related core engineering and software fields and be entrepreneurs eventually realizing the make in India dream. |
| **PEO3** | To have strong background to pursue higher studies, communicate effectively, become efficient team members and leaders. |
| **PEO4** | To inculcate strong ethical values and social responsibility. |
| **PEO5** | To lead in the conception, design and implementation of new products, processes, services and systems. |

## MISSION OF THE PROGRAM – PEOs MATRIX

| | M1 | M2 | M3 | M4 | M5 |
|---|---|---|---|---|---|
| PEO1 | 3 | 1 | - | - | - |
| PEO2 | 3 | 2 | 1 | 2 | 2 |
| PEO3 | 2 | 3 | 3 | 2 | - |
| PEO4 | - | - | 3 | - | 3 |
| PEO5 | 1 | 3 | 1 | 3 | 3 |

## PROGRAM OUTCOMES OF B. TECH. (EEE)

| | |
|---|---|
| **PO1** | **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **PO2** | **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| **PO3** | **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| **PO4** | **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| **PO5** | **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. |
| **PO6** | **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| **PO7** | **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| **PO8** | **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO9** | **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO10** | **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| **PO11** | **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| **PO12** | **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

## PROGRAM SPECIFIC OUTCOMES (PSOs) OF B. TECH. (EEE)

| | |
|---|---|
| **PSO1** | Apply the skill to solve complex engineering problems Electric circuits, Analog and Digital electronics circuits, Control systems, Electrical machines and Power system. |
| **PSO2** | Develop suitable techniques and cutting-edge engineering hardware and software tools in electrical engineering to engage in life-long learning and to successfully adapt in multi-disciplinary environments. |
| **PSO3** | Aware of the impact of professional engineering solutions in societal, environmental context, professional ethics and be able to communicate effectively. |

# VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA, ODISHA

## PROPOSED COURSE STRUCTURE FOR BACHELOR OF TECHNOLOGY COURSES TO BE EFFECTIVE FROM JULY 2019 - 2020

| COURSE STRUCTURE FIRST SEMESTER FIRST YEAR (THEORY) | | | | |
|---|---|---|---|---|
| **Sl. No** | **Course Code** | **Subject** | **Contact Hrs. L-T-P** | **Credits** |
| 1 | BMA01001 | Mathematics-I | 3-1-0 | 4 |
| 2 | BPH01001 | Physics | 3-0-0 | 3 |
| 3 | BEE01001 | Basic Electrical Engg. | 3-0-0 | 3 |
| 4 | BHU01001 | English For Business Communication | 3-0-0 | 3 |
| 5 | BME01001 | Engineering Mechanics | 3-0-0 | 3 |
| SESSIONALS | | | | |
| 1 | BPH01002 | Physics Laboratory | 0-0-3 | 1.5 |
| 2 | BEE01002 | Basic Electrical Engg. Lab | 0-0-3 | 1.5 |
| 3 | BHU01002 | Business Communication Skills | 0-0-3 | 1.5 |
| 4 | BME01002 | Workshop & Manufacturing Practices | 0-0-3 | 1.5 |
| NON-CREDIT | | | | |
| 1 | BNC01001 | Induction Programme and participation in Clubs / Societies | 0-0-0 | 0 |
| Total | | | 15-1-12 | 22 |

| COURSE STRUCTURE SECOND SEMESTER FIRST YEAR (THEORY) | | | | |
|---|---|---|---|---|
| **Sl. No.** | **Course Code** | **Subject** | **Contact Hrs. L-T-P** | **Credits** |
| 1 | BMA02001 | Mathematics - II | 3-1-0 | 4 |
| 2 | BCH02001 | Chemistry | 3-0-0 | 3 |
| 3 | BEC02001 | Basic Electronics | 3-0-0 | 3 |
| 4 | BIT02001 | Programming for Problem Solving | 3-0-0 | 3 |
| 5 | BME02001 | Basic Civil Engg. | 3-0-0 | 3 |
| SESSIONALS | | | | |
| 1 | BCH02002 | Chemistry Lab | 0-0-3 | 1.5 |
| 2 | BEC02002 | Basic Electronics Lab | 0-0-3 | 1.5 |
| 3 | BIT02002 | Programming Lab / | 0-0-3 | 1.5 |
| 4 | BCE02002 | Engineering Graphics & Design | 0-0-3 | 1.5 |
| NON-CREDIT | | | | |
| 1 | BNC02001 | NSS/NCC/Yoga | 0-0-0 | 0 |
| Total | | | 15-1-12 | 22 |

| COURSE STRUCTURE THIRD SEMESTER<br>SECOND YEAR (THEORY) | | | | |
|---|---|---|---|---|
| **Sl. No** | **Course Code** | **Subject** | **Contact Hrs. L-T-P** | **Total Credits** |
| **1** | **BMA03001** | **Math-III** | **3-1-0** | **4** |
| **2** | **BEL03001** | **Electrical Machines-I** | **3-0-0** | **3** |
| **3** | **BEL03002** | **Network Theory** | **3-0-0** | **3** |
| **4** | **BEL03003** | **Analog and Digital Electronics** | **3-0-0** | **3** |
| **5** | **BHU03001** | **Organisational Behavior** | **3-0-0** | **3** |
| **SESSIONAL** | | | | |
| **1** | **BEL03004** | **Electrical Machines Lab-I** | **0-0-3** | **1.5** |
| **2** | **BEL03005** | **Network Lab.** | **0-0-3** | **1.5** |
| **3** | **BEL03006** | **Analog and Digital Electronics Lab.** | **0-0-6** | **3** |
| **NON-CREDIT** | | | | |
| **1** | **BNC03001** | **Essence of India Traditional Knowledge/ Environmental Sciences** | **2-0-0*** | **0** |
| **TOTAL** | | | **15-1-12** | **22** |

| COURSE STRUCTURE FOURTH SEMESTER<br>SECOND YEAR (THEORY) | | | | |
|---|---|---|---|---|
| **SI. No** | **Course Code** | **Subject** | **Contact Hrs. L-T-P** | **Credit** |
| **1** | **BEL04001** | **Electrical Machines-II** | **3-0-0** | **3** |
| **2** | **BEL04002** | **Measurement and Instrumentation** | **3-0-0** | **3** |
| **3** | **BEL04003** | **Signals and Systems-I** | **3-0-0** | **3** |
| **4** | **BMA04001** | **Math-IV** | **3-1-0** | **4** |
| **5** | **BHU04001** | **Economics for Engineers** | **3-0-0** | **3** |
| **SESSIONALS** | | | | |
| **6** | **BEL04004** | **Electrical Machines Lab-II** | **0-0-6** | **3** |
| **7** | **BEL04005** | **Signals and Systems Lab-I** | **0-0-3** | **1.5** |
| **8** | **BEL04006** | **Measurement and Instrumentation Lab.** | **0-0-3** | **1.5** |
| **NON-CREDIT** | | | | |
| **1** | **BNC04001** | **Environmental Sciences/ Essence of India Traditional Knowledge** | **2-0-0*** | **0** |
| **2** | **BNC04002** | **Summer Internship/ Training/ Project** | **0-0-0** | **0** |
| **Total** | | | **15-1-12** | **22** |

*** This contact hour is beyond the regular time table teaching.**

| COURSE STRUCTURE THIRD YEAR | | FIFTH SEMESTER (THEORY) | | |
|---|---|---|---|---|
| **SI. No** | **Course Code** | **Subject** | **Contact Hrs. L-T-P** | **Credit** |
| **1** | **BEL05001** | **Power System-I** | **3-0-0** | **3** |
| **2** | **BEL05002** | **Power Electronics** | **3-0-0** | **3** |
| **3** | **BEL05003** | **Communication System-I** | **3-0-0** | **3** |
| **4** | | **Professional Elective -I** | **3-0-0** | **3** |
| **5** | | **Open Elective -I** | **3-0-0** | **3** |
| **6** | | **Professional Ethics, Professional Law & Human Values / Financial Management, Costing, Accounting, Balance Sheet & Ratio Analysis** | **2-0-0** | **2** |
| **SESSIONAL** | | | | |
| **1** | **BEL05004** | **Communication System Lab-I** | **0-0-3** | **1.5** |
| **2** | **BEL05005** | **Power Electronics Lab.** | **0-0-3** | **1.5** |
| **3** | **BEL05006** | **Microprocessor & Microcontroller Lab** | **0-0-3** | **1.5** |
| **Total** | | | **17-0-9** | **21.5** |

| COURSE STRUCTURE THIRD YEAR | | SIXTH SEMESTER (THEORY) | | |
|---|---|---|---|---|
| **SI. No** | **Course Code** | **Subject** | **Contact Hrs. L-T-P** | **Credit** |
| **1** | **BEL06001** | **Power System-II** | **3-0-0** | **3** |
| **2** | **BEL06002** | **Control System Engineering** | **3-0-0** | **3** |
| **3** | | **Professional Elective -II** | **3-0-0** | **3** |
| **4** | | **Professional Elective-III** | **3-0-0** | **3** |
| **5** | | **Open Elective-II** | **3-0-0** | **3** |
| **6** | | **Financial Management Costing, Accounting, Balance Sheet & Ratio Analysis/ Professional Ethics, Professional Law & Human Values** | **2-0-0** | **2** |
| **SESSIONALS** | | | | |
| **1** | **BEL06003** | **Signals and Systems Lab-II** | **0-0-3** | **1.5** |
| **2** | **BEL06004** | **Control System Lab** | **0-0-3** | **1.5** |
| **3** | **BEL06005** | **CAD of Electrical Apparatus** | **0-0-3** | **1.5** |
| **NON-CREDIT** | | | | |
| | | **Summer Internship/ Training/ Project** | **0-0-0** | **0** |
| **Total** | | | **17-0-9** | **21.5** |

| COURSE STRUCTURE SEVENTH SEMESTER FOURTH YEAR (THEORY) | | | | |
|---|---|---|---|---|
| **SL NO** | **COURSE CODE** | **SUBJECT** | **CONTACT HRS L-T-P** | **CR** |
| **1** | **BEL07001** | **Power System-III** | **3-0-0** | **3** |
| **2** | **BEL07002** | **High Voltage Engineering** | **3-0-0** | **3** |
| **4** | | **Professional Elective-IV** | **3-0-0** | **3** |
| **5** | | **Open Elective-III** | **3-0-0** | **3** |
| **SESSIONALS** | | | | |
| **1** | | **Project - I** | **0-0-6** | **3** |
| **2** | **BEL07003** | **Power System Lab** | **0-0-3** | **1.5** |
| **3** | | **Seminar on internship** | **0-0-3** | **1.5** |
| **TOTAL** | | | **12-0-12** | **18** |

**Steel Structures**

| COURSE STRUCTURE EIGHTH SEMESTER FOURTH YEAR (THEORY) | | | | |
|---|---|---|---|---|
| **SL NO** | **COURSE CODE** | **SUBJECT** | **CONTACT HRS L-T-P** | **CR** |
| **1** | | **Professional Elective-V** | **3-0-0** | **3** |
| **2** | | **Professional Elective-VI** | **3-0-0** | **3** |
| **3** | | **Open Elective-IV** | **3-0-0** | **3** |
| **SESSIONALS** | | | | |
| **1** | | **Project II** | **0-0-12** | **6** |
| **2** | | **Seminar on Project** | **0-0-2** | **1** |
| **TOTAL** | | | **9-0-14** | **16** |

**GRAND TOTAL CREDITS: 165**

**Note: Each hour of practical /lab/sessional class = 0.5 credit**
**The students should undergo Summer Internship or Project in India or Abroad for a minimum period of 8 weeks either in $4^{th}$& $6^{th}$ Semesters together or in one semester at a stretch.**

| List of Professional Elective (Third Year) | | | |
|---|---|---|---|
| Sl. No. | Category | Course Code | Subject Name |
| 1 | BPE-I | BELPE501 | Microprocessor & Microcontroller Theory & Applications |
| 2 | | BELPE502 | MEMS and NEMS |
| 3 | | BELPE503 | VLSI Theory & Design |
| 4 | | BELPE504 | Embedded System |
| 1 | BPE-II | BELPE601 | Communication System-II |
| 2 | | BELPE602 | Wireless Communication |
| 3 | | BELPE603 | Mobile Communication |
| 4 | | BELPE604 | Optical and Satellite Communication |
| 1 | BPE-III | BELPE605 | Signals and Systems-II |
| 2 | | BELPE606 | Digital Image Processing |
| 3 | | BELPE607 | Electromagnetic Field Theory |
| 4 | | BELPE608 | Industrial Automation and Control |

List of Professional Elective (Fourth Year)

| Sl. No. | Category | Course Code | Subject Name |
|---|---|---|---|
| 1 | BPE-IV | BELPE701 | HVDC transmission |
| 2 | | BELPE702 | Power Quality |
| 3 | | BELPE703 | Alternative Energy Sources |
| 4 | | BELPE704 | Illumination Engineering |
| 5 | | BELPE705 | Electrical and Electronic Engineering Materials |
| 1 | BPE-V | BELPE801 | Wide Area Monitoring & Control |
| 2 | | BELPE802 | Robust & Optimal Control |
| 3 | | BELPE803 | Digital Control |
| 4 | | BELPE804 | Optimization Techniques |
| 5 | | BELPE805 | AI and Machine Learning |
| 1 | BPE-VI | BELPE806 | Smart Power Grids |
| 2 | | BELPE807 | Electrical & Hybrid Vehicles |
| 3 | | BELPE808 | Forecasting Methods in Engineering |
| 4 | | BELPE809 | Reliability Engineering |
| 5 | | BELPE810 | Bio-Medical Instrumentation |

**Open Elective subjects:**

| COURSE CODE | SL. NO. | Course Code | OPEN ELECTIVE SUBJECTS |
|---|---|---|---|
| UOE-I | 1 | BELOE501 | MEMS and NEMS |
| | 2 | BELOE502 | Microprocessor & Microcontroller Theory & Applications |
| | 3 | BELOE503 | Electromagnetic Field Theory |
| UOE-II | 1 | BELOE601 | VLSI Theory & Design |
| | 2 | BELOE602 | Digital Circuit Design |
| | 3 | BELOE603 | Signals & Systems |
| UOE-III | 1 | BELOE701 | Digital Signal Processing |
| | 2 | BELOE702 | Digital Image Processing |
| | 3 | BELOE703 | Modelling and Simulation |
| UOE-IV | 1 | BELOE801 | Mobile Computing |
| | 2 | BELOE802 | Utilization of Electrical Energy |
| | 3 | BELOE803 | Process Control and Instrumentation |

# DETAILS SYLLABI
# 1st Semester

**B. Tech.: Mathematics-I (Calculus and Linear Algebra) (BMA 01001) [3-1-0]**

***Module 1: Calculus (8 Lectures)***

Rolle's theorem, Mean value theorems (statements only) and applications. Introduction to improperintegrals. Beta and Gamma functions and their properties.

***Module 2: Calculus (8 Lectures)***

Convergence of sequence and series, tests of convergence. Fourier series, arbitrary period, even andodd function, half range series.

***Module3: Calculus (8 Lectures)***

Limit, continuity and partial derivatives (two variables), maxima and minima. Vector and scalar point functions and fields, gradient of a scalar field, directional derivative, divergence of a vector field, curl of a vector field and applications

***Module 4:* Linear Algebra *(8 Lectures)***

Linear systems of equations, Gauss elimination, linear independence, rank of a matrix, Gauss-Jordan elimination. Vector Space; basis and dimension'

***Module 5:* Linear Algebra *(8 Lectures)***

Eigenvalues, eigenvectors, some applications of eigenvalue problems, symmetric, skew-symmetric and orthogonal matrices, diagonalization, quadratic forms, complex matrices and forms.

**Text Book:**

1) Erwin Kreyszig, Advanced Engineering Mathematics (9th Edition), Wiley India Pvt. Ltd
2) S.C. Malik and S. Arora, Mathematical Analysis, New Age International

Reference Books:

1) George B. Thomas, Jr. and Ross L. Finney, Calculus and Analytic Geometry, Addison WesleyPublishing Company
2) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill
3) A. Stroud, Advanced Engineering Mathematics, Industrial Press
4) S.K. Paikray,Text book of Matrix Algebra, Kalyani Publisher

Course Outcomes:

Upon completion of the subject the students will be able to:

| | |
|---|---|
| CO1 | Recognize basic knowledge of differential calculus, improper integral, Beta and Gamma functions which are useful in various fields of engineering |
| CO2 | Analyse periodic phenomenon and describe Fourier series expansion of periodic function |
| CO3 | Demonstrate functions of several variables that is essential in most of the branches of engineering |
| CO4 | Apply Gauss elimination method and rank of a matrix in solving linear equations |
| CO5 | Implement knowledge of eigenvalues and eigenvectors in a comprehensive manner |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 2 | 2 | 1 | 2 | 1 | - | - | - | 1 | 1 |

# ENGINEERING PHYSICS (BPH01001)

## Course Objectives:

- To understand the concept of Elasticity
- To gain the knowledge of Oscillations and Resonance
- To obtain knowledge and concept of wave optics through Interference, Diffraction and Polarization
- To understand the fundamentals of Electromagnetism
- To gain the basic idea on Quantum Physics and Photonics

## Syllabus

### Module-I PROPERTIES OF MATTEER

Ideas of Elastic Constants (Y, K, η and σ), relation between elastic constants, torsion pendulum, determination of η, cantilever at one end.

### Module-II OSCILLATION AND WAVES

Review of Simple Harmonic Oscillation and application to Compound pendulum, Damped Harmonic Oscillation, Forced Oscillation, Resonance, (Amplitude Resonance, Velocity Resonance, and Sharpness of Resonance).

### Module-III OPTICS

Concept of Wave and wave equation, Superposition of Many harmonic waves, Interference, Concept of coherent sources (Division of wave front and division of amplitude), Interference in thin parallel film, Newton's ring (Theory, Application, Determination of Wavelength of Light, Refractive index of liquid), Concept of Diffraction (Huygen's Principle), Types of Diffraction, Fraunhofer Diffraction due to a single slit and diffraction Grating, Determination of Wavelength, Dispersive Power and Resolving Power of a Plane Diffraction Grating, Polarization, Double Refraction, Half wave Plate, Quarter wave Plate.

### Module-IV ELECTROMAGNETISM

Vector Calculus, Gradient, Divergence, Curl (Mathematical Concept), Gauss' Divergence Theorem and Stoke's Theorem (Statement Only), Derivation of Maxwell's Electromagnetic Equations in Differential form and Integral form, Electromagnetic Wave equations for $\vec{E}$ and $\vec{B}$ in vacuum and in conducting medium, Transverse nature of EM waves.

### Module-V QUANTUM MECHANICS AND PHOTONICS

Wave particle duality, Matter Wave (de-Broglie Hypothesis), Wave Functions, Observables as Operators, Eigen Functions and Eigen Values, Normalization, Expectation Values, Schrodinger equation (Time Dependent and Time Independent), Particle in a box. **Lasers:** Introduction and Characteristics of Lasers, Einstein's Coefficients and Relation between them, Lasing Action (Population Inversion, Three and Four level Pumping Schemes), Different types of Lasers (Ruby lasers, He-Ne Lasers).

### Text Book:


1. Principle of Engg. Physics: Md. N. Khan and S. Panigrahi
2. Engg. Physics: H.K. Malik and A.K. Singh

**Reference Books:**


1. Oscillations and Waves: N. Subramanyam and Brij Lal
2. Optics: A. Ghatak
3. Electrodynamics: D.J. Griffith
4. Concept of Modern Physics: A. Beiser
5. Lasers: Theory and Applications: K. Thyagarajan and A.K. Ghatak


**Course Outcomes:**

Upon completion of the subject the students will be able to:

| | |
|---|---|
| CO1 | Explain the concepts of Stress, Strain, Elastic Modulus and Elastic Constant, Bending of Beams. Identify the importance Elastic properties in Engineering Applications |
| CO2 | Understand simple harmonic Oscillator, Damped Harmonic and Forced Oscillators.<br>Explain Quality factor and resonance with applications |
| CO3 | Explain the link between Simple Harmonic Motion and Waves. Understand the principle of superposition, the need of coherent sources, analyze the difference between Interference and Diffraction and their applications.<br>Illustrate the concept of Polarization of light and its applications. |
| CO4 | Understand the basic mathematical concepts related to electromagnetic vector fields, Understand the concepts related to electromagnetic wave. |
| CO5 | Understand and explain the differences between classical and quantum mechanics. Interpret the wave function, operators and Schrodinger equation to solve physical problems. Understand generation, outline and need for the laser |

**Course Articulation Matrix row for this Course**

| Table | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | POP11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 1 | - | - | 1 | - | 1 | - | 1 |
| CO2 | 3 | 3 | 3 | 2 | 1 | - | - | 1 | - | 1 | - | 2 |
| CO3 | 3 | 3 | 3 | 3 | 1 | - | - | 1 | - | 1 | - | 2 |
| CO4 | 3 | 3 | 3 | 2 | 1 | - | - | 1 | - | 1 | - | 2 |
| CO5 | 3 | 3 | 2 | 3 | 2 | - | - | 2 | - | 2 | - | 2 |

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 1 |

# BASIC ELECTRICAL ENGINEERING (BEE 01001)

**MODULE-I (8 HOURS)**

**D.C circuit analysis and network theorems:** Concept of network, Active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, source transformation, Kirchoff's Law: loop and nodal methods of analysis, star delta transformation, network theorems: Thevenin's theorem, Norton's theorem, maximum power transfer theorem. Transients, in R-L, R-C and R-L-C circuits with DC Excitation.

**MODULE-II (8 HOURS)**

**Single phase and three phase ac circuit:** Sinusoidal, square and triangular waveforms-average and effective value, form the peak factors, concept of phasors, phasors representation of sinusoidally varying voltage and current, analysis of series-parallel RLC circuits. Apparent, active and reactive powers, power factor, power factor improvement, resonance in series and parallel circuits, bandwidth and quality factors, star and delta connections, balanced supply and balanced load, line and phase voltage/current relation, three phase power measurements.

**MODULE-III (8 HOURS)**

**Magnet circuit & principle of electromechanical energy conversion:** Analogy between electric and magnetic circuit, magnetic circuits with DC and AC excitation, magnetic leakage, BH curve, hysteresis and eddy current losses, magnetic circuit calculation, mutual coupling. Principles of dc motor & generator, types, emf equation of DC machine, torque equation of motor, Speed control of dc motor. characteristics and applications of DC motors.

**MODULE-IV (8 HOURS)**

**AC MACHINES:** Single Phase Transformer: Principle of operation, construction, emf equation, equivalent circuit, power losses, efficiency, Introduction to auto transformers. Three Phase Induction Motor: Type, principle of operation, slip-torque Characteristics, applications. Single Phase Induction Motor: Principle of operation and introduction to methods of starting, applications. Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor, emf equation, voltage regulation, applications.

**MODULE-V (7 HOURS)**

**Measurement Instruments & Introduction to Power System:** Types of instruments: construction and working principle of PMMC and MI type voltmeter and ammeters, single phase dynamometer type wattmeter and induction type energy meter, use of shunts and multipliers: general layout of electrical power system and function of its elements, concept of grid, Introduction to power converters.

**TEXT BOOKS**

[1]. Edward Hughes (revised by Ian McKenzie Smith), "Electrical & Electronics Technology", Pearson Education Limited. Indian Reprint 2002, 10th Edition.
[2]. D.Kulshreshtha, "Basic Electrical Engineering" TMH, 1st Edition.

**REFERENCE BOOKS**

[1]. C.L. Wadhwa, "Electrical Engineering", New Age International Publishers, 2nd Edition.
[2]. S. Parker Smith, "Problems in Electrical Engineering", Asia Publications, 10th Edition.

**Course Outcomes:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Implement principles of DC network, theorems and transients. |
| CO2 | Analyze the concept of Single phase and three phase AC circuits. |
| CO3 | Express the concept of magnetic circuit and DC machines. |
| CO4 | Apply basic principles of AC machines and their working. |
| CO5 | Demonstrate basic principles of measuring instruments and power system. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 2 | 1 | 1 | 2 | 1 | - | - | - | - | 1 |

# ENGLISH FOR BUSINESS COMMUNICATION (BHU01001)

**Course Description**

The course is designed to give students a comprehensive view of communication, its scope and importance in business, and to build the proficiency needed to succeed in today's technologically enhanced workplace. Effective communication is an integral part of life. This course focuses on improving the LSRW skills, i.e. listening, speaking, reading and writing of the students. Students will learn how to communicate effectively though the prescribed syllabus followed by an intensive practice in the language lab. This integrated approach of theory and language lab sessions will help students to communicate clearly with an impact, by improving their verbal and non-verbal communication style, as well as enhancing their competency in grammar and pronunciation. This course further tries to conversant students with the correct practices and strategies in drafting effective business correspondence.

**Syllabus**

Module 1: Fundamentals of Communication (6 Hours)

- Process of Communication, Types of Communication (Verbal & Non Verbal)
- Channels of Business Communication
- Barriers to Communication.
- Plain English
- Bias free language
- Cross Cultural Communication

Module 2: Communicative Grammar (6 Hours)

- Time and Tense
- Aspects (Perfective & Progressive)
- Verbs of State and Event
- Passive and Active Voice
- Conditionals

Module 3: Sounds of English (06 Hours)

- The Speech Mechanism and Organs of Speech
- Consonant Sounds of English
- Vowel Sounds of English
- Stress Pattern: Syllable, Stress and Intonation.
- Problem sounds for Indian Speakers

Module 4: Business Writing (06 Hours)

- Paragraph writing
- Sentence Linker
- Business Letters
- Report Writing
- Proposal writing

Module 5: Professional Writing (06 Hours)

- Notice, Circular and Memo writing
- Agenda & Minute writing
- Writing Cover letter
- Résumé (CV) Writing

Reference Books


1. Effective Technical Communication by M Ashraf Rizvi (Tata McGraw Hill)
2. Business Communication by Hory Sanker Mukerjee (Oxford University Press)
3. Better English Pronunciations by J. D.O Conner (Cambridge University Press)
4. A Communicative Grammar of English by G.N. Leech and Jan Svartik (OUP)
5. Business communication by Ramachandran, Lakshmi and Krishna (Macmillan)


**Programme Outcomes of BTech Programme**

| | |
|---|---|
| PO1 | Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| PO2 | Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| PO3 | Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| PO4 | Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| PO5 | Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. |
| PO6 | The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| PO7 | Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| PO8 | Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| PO9 | Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| PO10 | Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| PO11 | Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| PO12 | Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

**Course Outcomes**

Upon completion of the course the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Analyse various components of human communication and to identify key elements and principles of organizational communication. |
| CO2 | Apply correct usage of English grammar in writing and speaking. |
| CO3 | Evaluate students' ability to articulate English key sounds as well as its basic rhythm, stress and intonation patterns correctly. |
| CO4 | Compile, plan and structure various forms of business writing in a professional manner. |
| CO5 | Write various business documents appropriate for different business and employment situations. |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course | - | - | - | - | - | - | - | - | 1 | 3 | 1 | - |

# ENGINEERING MECHANICS (BME 01001)

**Course Contents**

**Module - I (8 Hours)**

Concurrent forces on a plane: Composition, resolution and equilibrium of concurrent coplanar forces, method of moment.General case of forces on a plane: Composition and equilibrium of forces in a plane, plane trusses, method of joints and method of sections, plane frame, equilibrium of ideal systems.

**Module-II (8 Hours)**

Friction: Problems involving dry friction, Ladder, WedgesPrinciple of virtual work.

**Module - III (8 Hours)**

Parallel forces on a plane: General case of parallel forces, center of parallel forces and center of gravity, centroid of composite plane figure and curves, Theorems of Pappus.

Moments of inertia: Plane figure with respect to an axis in its plane and perpendicular to the plane, Polar moment of inertia, parallel axis theorem

**Module – IV (8 Hours)**

Rectilinear translation: Kinematics, principle of dynamics, D Alembert's Principle,

Principle of work and energy for a particle and a rigid body in plane motion, Conservation of energy, Principle of impulse and momentum for a particle and a rigid bodies in plane motion, Conservation of momentum, System of rigid bodies, Impact, direct and central impact, coefficient of restitution.

**Module – V (8 Hours)**

Curvilinear translation: Kinematics, equation of motion, projectile, D Alembert's principle of curvilinear motion. Kinematics of rotation of rigid body.

**Text Book:**

1. Engineering Mechanics: S Timoshenko & Young; 4th Edition (International edition) McGraw Hill.

**Reference Books:**

1. Fundamental of Engineering mechanics (2nd Edition): S Rajesekharan& G ShankaraSubramanium; Vikas Pub. House Pvt ltd.
2. Engineering mechanics: K. L. Kumar; Tata MC Graw Hill.

Upon completion of the subject the students will be able to:

| | |
|---|---|
| CO1 | Draw free body diagrams and determine the resultant of forces and/or moments. |
| CO2 | Solve the problems involving dry friction. |
| CO3 | Determine the centroid and second moment of area of sections. |
| CO4 | Apply Newton's laws and conservation laws to elastic collisions and motion of rigid bodies. |
| CO5 | Determine the various parameters in projectile motion. |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 2 | - | - | - | 3 | 1 | - | 1 |

# PHYSICS LABORATORY (BPH01002)

**List of Experiments**

1. Determination of acceleration due to gravity by using Bar pendulum
2. Determination of surface tension of water by capillary rise method
3. To draw the characteristics of a bipolar junction transistor
4. To determine the rigidity modulus of the material of a wire by using Barton's apparatus.
5. Determination of wave length of monochromatic light with the help of Newton's ring apparatus.
6. Determination of grating element of a diffraction grating using spectrometer.

**Course Outcomes**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Express the idea of calculation of acceleration due to gravity at any place using the concept of oscillatory system and simple harmonic motion. |
| CO2 | Demonstrate the working and operational technique to calculate the mechanical properties of fluid and other materials. |
| CO3 | Evaluate the voltage, current, power and characteristics behaviour of the electronic devices. |
| CO4 | Analyze the mechanical properties of any material with the idea of elasticity and its various applications. |
| CO5 | Implement the measurement of different characteristic properties and related calculations of optical devices. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 1 |

# BASIC ELECTRICAL ENGINEERING LABORATORY (BEE01002)

**List of Experiments**

1. Preliminary: Preparation of symbol chart for various systems & components as per ISS, to study the constructional & operational features for Voltmeter, Ammeter, Wattmeter, Frequency meter, multi-meter and Rheostat, Study of safety rules as per ISS
2. Measurement of the armature & field resistance of D.C. Machine by volt-amp method. & Starting and speed control of a D.C. shunt motor
3. Study of BH Curve
4. Determination of open circuit characteristics (O.C.C) of D.C shunt generator when separately excited at different speeds.
5. Measurement of earth resistance and insulation resistance.
6. Starting of Induction motor and measurement of three phase power & power factor by 2- wattmeter method.
7. Callibration of a single phase Energy Meter by directed loading & Phantom loading.
8. Obtaining the voltage, current, power and power factor of fluorescent lamp.
9. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
10. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform

**Course Outcomes**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Express the safety rules as per ISS and symbols of different electrical components and the use of various electrical instruments in laboratory. |
| CO2 | Demonstrate the working and operational characteristics of dc motor and dc generator. |
| CO3 | Evaluate the voltage, current, power and power factor of fluorescent lamp. |
| CO4 | Implement the measurement of earth resistance and insulation resistance and demonstrate the internal structure of different machines. |
| CO5 | Analyze the connection and calibration of single phase energy meter, three phase power and power factor by two wattmeter method and basic idea about converters. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | 3 | 3 | 1 | 1 |

# BUSINESS COMMUNICATION AND PRESENTATION SKILLS LAB (BHU 01002)

Course Description

Good communication skills are indispensable for the success of any professional. The English language, in particular, has become essential in the lives of young engineers who aspire to build their careers anywhere in the world. In this regard the language laboratory plays an important role in developing the students' basic proficiency in English. Since a large number of engineering students completed their education from vernacular medium schools, they lack the basic English language proficiency which is a detrimental factor during recruitment drives in engineering colleges. In this context the language laboratory is very helpful in practicing and assessing students' speech in different communication environments. It provides them facilities to learn pronunciation, accent, stress and rudimentary communicative English grammar along with various practice sessions like presentations, group discussions, debates, case studies which are the part and parcel of corporate life.

Syllabus (Assignments)

1. Functional English grammar: Practice and exercises
2. Practice of English phonemes
3. Reading comprehension
4. Drafting business correspondence
5. Understanding the importance of body language
6. Oral presentations (Self Introduction, Extempore, Formal Presentation, power point presentations etc.)
7. Group discussion
8. Preparation for appearing an interview
9. Situational conversation practice

Reference Books


1. Effective Technical Communication by M Ashraf Rizvi (Tata McGraw Hill)
2. Business Communication by Hory Sanker Mukerjee (Oxford University Press)
3. Better English Pronunciations by J. D.O Conner (Cambridge University Press)
4. A Communicative Grammar of English by G.N. Leech and Jan Svartik (OUP)
5. Business communication by Ramachandran, Lakshmi and Krishna (Macmillan)


Programme Outcomes of BTech Programme

| | |
|---|---|
| PO1 | Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| PO2 | Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| PO3 | Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| PO4 | Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of |

| | |
|---|---|
| | data, and synthesis of the information to provide valid conclusions. |
| PO5 | Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. |
| PO6 | The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| PO7 | Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| PO8 | Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| PO9 | Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| PO10 | Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| PO11 | Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| PO12 | Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

Course Outcomes

Upon completion of the sessional the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Analyse various components of effective human communication and to apply them during various practice sessions. |
| CO2 | Apply correct usage of English grammar in writing and speaking. |
| CO3 | Articulate English key sounds as well as its basic rhythm, stress and intonation patterns correctly. |
| CO4 | Compile, plan and structure various forms of business writing in a professional manner. |
| CO5 | Confidently face various recruitment drives and qualify them. |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course | - | - | - | - | - | - | - | - | 1 | 3 | 1 | - |

# WORKSHOP & MANUFACTURING PRACTICES (BME01002)

**Course content**

1. **Carpentry Section**:

Study of different Hand tools, measuring instruments and equipments used in Carpentry work. Safety precautions.

**Preparation of Job:**

Wooden rack/bench/chair/stool (any one)

**Includes the operations:**

Measuring, Marking, Sawing, Planing, Chiseling, Mortesing, Tenoning, making Half-lap joint,
Mortese&Tenon joint and Nail joint.

2. **Fitting Section**:

Study of different Hand tools, measuring instruments and equipments used in Fitting work. Safety precautions. Study of Drilling Machine and Grinding Machine.

**Preparation of Job:**

Paper Wt. / Square or Rectangular joint (male-female joint) (any one)

**Includes the operations:**

Measuring, Marking, Filing, Sawing, Drilling, Tapping, Dieing and Punching.

3. **Black Smith Section**:

Study of different Hand tools, equipments, Open hearth furnace and Induction furnaces used in Blacksmith work. Different types of heat treatment processes. Safety precautions.

**Preparation of Job:**

Weeding hook/Hexagonal headed bolt/Chisel (any one)

**Includes the operations:**

Measuring, Marking, Cutting, Upsetting, Drawing down, Bending, Fullering and Quenching.

**Course Outcomes**:

Upon completion of the subject the students will be able to:

| | |
|---|---|
| CO1 | Acquire knowledge on different types of hand tool, measuring instruments and machine tools are used in Fitting, Carpentry and Smithy work. |
| CO2 | Know about different types of operations and joints performed in different shops i.e. in Fitting and Carpentry. |
| CO3 | Know about the forging temperature of different types of ferrous metals and different types of operation (e.g. upsetting, edging, flattening and bending etc.) carried out on hot metals to prepare jobs. |
| CO4 | Acquire skills for the preparation of different types of jobs Carpentry/fitting/smithy shops by using different types of hand tools and machine tools. |
| CO5 | Understand the importance of safety precaution in different shops. |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | - | - | 1 | - | 2 | 2 | 1 | 1 | 3 | 1 | 2 | 1 |

# 2nd Semester

## Mathematics-II (Differential Equations and Complex Variables) [3-1-0]

**BMA 02001**

### *Module 1:* Differential Equations *(8 Lectures)*

Exact ODEs, integrating factors, linear ODEs, Bernoulli equation, homogeneous linear odes of second order, homogeneous linear ODEs with constant coefficients, Euler-Cauchy equations, non-homogeneous ODEs, Applications of ODEs to electric circuits

### *Module 2:* Power Series Solution of Differential Equations *(8 Lectures)*

Series solution of differential equation (excluding Frobenius method), Legendre's equation, Legendrepolynomials. Bessel's Equation, properties of Bessel's functions, Bessel Functions of the first and Second Kind. ***Module 3:*** **Complex Variables *(8 Lectures)***

Complex valued function, differentiation, analytic function, Cauchy-Riemann equations, harmonic and conjugate harmonic functions, exponential function, trigonometric and hyperbolic functions, logarithm, general power

### *Module 4:* Complex Variables *(8 Lectures)*

Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, power series, radiusof convergence, Taylor and Maclaurin series, singularities and zeros, Laurent series, Cauchy residue theorem (statement only) and applications.

### *Module 5:* Elementary Numerical Methods *(8 Lectures)*

Solution of algebraic and transcendental equations by Newton-Raphson and secant method.

Interpolation: Lagrange's method, divided difference method, Newton's forward and backward method. Numerical Integration: Trapezoidal and Simpson's Rule. Numerical solutions of differential equations: Euler's method and improved Euler's method.

**Text Book:**


1) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd, 9th edition.


**Reference Books:**


1) K.A. Stroud, Advanced Engineering Mathematics, Industrial Press
2) Milton Abramowitz and Irene A. Stegun, *Handbook of Mathematical Functions*, National Bureau ofStandards, Applied Mathematics Series - 55
3) J. Sinha Roy and S. Padhy, Ordinary and Partial Differential Equation, Kalyani Publisher.
4) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill

**Course Outcomes:**

Upon completion of the subject the students will be able to:

| | |
|---|---|
| CO1 | Develop adequate knowledge of the effective mathematical tools for the solutions of differentialequations that models various physical processes |
| CO2 | Describe power series solution of differential equations |
| CO3 | Demonstrate analytic functions and applications of Cauchy-Riemann equations |
| CO4 | Evaluate integration of complex valued functions, and apply Taylor and Laurent series expansionsof functions in various fields of engineering problems |
| CO5 | Compute roots of algebraic and transcendental equations, and also evaluate the integralsby Trapezoidal and Simson's rules |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 2 | 2 | 1 | 2 | 1 | - | - | - | 1 | 1 |

## Code: Subject: Chemistry Credits: 4 [3-1-0] (BCH 02001)

**Module–I (9 Hours)**

Schrodinger Wave equations (not to be derived), Application to particle in ID box.
Molecular rotational (microwave) spectroscopy: Basic principle and application to diatomic molecules, selection rules.
Molecular vibrational (IR) spectroscopy: Basic principle, types of vibrations and vibrational frequency, application to Harmonic and anharmonic oscillators, selection rules, modes of vibration.
Electronic (UV-Visible) spectroscopy: Basis principle, types of electronic transitions, The Franck - Condon principle, and Jablonski diagram.

**Module – II (9 Hours)**
**Thermodynamics of Chemical Processes:**

Concept of Entropy and free energy, Chemical Potential, Equilibrium Conditions.

**Phase equilibria:**

Phase, Components, Degree of Freedom, Phase Rule Equation.
Phase Diagrams: One Component Systems – Water and Sulphur, Basic idea of (a) Peritectic system, (b) Eutectoid system, (c ) Binary phase diagrams of Pb-Ag & Fe-C system.

**Module–III (9 Hours)**
**Electrochemistry:**

Electrode Potentials and its Relevance to Oxidation and Reduction, Types of electrodes, Galvanic cell, Measurement of EMF and application of EMF measurements, Types of reference electrodes (Hydrogen, Glass, Quinhydrone Electrodes,) Determination of pH, Electrochemical energy systems its types (Dry Cells, lead acid cell and Fuel Cells: Construction, reaction, advantages and applications).

**Corrosion:** Concept, types of corrosion, dry or chemical and wet or Galvanic/electrochemical Corrosion, Factors affecting corrosion.

**Module–IV (9 Hours)**

Kinetics of complex Chemical Reactions: Reversible, Consecutive and Parallel Reactions, Steady State Approximation, Chain reaction.

**Module-V (9 Hours)**

Chemistry of engineering materials:

**Nanomaterials**: Applications of nanomaterials.
**Organometallics:** Application of organometallics
**Books Recommended:**
1) P. W. Atkins, Elements of Physical Chemistry, 4th Edition, Oxford University Press
2) C. N. Banwell and E. M. MacCash, Fundamentals of Molecular Spectroscopy, 5th Edition,
3) P. K. Kar, S. Dash and B. Mishra, B.Tech. Chemistry Vol. I, Kalyani Publications

**Course Outcomes:**

CO1: Apply the basic concept of classical mechanics and quantum chemistry to real life applications & to understand the basic concept of electromagnetic radiation, spectroscopic techniques and their applications.

CO2: Should perceive the spontaneity/feasibility of a process applying thermodynamics concepts and to keep up with the idea of phase equilibria, phase rule and its application to one and two component system.

CO3: Define the application of electrochemistry to commercial electrochemical cell and corrosion.

CO4: Able to apply the basic concept of kinetics of a reaction to complex reactions.

CO5: To demonstrate the properties and applications of organometallics and nanomaterials.

**Course Articulation Matrix**

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

**Program Articulation Matrix**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | 3 | 3 | 1 | - | - | - | 1 | - | - | 1 | 1 | 1 |

# BASIC ELECTRONICS (BEC 02001)

| MODULE | CONTENT | HOURS |
|---|---|---|
| MODULE 1 | Introduction to Electronics: - Signals, Frequency Spectrum of Signals, Analog and DigitalSignals,<br>Linear Wave Shaping Circuits: - RC LPF, Integrator, RC HPF, Differentiator.<br>Properties of Semiconductors: - Intrinsic, Extrinsic Semiconductors, Current Flow in Semiconductors,<br>Diodes: - p-n junction theory, Current-Voltage characteristics, Analysis of Diode circuits, Rectifiers,<br>Clippers, Clampers, Special diodes- LED, Photo diode, Zener Diode. | **12** |
| MODULE 2 | Bipolar junction Transistor (BJTs):- Device Structure and Operation, Current-Voltage Characteristics, BJT as an Amplifier and as a Switch. Introduction to Power Amplifiers: - A,B and Ctypes.<br>JFET:- Physical Structure, Operation and Characteristics | **10** |
| MODULE 3 | Feedback Amplifiers: - General Feedback Structure, Properties of Negative Feedback, Four Basic Feedback Topologies (block diagram only), Practical feedback circuit.<br>Operational Amplifiers (OP-AMPs): - The Ideal OP-AMP, Inverting Configuration, Non-Inverting Configuration. OP-AMP Applications (Adder, Subtractor, Integrator, Differentiator). | **08** |
| MODULE 4 | Digital Fundamentals:- Binary Numbers, Signed-binary numbers, Decimal-to-Binary & Binary-to-Decimal Conversion, Binary Addition, Subtraction, Multiplication and Division, Hexadecimal Number Systems, Logic Gates, Boolean Algebra, De Morgan's Theorems, Laws of Boolean Algebra, RS Flip Flop | **06** |
| MODULE 5 | Introduction to Electronic Instruments: - CRO: CRT, Waveform Display, Applications of CRO, Electronic Multimeter, Audio Signal Generator: - Block diagram, Front Panel Controls.<br>Principles of Communication:- Fundamentals of AM & FM, Block diagram of Transmitters | **06** |
| TEXT BOOK | **1.** Microelectronics Circuits, A.S Sedra, K.C. Smith, Oxford UniversityPress. Selected portions from chapters 1 to 3, 5, 8,13.<br>**2.** Electronics Fundamentals and Applications, D Chattopadhyay and P.C. Rakshit, New Age International Publications. Selected portions fromchapters 4 to 12, 14, 16 to 18,20,21. | |
| REFERENCE BOOK | 1. Integrated Electronics, Millman and Halkias, TMHPublications.<br>2. Electronic Devices & Circuit Theory, R.L Boylestad and L.Nashelsky, PearsonEducation. | |

**Course Outcomes:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Implement different types of signals and its application to semiconductor devices and circuits. |
| CO2 | Analyze the concept of different BJTs and its operation. |
| CO3 | Express the concept of the Feedback Amplifiers and Operational Amplifiers. |
| CO4 | Apply fundamentals of different Digital arithmetic operations and Digital circuits. |
| CO5 | Demonstrate basic principles of important Electronic Instruments and Communication systems. |

| Relationship of Course Outcomes (CO) to Program Outcomes (PO)<br>1 – Low 2 – Moderate 3 – High | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | 3 | 2 | 2 | 3 | 2 | 1 | 2 | - | - | - | - | 1 |
| CO2 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | - | - | - | - | 1 |
| CO3 | 3 | 2 | 3 | 3 | 2 | 1 | 2 | - | - | - | - | 1 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | 1 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | - | - | - | - | 1 |

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 2 | 3 | 3 | 2 | 1 | 2 | - | - | - | - | 1 |

# PROGRAMMING FOR PROBLEM SOLVING (BIT 02001)

**L-T-P: 3-0-0** **Cr.-3**

**Module I:** **(8 Lectures)**

Introduction to computing- Block architecture of a computer, fundamental units of storage: bit, bytes, nibbles, word size. Introduction to problem solving- Basic concepts of an algorithm, program design methods, flowcharts. Level of programming Languages, structure of C program, Compiling and Executing C program

**Module II:** **(8 Lectures)**

C Language Fundamentals- Character set, Identifiers, Keywords, Data Types, Constant and Variables, Statements. Input &Output - Input & Output Assignments, Formatted Outputs. Operators and Expressions-Operators, Precedence of operators. Decision Control Structure, Loop Control Structure and Case Control Structure.

**Module III:** **(8 Lectures)**

Functions: Monolithic vs Modular programs, User defined vs standard functions, formal vs Actual arguments, Functions category, function prototypes, parameter passing, Recursion.Arrays1D Array, 2D Array & Multi-Dimensional Array. Strings- Declaration & Initialization, String Handling Functions.

**Module IV:** **(8 Lectures)**

Pointer variable and its importance, Pointer Arithmetic, Passing parameters, pointer to pointer, pointer to function. Dynamic Memory Allocation. Structure, Nested Structure, Array of Structures, Pointer to Structure, Structure & Functions, Union, Array of Union Variables, Union inside Structure, Bit Fields. Storage Class.

**Module V:** **(8 Lectures)**

Preprocessor Directives- Types, Pragma Directives, Conditional Directives. typedef, Enumerated Data Type. Files- Reading data from Files, Reading data from Files, Writing data to Files, Error Handling during File Operations. Advanced Issues in Input & Output – using argc&argv.

**Text Books:**


1. Programming in ANSI C, E Balaguruswamy
2. Computer Fundamentals &Programming in C: ReemaThareja, Oxford University Press.


**Reference Books**:


1. Let us C- Y.Kanetkar, BPB Publications.
2. Programming with ANSI and Turbo C- Kamthane, A.N. Pearson Education
3. C How to Program- Deitel and Deitel, Pearson Education.
4. The C Programming Language- Brian W. Kernighan and Dennis M. Ritchie, PrenticeHall.

**Course Outcomes:**
Upon completion of the subject the students will demonstrate the ability to:

1. grasp the fundamentals of Computer and problem solving.
2. conceptualize fundamentals of C Programming along with control structures.
3. Implement different problems on functions and arrays.
4. Apply pointers structures and unions for problem solving.
5. Gain knowledge of pre-processor directives and file operations.

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 3 | 3 | 2 | - | - | - | 2 | - | - | 3 |

# Basic of Civil Engineering

**BCE 02001**

**Module-II**

Introduction to Civil Engineering – Various disciplines of Civil engineering, Importance of Civil engineering in infrastructure development of the country.

Introduction to types of buildings as per NBC, Selection of site for buildings, Components of a residential building and their functions, Introduction to Industrial buildings and types.

Building Planning – Basic requirements, elements, introduction to various building area terms, computation of plinth area, carpet area.

**Module-II**

Surveying – Principle and objectives, Instruments used, Horizontal measurements, Ranging (direct ranging only), Instruments used for ranging, Leveling – Definition, Principles, Instruments, Preparation of level book, problems on leveling, Modern surveying instruments – EDM, Total station, GPS (Brief discussion)

Building Materials – Bricks, properties and specifications, Cement – Types, properties, grades, other types of cement and uses, Cement mortar – Constituents, Preparation, Concrete – PCC and RCC, Grades, Steel – Use of steel in buildings, types.

**Module-III**

Building Construction – Foundations, Classification, Bearing Capacity of Soil and related terms (definition only), Masonry Works – classifications, definition of different technical terms, Brick masonry – types, bonds, general principle, Roofs – functional requirements, basic technical terms, roof covering material, Floors – function, types, flooring materials(brief discussion), Plastering and Painting – objectives, types, preparation and procedure of application.

**Module-IV**

Basic Infrastructure services – air conditioning & purpose, fire protection & materials, Ventilation, necessity & functional requirements, Lifts, Escalators.

Introduction to planning and design aspects of transportation engineering, Transportation modes, Highway engineering – historical development, highway planning, classification of highway, Railway Engineering – cross section of rail track, basic terminology, geometric design parameter(brief discussion only).

**Module-V**

Airport engineering – development, types, definition, characteristics of aircraft, basic terminology, Traffic engineering – traffic characteristics, traffic studies, traffic operations (signals, signs, markings), Urban engineering – classification of urban road.

Irrigation & Water Supply Engineering – Introduction, Types of Irrigation, different types of hydraulic structures, dam and weirs, types of dam, purpose and functions.

**Text Books:**


- Basic Civil engineering, Gopi, S., Pearson Publication
- Basic Civil Engineering, Bhavikatti, S. S., New Age.

**Reference Books:**


- Construction Technology, Chudley, R., Longman Group, England
- Basic Civil and Environmental Engineering, C.P. Kausik, New Age.
- American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application


**Course Outcomes:**

- Analyze the fundamental aspect of building planning.
- Summarize general aspect of building material and surveying.
- Explain about building constructions.
- Judge transportation modes and planning.
- Describe about Airport & Irrigation Structures.

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

| | PO1 | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 1 | 2 | 2 | 2 | 3 |

# B Tech Chemistry Lab: (BCH 02002)

**List of Experiments to be done (Any ten Experiments)**

1. Determination of amount of sodium hydroxide and sodium carbonate in a Mixture.
2. Determination of Total hardness of water by EDTA method.
3. Estimation of calcium present in the limestone.
4. Standardization of KMnO4 using sodium oxalate.
5. Determination of ferrous iron in Mohr's salt by potassium permanganate.
6. Determination of Rate constant of acid catalyzed hydrolysis of ester.
7. Determination of dissolved oxygen in a sample of water.
8. Conductometric titration of strong acid and strong base
9. Determination of Viscosity of lubricating oil by red wood Viscometer.
10. Determination of Flash point of given oil by Pensky Marten's Flash Point Apparatus.
11. Determination of available chlorine in bleaching powder.
12. Preparation of acidic and basic buffer solution and measurement of PH using PH meter

**Book Recommended:**

B. Tech Practical Chemistry- .

**Course Outcomes:**

CO1: Develop knowledge of concepts and applications of chemistry, important laboratory analytical techniques, and instrumentation.

CO2: Apply fundamental principles for environmental analytical methods.
CO3: Identify suitable analytical techniques for analysing a specific compound in a sample and ensure quality control.
CO4: Implement suitable techniques for sampling and handling of environmental and chemical samples.
CO5: Hands on training on using different laboratory apparatus and equipments including data analysis and conclusions.

**Course Articulation Matrix**

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

**Program Articulation Matrix**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO1- | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | 3 | 1 | 2 | - | 1 | - | 2 | - | 1 | - | 1 | - |

**BASIC ELECTRONICS LAB (BEC 02002)**

| Experiment No. | CONTENT |
|---|---|
| 1 | Familiarity with electronic components and devices( Testing of semiconductor diode, Transistor, IC Pins connection) Digital Multimeter should be used. |
| 2 | Study and use of CRO to view waveforms and measure its Amplitude and Frequency. |
| 3 | Frequency response of LPF and HPF. |
| 4 | V-I Characteristics of a Semiconductor Diode. Determining DC and AC resistance. |
| 5 | Clipper Circuit. |
| 6 | Clamper Circuit. |
| 7 | Half Wave and Full Wave Rectifier without Capacitor filter. Record of Waveforms, Measurement of Average and RMS value. |
| 8 | V-I (Output) Characteristics of N-P-N/P-N-P Transistor in CE Configuration. |
| 9 | OP-AMP: Inverting and Non-Inverting Configuration. Record of Waveforms. |
| 10 | Verification of Truth table of Logic gates (AND, OR,NOT, NAND, NOR, EX-OR) |
| **SUPPLEMENTARY BOOK** | 1. Integrated Electronics, Millman and Halkias, TMHPublications.<br>2. Electronic Devices & Circuit Theory, R.L Boylestad andL. Nashelsky, PearsonEducation. |

**Course Outcomes:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Implement Acquire basic knowledge on electronic devices and components |
| CO2 | Analyze different electronics circuits using semiconductor diodes. |
| CO3 | Analyze and develop the characteristics of BJT and FET Circuits. |
| CO4 | Apply fundamentals Operational amplifier circuits. |
| CO5 | Implement knowledge on basic digital logic gates |

**Relationship of Course Outcomes (CO) to Program Outcomes (PO)**

**1 – Low 2 – Moderate 3 – High**

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

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 2 | 3 | 3 | 2 | 1 | 2 | - | - | - | - | 1 |

# PROGRAMMING FOR PROBLEM SOLVING LAB (BIT 02002)

**L-T-P: 0-0-3** **Cr.-1.5**

Topics to be covered:

1. Programs using Input – Output functions.
2. Programs on variable declaration, assignments, operators and typecasting.
3. Program on selection & iterative constructs.
4. Programs on functions.
5. Programs on arrays.
6. Programs on string manipulation.
7. Programs on pointers.
8. Programs on structure & union.
9. Programs on file handling.
10. A mini-project to be designed by students using features of C.

**Course Outcomes**

Upon completion of the subject the students will demonstrate the ability to:

CO1: Implement the basicsof C programming.

CO 2: Exercise conditional and iterative statements to develop programs.

CO 3: Exercise user defined functions to solve real time problems.

CO 4: Demonstrate the concept of pointers to access arrays, strings and functions.

CO 5: Create C programs on file manipulations.

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 3 | 3 | 2 | - | - | 2 | 3 | - | - | 3 |

# Engineering Graphics & Design (BCE02002)

**Course Content**

**Module-I**

Introduction to Engineering Drawing: Drawing instruments, lines, lettering and dimensioning. Scales: Plain, Diagonal and Vernier Scales.

**Module-II**

Curves: Parabola, Ellipse, Hyperbola, Cycloid, Epicycloid, Hypocycloid and Involute.

**Module-III**

Orthographic Projections: Concepts, Orthographic projections of points, Lines, Planes and Solids. Sections of solids; Development of surfaces

**Module-IV**

Isometric Projections: Principles, Isometric Scale, Isometric Views, Isometric Views of lines, Planes, Simpleand compound Solids.

**Module-V**

**Introduction to Auto-Cad:**

Curves: Parabola, Ellipse, Hyperbola, Cycloid, Epicycloid, Hypocycloid and Involute

**Reference Books:**

1 Engineering drawing by N.D. Bhatt and V.M Panchal, Charotar Publishing House, Anand.
Engineering Drawing by Venugopal, New Age publisher.

**Course Outcomes:**

1. Revise basics of engineering drawings and curves.
2. Use Orthographic projections of Lines, Planes, and Solids.
3. Apply Sectioning of various Solids and their representation.
4. Change Pictorial views to Orthographic Projections
5. Construct Isometric Scale, Isometric Projections and Views.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **3** | **2** | 2 | 2 | **1** | **1** | **3** | **1** | **2** | **2** | **2** | **2** |

# 3RD SEMESTER

## MATHEMATICS-III (BMA 03001)

**(Transforms, Probability and Statistics and Multivariate Analysis) [3-1-0]**

***Module 1:*** **Laplace Transforms** ***(10 Lectures)***

Laplace transforms, inverse transforms, linearity, shifting, transforms of derivatives and integrals, solution of ODEs, unit step function, Dirac's delta function, differentiation and integration of transforms, convolution, integral equations.

***Module 2:*** **Fourier Transforms** ***(8 Lectures)***

Basic concept of Fourier integral, Fourier sine and cosine integral, condition of convergence, Fourier transformation, Fourier sine transform, Fourier cosine transform, properties.

***Module 3:*** **Probability** ***(6 Lectures)***

Random variables, probability distributions, mean and variance, Binomial, Poisson and hyper-geometric distributions, Normal distribution.

***Module 4:*** **Statistics** ***(8 Lectures)***

Random sampling, point estimation of parameters, maximum likelihood estimation, confidence intervals, testing of hypotheses for mean and variance, correlation and regression.

***Module 5:*** **Multi-variate Analysis** ***(8 Lectures)***

Line integrals, double integrals, change of order, Green's theorem (statements only), surface integrals, triple integrals, Divergence theorem of Gauss (statements only), Stoke's theorem (statements only) and applications.

Text Book:

Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd, 9th edition

Reference Books:

1) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill
2) K.A. Stroud, Advanced Engineering Mathematics, Industrial Press

Course Outcomes:

Upon completion of the subject the students will be able to:

| | |
|---|---|
| CO1 | Develop adequate knowledge of Laplace and Fourier transforms, and apply this idea to solve differential equations |
| CO2 | Describe unit step function and Dirac's delta function which are useful in engineering problems |
| CO3 | Apply Binomial, Poisson and Normal distributions in probabilistic models |
| CO4 | Demonstrate random sampling and estimation of parameters |
| CO5 | Evaluate multiple integrals and with various applications |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 2 | 2 | 1 | 2 | 1 | - | - | - | 1 | 1 |

# ELECTRICAL MACHINES-I (BEL03001)

**SYLLABUS**

**Module-I (10 hours)**

**Transformers:** Review of magnetic circuits. Single phase transformer: Constructional details, Core, windings, Insulation, principle of operation, emf equation, magnetizing current and core losses, no load and on load operation, Phasor diagram, equivalent circuit, losses and efficiency, condition for maximum efficiency, voltage regulation, approximate expression for voltage regulation, open circuit and short circuit tests, Sumpner's test. Autotransformers.

**Module-II (8 hours)**

**Electromechanical Energy conversion**: Forces and torque in magnetic field systems – energy balance, energy and force in a singly excited magnetic field system, determination of magnetic force, energy; multi-excited magnetic field systems.

**Basic concepts of DC Machines:** Principle of operation, Action of commutator, constructional features, armature windings, lap and wave windings, simplex and multiplex windings, use of laminated armature, E.M.F. Equation, Armature reaction: Cross magnetizing and demagnetizing AT/pole, compensating winding, commutation, reactance voltage, methods of improving commutation.

**Module-III (4 hours)**

**DC Generators** –Methods of Excitation: separately excited and self excited generators, build up of E.M.F., critical field resistance and critical speed, causes for failure to self excite and remedial measures, Load characteristics of shunt, series and compound generators, parallel operation of DC generators, use of equalizer bar and cross connection of field windings, load sharing.

**Module-IV (10 hours)**

**DC Motors:** Principle of operation, Back E.M.F., Torque equation, characteristics and application of shunt, series and compound motors, Armature reaction and commutation, Starting of DC motor, Principle of operation of 3 point and 4 point starters, drum controller, Constant & Variable losses, calculation of efficiency, condition for maximum efficiency.

Speed control of DC Motors: Armature voltage and field flux control methods, Ward Leonard method.

Methods of Testing: direct, indirect and regenerative testing, brake test, Swinburne's test, Load test, Hopkinson's test, Field's test, Retardation test, separation of stray losses in a DC motor test.

**Module-V (7 hours)**

**Three phase Transformers:** Constructional features of three phase transformers – three phase connection of transformers (Dd0, Dd6, Yy0, Yy6, Dy1, Dy11, Yd1, Yd11, zigzag), Scott connection, open delta connection, three-phase to six phase connection, oscillating neutral, tertiary winding, three winding transformer, equal and unequal turns ratio, parallel operation, load sharing. Inrush of switching currents, harmonics in single phase transformers, magnetizing current wave form.

**Text Books:**

[1]. J. Nagrath, D. P. Kothari, "Electric Machines", TMH Publishers.
[2]. A. E. Clayton, N. Hancock, "Performance and Design of D.C Machines", BPB Publishers

**Reference Books:**

[1]. A. E. Fritzgerald, C. Kingsley, and S. Umans, "Electric Machinery", TMH Publisher.
[2]. P.S. Bhimra, Electrical Machinery (Part 1, Part 2), Khanna Publishers.

**Course Outcomes:**

Upon completion of the course, the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Demonstrate the performance of single-phase transformers. |
| CO2 | Apply knowledge on the basic concepts of electromagnetic energy conversion and dc machines. |
| CO3 | Express and analyze the performance of DC generators. |
| CO4 | Describe and analyze the performance of DC motors. |
| CO5 | Define and analyze the performance of three phase transformers. |

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

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# NETWORK THEORY (BEL03002)

**Syllabus**

**MODULE-I (9 HOURS)**

**Analysis of Coupled Circuits:** Self-inductance and Mutual inductance, Coefficient of coupling, Series connection of coupled circuits, Dot convention, Ideal Transformer, Analysis of multi-winding coupled circuits, Analysis of single tuned and double tuned coupled circuits.

**Transient Response:** Transient study in series RL, RC, and RLC networks by time domain and Laplace transform method with DC and AC excitation. Response to step, impulse and ramp inputs of series RL, RC and RLC circuit.

**MODULE-II (7 HOURS)**

**Two Port networks:** Types of port Network, short circuit admittance parameter, open circuit impedance parameters, Transmission parameters, Condition of Reciprocity and Symmetry in two port network, Inter-relationship between parameters, Input and Output Impedances in terms of two port parameters, Image impedances in terms of ABCD parameters, Ideal two port devices, ideal transformer. Tee and Pie circuit representation, Cascade and Parallel Connections.

**MODULE-III (8 HOURS)**

**Network Functions & Responses:** Concept of complex frequency, driving point and transfer functions for one port and two port network, poles & zeros of network functions, Restriction on Pole and Zero locations of network function, Time domain behavior and stability from pole-zero plot, Time domain response from pole zero plot.

**Three Phase Circuits:** Analysis of unbalanced loads, Neutral shift, Symmetrical components, Analysis of unbalanced system, power in terms of symmetrical components.

**MODULE-IV (9 HOURS)**

**Network Synthesis:** Realizability concept, Hurwitz property, positive realness, properties of positive real functions, Synthesis of R-L, R-C and L-C driving point functions, Foster and Cauer forms.

**MODULE-V (6 HOURS)**

**Graph theory:** Introduction, Linear graph of a network, Tie-set and cut-set schedule, incidence matrix, Analysis of resistive network using cut-set and tie-set, Dual of a network.

**Filters:** Classification of filters, Characteristics of ideal filters.

**TEXT BOOKS**

[1]. A. Chakrabarti, “Circuit Theory (Analysis and Synthesis)”, Dhanpat Rai Publications.
[2]. Mac.E Van Valkenburg, “Network Analysis”, PHI Learning publishers.
[3]. Franklin Fa-Kun. Kuo, “Network Analysis & Synthesis”, John Wiley & Sons.

**REFERENCE BOOKS**

[1]. M. L. Soni, J. C. Gupta, “A Course in Electrical Circuits and Analysis”, Dhanpat Rai Publications.
[2]. Mac.E Van Valkenburg, “Network Synthesis”, PHI Learning publishers.
[3]. Joseph A. Edminister, Mahmood Maqvi, “Theory and Problems of Electric Circuits”, Schaum's Outline Series, TMH publishers.

**Course Outcomes:**

Upon successful completion of this course, students will be able to

| | |
|---|---|
| CO1 | Analyze coupled circuits and understand the role of steady state response and transient response of the 1st and 2nd order networks. |
| CO2 | Apply different parameters of the two-port network in relation to their applications. |
| CO3 | Concept of network function and three phases circuit, and measurement of power in balanced and unbalanced systems/ circuits and their components. |
| CO4 | Synthesize the passive electrical networks. |
| CO5 | Implement and analyze the network using graph theory, and understand the importance of filters in electrical systems. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# ANALOG AND DIGITAL ELECTRONICS (BEL03003)

**Syllabus**

**MODULE-I** **(9 Hours)**

Biasing of BJT: Fixed bias circuit, Self-bias circuit, Feedback bias circuit, Bias Stabilization. Transistor at Low Frequencies: Transistor Hybrid Model, h- parameters, Analysis of the transistor amplifier using h-parameter. Emitter Follower, Miller's theorem and its dual, cascading transistor amplifiers, Simplified CE and CC configurations. Transistor at high frequency: Hybrid-pi CE Transistor Model.

**MODULE-II** **(6 Hours)**

Biasing the JFET: FET in fixed bias, self-bias and feedback bias configurations. FET small signal modelling. Frequency response of an amplifier, Bode plot, Bandpass of cascaded stages, RC-Coupled amplifier and its low frequency response. Classification of amplifier, Feedback concept, Transfer gain, Negative feedback, Input-output resistance, Method of analysis of a feedback amplifier, Voltage series feedback, Current series feedback, Voltage shunt feedback, Current shunt feedback.

**MODULE-III** **(9 Hours)**

The basic operational amplifier (OPAMP), Off-set error voltages and currents, temperature drift of input offset voltage and current, measurement of OPAMP parameters and its frequency response. Class –A large signal amplifier, higher order harmonic generation, Transformer-coupled audio amplifier, push-pull amplifier.

Digital circuits: Digital (Binary) operation of a system, OR gate, AND gate, NOT or inverter circuit, De Morgan's laws, NAND and NOR DTL gates, HTL gate, TTL gate, RTL and DCTL.

**MODULE-IV** **(6 Hours)**

Binary codes: BCD codes, gray codes, ASCII Character Code, Boolean Algebra & Logic gates: Axiomatic definition of Boolean algebra. Property of Boolean algebra, Boolean functions, Canonical & standard form; min terms & max terms, standard forms; Digital Logic Gates, Multiple inputs. Gate level Minimization: The Map Method, K Map up to five variables, Product of Sum simplification, Sum of Product simplification, Don't care conditions.

**MODULE-V** **(9 Hours)**

Combinational digital systems: Standard gate assembles, Binary adder, arithmetic functions, Decoder/Demultiplexer, Data selector/Multiplexer, Encoder.

Sequential digital systems: A 1-bit memory, Flip-flops, shift registers, Ripple (Asynchronous) counters, Synchronous counters, Application of counters.

**Text Books:**


1. Milliman. J, Halkias. C and Parikh. C.D., "Integrated Electronics", Tata Mc. Graw Hills 2nd Ed. 2010.
2. R.L Boylestad and L. Nashelsky, "Electronic Devices & Circuit Theory:, Pearson Education.
3. M. Morris Mano, "Digital Design", PHI Publishers.

**Reference Books:**


1. Mohammad Rashid, “Electronic Devices and Circuits”, Cengage Learning Publishers.
2. Sergio Fransco, “Design with Operational Amplifiers& Analog Integrated Circuits”, TMH Publishers.
3. Charles H.Roth, “Fundamentals of Logic Design”, Cengage Learning Publishers.


**Course Outcomes:**

Upon the completion of the course, the students will able to:

| | |
|---|---|
| CO1 | Implement the concept of DC and AC analysis for the design of various types of amplifiers using BJT and FET. |
| CO2 | Analyse the frequency response of various amplifiers. Comprehend the fundamental concepts in feedback amplifier circuits. |
| CO3 | Evaluate the design of various digital logic gates. |
| CO4 | Implement the concept of Boolean algebra for the analysis and design of various combinational and sequential circuits. Design of various logic gates starting from simple ordinary gates to complex programmable logic devices. |
| CO5 | Analyse the sequential logic circuits design both in synchronous and asynchronous modes for various complex logic and switching devices. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

**ORGANIZATIONAL BEHAVIOUR (BHU03001)**

**Credit- 3-0-0 Class Hours - 30**

Syllabus

Module I (6 hours)

Fundamentals of OB: Learning objectives, Definition, scope and importance of OB, why to study OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework

(cognitive), Behavioristic and social cognitive, Models of OB, New Challenges of OB Manager,Limitations of OB

Learning: Nature of learning, Determinant of learning, How learning occurs, Learning and OB

Case Study Analysis

Module II (6 hours)

Personality: Definition and importance of personality for performance, Nature and Determinants of personality, Theories of Personality, Personality Traits, Personality and OB

Perception: Meaning and concept of perception, Perceptual process, Importance of perception in OB Motivation: Definition & Concept of Motive & Motivation, Theories of Motivation (Herzberg's Two Factor model Theory, Maslow's Need Hierarchy, Aldefer's ERG theory)

Case Study Analysis

Module III (6 hours)

Communication: Importance, The Communication Process, Types of communication, Barriers to communication, Communication networks, Making communication effective

Groups in organization: Nature, Types of Groups, Why do people join groups? Stages of Group

Development, Group cohesiveness, Group decision making and managerial implication,

Developing Work Teams, Team Building, Effective team building

Leadership: Concept of Leadership, Styles of Leadership, Theories of leadership (Trait theory,

Behavioral theory, Contingency theory), How to be an effective leader, Success stories of

today's Global and Indian leaders.

Case Study Analysis

Module IV (6 hours)

Conflict: Nature of conflict, Sources of Conflict, Conflict resolutions, Stages of conflict episode,Conflict management technique

Transactional Analysis (TA): Meaning of TA, Ego states, Types of transactions, Life position

Case Study Analysis

Module V (6 hours)

Organizational Change: Why organizational change? Types of Organizational Change, Planned change, Kurt Lewin's-Three step model, Resistance to Change, Managing resistance to change. Organizational Culture: Meaning & definition, Types of culture, creating, sustaining and

changing a culture, Concept of workplace spirituality.

International OB: Introduction to International business, Individual and group behavior in

International organization, How culture influence International OB?

Case Study Analysis

Reference Books

1. Stephen P. Robbins, Organizational Behaviour, Printice Hall of India, New Delhi, 2013
2. K. Aswathappa, Organizational Behaviour, Himalaya Publishing House, Bombay, 2018
3. Nelson, D. L., and Quick, J. C. (2007)., Understanding Organizational Behaviour (3rded.)., Thompson South-Western Publication
4. Pareek, U. (2012), Understanding Organizational Behaviour (3rded.)., Oxford University Press.

## Programme Outcomes of BTech Programme

| | |
|---|---|
| PO1 | Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| PO2 | Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| PO3 | Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| PO4 | Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| PO5 | Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. |
| PO6 | The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| PO7 | Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| PO8 | Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| PO9 | Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| PO10 | Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |

| | |
|---|---|
| PO11 | Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| PO12 | Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

**COURSE OUTCOMES: At the end of this course, the students will be able to**

| | |
|---|---|
| **CO1** | Explain the transition process of management thought from traditional period to modern approaches**.** |
| **CO2** | Transfer the different motivational theories and evaluate motivational strategies used in a variety of organizational settings. |
| **CO3** | Identify and analyze the factors affecting individual and group behavior and evaluate the appropriateness of various leadership styles. |
| **CO4** | Evaluate the appropriateness of various conflict management strategies used in organizations and develop strategies for resolving group conflict. |
| **CO5** | Explain how organizational change and culture affect working relationships within organizations. |

**Course Articulation Matrix**

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

**Program Articulation Matrix**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | - | - | - | - | - | **2** | **1** | **1** | **3** | **2** | **3** | **2** |

# Sessional

## ELECTRICAL MACHINES LABORATORY-I (BEL03004)

**Syllabus:**

**LIST OF EXPERIMENTS**

1. Open circuit and short circuit on single phase transformer
2. Parallel operation of two single phase transformer and load sharing
3. Back –to-back test of Single phase transformer
4. Load characteristics of DC shunt/compound generator
5. Load characteristics of DC series Motor
6. Swinburne test and brake test of DC shunt machine

**Books:**

1. Lab manual

**Course Outcomes:**

Upon successful completion of this course, students should be able to:

| | |
|---|---|
| CO1 | Create opportunity for the betterment in the power sector of day to day life |
| CO2 | Produce techniques applicable in traction motors. |
| CO3 | Evaluate the efficiency and parameters of the machines and implement in research related work |
| CO4 | Incorporate the present scenario and the future scenario in DC machines as well as transformers |
| CO5 | Develop methods to cater better services in field of electrical engineering. |

**Course Articulation Matrix:**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | - | 1 |

# NETWORK LABORATORY (BEL03005)

**List of Experiments:**

1. Verification of Superposition and Thevenin's Theorem.

2. Verification of Maximum Power Transfer Theorem.

3. Find out the band width, Q-factor and resonance frequency of a R-L-C series circuit.

4. Transient response of a D.C R-L, R-C and R-L-C circuit.

5. Determination of ABCD, Z,Y and h parameters of a two port network.

6. Spectral Analysis of a non-sinusoidal waveform.

**Course Outcomes:**

Upon successful completion of this course, students should be able to

| | |
|---|---|
| CO1 | Develop and analyze the linear circuits using Superposition theorem, and Thevenin's theorem, Maximum Power Transfer (MPT) theorem. |
| CO2 | Evaluate the resonant circuits by understanding its basic properties, and able to find dynamic parameters such as BW, Q-factor and $f_r/w_r$ of a R-L-C series network. |
| CO3 | Analyzethe Transient response of R-L, R-C and R-L-C circuits using DC excitation. |
| CO4 | Determine ABCD, Z, Y and h parameters of a two-port network, and know the property of symmetricity and reciprocity of networks. |
| CO5 | Develop the understanding and analyzing the importance of non-sinusoidal waveforms related to different applications. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 3 | 2 | - | - | - | - | - | 1 |

# ANALOG AND DIGITAL ELECTRONICS LABORATORY (BEL03006)

## LISTS OF EXPERIMENTS

***Analog Electronics:***

1. Determination of the frequency response of Low pass filter.
2. Determination of the frequency response of High pass filter.
3. Study of different clipper and clamper circuits
4. Study of output characteristics of FET.
5. Study of Class A Amplifier.
6. Study of Class B Amplifier.
7. RC phase shift oscillator and to observe its output waveform

***Digital Electronics:***

1. Verification of Truth table of logic gates and verification of Demorgan's Theorems.
2. Realization of half adder, full adder, half subtractor and full subtractor.
3. Design and implementation of multiplexer using logic gates.
4. Realization of S-R and J-K flip flop using 7400.
5. Design of 3-bit asynchronous counter and mod-N counter.
6. Design of SISO, SIPO, PISO, PIPO shift registers.
7. Application of multiplexer: - design of full adder using DUAL MUX IC.

**Course Outcomes:** Upon completion of the course, the students will be able to:

| | |
|---|---|
| CO1 | Develop basic filter circuits, clipper and clamper circuits. |
| CO2 | Evaluate the characteristics of transistors. |
| CO3 | Analyse different power amplifier circuits. |
| CO4 | Develop combinational circuits such as adder, subtractor and multiplexers. |
| CO5 | Develop sequential circuits such as FFs, counters and shift registers. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 3 | 2 | - | - | - | - | - | 1 |

# Fourth Semester

## MEASUREMENT & INSTRUMENTATION (BEL04002)

**Syllabus:**

**Module-I (8 Hours)**

Measuring Instruments: Classification, Absolute and secondary instruments, indicating instruments, deflecting, control and damping torques, Ammeters and Voltmeters, PMMC, Moving Iron (MI) type, expression for the deflecting torque and control torque, extension of range using shunts and series resistance. Electrostatic Voltmeters-electrometer type and attracted disc type, extension of range of E.S. Voltmeters.

**Module-II (8 Hours)**

Electrodynamometer type wattmeter – Theory & its errors – Methods of correction – LPF wattmeter – Phantom loading – Induction type KWH meter – Calibration of wattmeter, energy meter. Measurement of active and reactive powers in balanced and unbalanced systems.

Galvanometers: General principle and performance equations of D'Arsonval Galvanometers, Vibration Galvanometer and Ballistic Galvanometer.

**Module-III (8 Hours)**

DC/AC Bridges: General equations for bridge balance, measurement of self-inductance by Maxwell's bridge (with variable inductance & variable capacitance), Hay's bridge, Owen's bridge, measurement of capacitance by Schearing bridge, errors, Wagner's earthing device.

Method of measuring low, medium and high resistance: Kelvin's double bridge for measuring low resistance, Wheat-stone's bridge, measurement of high resistance – loss of charge method.

**Module-IV (8 Hours)**

Instrument Transformers: Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors.

Potentiometers: DC Potentiometer, Crompton potentiometer, construction, standardization, application. AC Potentiometer, Drysdale polar potentiometer; standardization, application.

**Module-V (7 Hours)**

Digital Multi-meter: Block diagram, principle of operation, Accuracy of measurement, Electronic Voltmeter: Transistor Voltmeter, Block diagram, principle of operation, various types of electronic voltmeter, Digital Frequency meter: Block diagram, principle of operation

Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, gauge factor,.

**Text Books**

[1]. A K. Sawhney, "A Course in Electrical & Electronics Measurements & Instrumentation", Dhanpat Rai Publications.

[2]. Helfrick & Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI Publshers.

**Reference Books**

[3]. Larry Jones &A Foster Chin, "Electronic Measurement & Instrumentation Systems", John Wiley & Son Publishers.

[4]. Golding & Waddis, "Electrical Measurement and Measuring Instruments", Reem Publishers.

**Course Outcomes:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Implement the principles of basic electrical measuring instruments. |
| CO2 | Analyse the performance characteristics of measurable instrumentations. |
| CO3 | Design and analyze the working of different ac and dc bridges |
| CO4 | Construct the potentiometers to measure AC and DC values of unknown voltage |
| CO5 | Employ the operation of electronic measuring instruments and transducers |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 2 | 3 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# ELECTRICAL MACHINES-II (BEL04001)

**Syllabus**

**Module-I (8 hours)**

Three phase synchronous generators: Principle and construction, relation between speed & frequency, three-phase windings, winding factors, EMF equation, Harmonic EMFs.

Cylindrical rotor theory: armature reaction, armature reaction reactance, synchronous reactance, phasor diagram, open & short circuit characteristics, short-circuit ratio, load characteristics.

**Module-II (8 hours)**

Voltage regulation, EMF method, MMF method, modified MMF method, ZPF method, Theory of salient pole machine: Blondel's two reaction theory, phasor diagram, direct and quadrature axis synchronous reactances, Slip Test. Power Angle characteristics. Synchronizing coefficient.

**Module-III (8 hours)**

Parallel operation: Synchronizing method, effect of wrong synchronization, load sharing between alternators in parallel. Sudden Short Circuit of a Synchronous Generator, Transient and Sub-transient reactance.

Synchronous Motors: Operating principle, torque-angle characteristics in non-salient pole and salient pole motors, Effect of change of excitation, V-curves & inverted V-curves, power factor correction applications. Hunting.

**Module-IV (8 hours)**

Three Phase Induction Motors: Types, Construction and principle of operation. Torque-slip characteristics, condition for maximum torque, effect of rotor resistance, stable & unstable region of operation. Losses and efficiency. Equivalent circuit, phasor diagram, circle diagram and performance equations. Operation with unbalanced supply voltage. Methods of starting (DOL, stator resistance starter, autotransformer starter, star-delta starter, rotor resistance starter). Methods of speed control. Double cage induction motor, Cogging and Crawling of Induction motor.

**Module-V (7 hours)**

Induction Generator: types, principles and applications.

Single phase induction motor: theory of operation (Double revolving field theory, equivalent circuit, Determination of parameters). Methods of starting: split phase starting, Repulsion starting, shaded pole starting, performance characteristics.

Single phase series motor, theory of operation performance and application. Universal motor.

**Text Books:**


[1] .M.G.Say, The performance and Design of Alternating Current Machines, CBSPublishers & Distributors

[2] P.S. Bimbhra, Electrical Machinery (Part 1, Part 2), Khanna Publishers

**Reference Books:**


[1] E. Fritzgerald, C. Kingsley, and S. Umans, "Electric Machinery", TMH Publisher.

[2] J. Nagrath, D. P. Kothari, "Electric Machines", TMH Publishers

[3] P.K. Mukherjee & S. Chakrabarty, Electrical Machines, Dhanpat Rai Publication


**Course Outcomes:**

Upon completion of the course, the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Incorporate the fundamental principles and classification of synchronous machines. |
| CO2 | Develop the concept of armature reaction and apply the same for evaluating voltage regulation in synchronous generators. Apply the concept to achieve improved voltage regulation |
| CO3 | Plan various performance characteristics of synchronous motors and analyze the characteristics accordingly to be fit for specific use of the mankind in specific field. |
| CO4 | Implement in new design as well as construction of three phase induction motors in recent advancements. |
| CO5 | Apply the fundamentals of single phase motors in making of advanced newest form of machines to cater the household need of the world. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program articulation matrix**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | - | 1 |

# SIGNALS & SYSTEMS-I (BEL04003)

**Module-I (7 hours)**

**Introduction of Signal and System:** Introduction of Signals, Classification of Signals, General Signal Characteristics, Energy & Power Signal, Continuous-Time Signals, Discrete-Time Signals. Basic System Properties, Systems with and without memory, Invertibility, Casuality, Stability, Time invariance, Linearity.

**Module-II (10 hours)**

**Convolution:** Linear Time Invariant (LTI) Systems, Discrete Time LTI Systems, Convolution representation of Linear Time-Invariant Discrete-Time Systems, Convolution Representation of Linear Time-Invariant Continuous-Time Systems, Properties of convolution, Properties of LTI Systems.

**Fourier Representations for Signals:** Representation of Discrete Time Periodic signals, Continuous Time Periodic Signals, Discrete Time Non Periodic Signals, Continuous Time Non-Periodic Signals, Properties of Fourier Representations.

**Module-III (8hours)**

**Frequency Response of LTI Systems:** Frequency Response of LTI Systems, Fourier Transform representation for Periodic and discrete time Signals, Sampling, reconstruction, Discrete Time Processing of Continuous Time Signals, Fourier Series representation for finite duration Non-periodic signals.

**Modulation:** Modulation Types and Benefits, Full Amplitude Modulation, Pulse Amplitude Modulation, Multiplexing, Phase and Group delays

**MODULE-IV (7 hours)**

**Representation of Signals using Continuous Time Complex Exponentials:** Laplace Transform, Unilateral Laplace Transform, its inversion, Bilateral Laplace Transform, Transform Analysis of Systems.

**MODULE-V (7 hours)**

**Representation of Signals using Discrete Time Complex Exponentials:** The Z-Transform, Properties of Region of convergence, Inverse Z-Transform, Transform Analysis of LTI Systems, Unilateral Z-Transform.

**TEXT BOOKS**

[1]. Simon Haykin and Barry Van Veen, "Signals and Systems", John Wiley & Sons Publisher.

[2]. Alan V. Oppenheim, Alan S. Willsky, with S. Hamid, S. Hamid Nawab, "Signals and Systems", PHI Publisher.

**REFERENCE BOOKS**

[1]. Hwei Hsu, "Signals and Systems", Schaum's Outline TMH Publisher.
[2]. Edward w. Kamen and Bonnie S. Heck, "Fundamentals of Signals & systems using Web and MATLAB", PHI Publisher

**Course Outcomes:**

Upon completion of the course, the students will:

| | |
|---|---|
| CO1 | Express the basic definition of different types of signals and systems. |
| CO2 | Implement the concept of convolution representation of LTI system and Fourier representation of signals. |
| CO3 | Evaluate frequency response of LTI system and express the basics of modulation. |
| CO4 | Apply Laplace Transform for analysis of signals and systems. |
| CO5 | Implement the Z Transform for analysis of signals and systems. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# MATHEMATICS-IV (Numerical Methods) (BMA04001) 4 Credits [3-1-0]

### *Module I:* Errors and Root Extraction *(8 Lectures)*

Definition and sources of error, Propagation of errors, finding roots of algebraic and transcendental equations by Bisection method, Newton's method, Secant method, fixed point iteration method.

### *Module I:* Interpolation *(8 Lectures)*

Interpolation, Lagrange's interpolation, Newton's divided differences, Forward differences, Backwarddifferences, Central differences, Interpolation error.

### *Module I:* Numerical integration *(8 Lectures)*

Numerical integration: Newton-Cotes Integration formula (without derivation), Trapezoidal rule,Simpson's rule, Gaussian quadrature, Errors in Numerical Integration.

### *Module I:* Numerical Solution of Differentianal Equations *(8 Lectures)*

Solution of ODE's: Euler's method, Improved Euler's method, Runge-Kutta Methods of order-2 & 4.

### *Module I:* Numerical Solution of system of linear equations *(8 Lectures)*

Numerical Solution of system of linear equations, Gauss Elimination method, LU decomposition,Gauss-Jordan Elimination method, Gauss Jacobi and Gauss-seidal iteration methods

Text Books:


1. An introduction to numerical analysis, Jain, Iyengar and Jain, New Age International
2. Numerical Analysis, B. S. Grewal, Khanna Publishers


Course Outcomes:

Upon completion of the subject the students will be able to:

| | |
|---|---|
| CO1 | Compile roots of algebraic and transcendental equations |
| CO2 | Incorporate interpolating polynomial for a given set of data |
| CO3 | Apply numerical integration methods for computing definite integrals |
| CO4 | Describe the solution of ordinary differential equations (IVP) by using numerical methods |
| CO5 | Demonstrate approximate solutions for system of linear equations |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 2 | 2 | 1 | 2 | 1 | - | - | - | 1 | 1 |

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 2 | 1 | 1 | 2 | 1 | - | - | - | - | 1 |

# ECONOMICS FOR ENGINEERS (3-0-0) (BHU03001)

**Course Objectives:**

- To understand the basic economic principle as a consumer in an economy
- To be able to know the utility measurement in the presence of risk and uncertainty
- To prepare the Engineering students to learn about the production process and analyse the cost/revenue data.
- To provide the foundation for engineers to make good decisions in business environment and learn about the market mechanism.
- To be able to make decision on project alternatives and justify projects on an economic basis

**Syllabus:**

**Module-1:**

Theory of Demand: Demand and Utility, Demand function and the factors determining demand, Law of Demand, Reasons for downward sloping demand curve, Exceptions to the law of demand. The market forces of Supply and Demand, Elasticity of demand and its application, Utility analysis: cardinal and ordinal measurability of utility, Assumptions of cardinal utility analysis, law of diminishing marginal utility, Consumer's equilibrium: Principle of equi-marginal utility

**Module-2:**

Indifference curve analysis of demand: Concepts, properties, Equilibrium of the consumer, Price Consumption Curve (PCC) and Income Consumption Curve, Decomposition of price effect into income effect and substitution effect, Revealed preference hypothesis, Individual choice under Risk and Uncertainty: St. Petersburg paradox and Bernoulli's hypothesis, Neumann-Morgenstern method of constructing utility index, Friedman-Savage hypothesis, Markowitz hypothesis

**Module-3**

Production function: short run analysis, Total product, Average product and Marginal product, output elasticity of input, law of variable proportion, Long run production function: Isoquants and concepts of returns to scale, Optimum factor combinations, Homogeneous Production Function, Cobb–Douglas production function, CES Production function, Cost Analysis: Concepts, Accounting cost, Fixed and variable cost, opportunity cost, Short run and long run cost curves, Relationships between average cost and marginal cost

**Module-4**

Market and its classifications, Perfect competition: Characteristics, Short run and long run equilibrium of firm under perfect competition. Monopoly market: Price and output determination. Modern theories of firms: Baumol's theory of sales revenue maximisation, Bain's limit pricing model

**Module-5**

Time value of money: use of cash flow diagram, Annual economic worth, present worth, future worth, Internal Rate of Return (IRR), Net Present Value (NPV), Payback period method, Analysis of public projects: Cost-Benefit analysis, cost effectiveness

**Reference Books:**


1. Koutsoyiannis, A. (1979). Modern Microeconomics. The Macmillan Press Ltd., London
2. Varian, H. R. (1992). Introduction to Micro Economic Analysis, Norton and company, New York
3. Salvatore, D. (2008). Microeconomics: theory and applications. Oxford University Press
4. Pindyck, R. S., D. N. Rubinfeld and P. L. Meheta (2009). Microeconomics, Pearson India, New Delhi
5. Panneerselvam, R. (2007). Engineering Economics, Prentice-Hall of India, New Delhi
6. Henderson, J. M. and R. E. Quant (2011). Microeconomic Theory: A Mathematical Approach, Indian Higher Education, New Delhi
7. Intriligator, M. D., R. G. Bodkin and C. Hsiao(1995). Econometric Models, Techniques, and Applications, Pearson India, New Delhi


**Programme Outcomes of BTech Programme**

| | |
|---|---|
| PO1 | Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| PO2 | Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| PO3 | Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| PO4 | Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| PO5 | Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. |
| PO6 | The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| PO7 | Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| PO8 | Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |

| | |
|---|---|
| PO9 | Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| PO10 | Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| PO11 | Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| PO12 | Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

**Course Outcomes:**

Upon completion of the subject the student will be able to :

| | |
|---|---|
| CO1 | Utilise economics principles in consumption process |
| CO2 | Describe the utility measurement and measure the utility associated with risk |
| CO3 | Efficient use of resources in production and take decision regarding optimum output |
| CO4 | Describe market mechanism and analyse product market to take proper decisions |
| CO5 | Implement economic principles in company related decision making |

**Course Articulation Matrix**

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

**Program Articulation Matrix**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | - | - | - | - | - | 3 | 2 | 1 | 1 | 1 | 3 | 2 |

# Sessional

## ELECTRICAL MACHINES LABORATORY-II (BEL04004)

| **Course Name** | **ELECTRICAL MACHINES LABORATORY-II** |
|---|---|
| Course code | UPL |
| Session of Course | Jan-June |
| L:T:P | 0 : 0 : 6 |
| Semester | IV |
| Credits | 3 |

**SYLLABUS**

1. To determine the voltage regulation of alternator by EMF method
2. To determine the V curve and inverted V curve of a 3-Ph synchronous motor
3. Speed control of a 3 phase induction motor by rheostatic, cascading and pole changing methods
4. Synchronization of alternator with infinite bus.
5. No load and Blocked rotor test of three phase Induction motor.
6. Three phase connections of transformer
7. Determination of power angle characteristics of an Alternator
8. Load test of 3-Ph Induction Motor
9. Determination of Parameters of single-phase induction motor
10. Separation of hysteresis and eddy current losses of single-phase transformer.
11. Voltage regulation of 3 phase alternator by ZPF method.
12. Determination of Parameters of 3 phase three winding transformer and trace the waveform of Magnetizing Current & Induced e.m.f.

**Course Outcomes:**

Upon completion of this course, students will demonstrate the ability to:

| | |
|---|---|
| CO1 | To analyze the performance of the synchronous generator at various load condition. |
| CO2 | To apply the knowledge of infinite busbar and implement synchronization methods advanced power system. |
| CO3 | Produce various parameters of three phase as well as single phase induction motors incorporating to run as reactive VAR supplement to power system and run IM as IG. |
| CO4 | Implement the loss separation procedure in single phase transformer and parameter evaluation in single phase IM to implement in design for IM |
| CO5 | Construct three phase transformers (Y-delta) for sector wise application |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 1 |

# SIGNALS AND SYSTEMS LABORATORY-I (BEL04005)

(Use MATLAB CONTROL SYSTEM and SIGNAL PROCESSING TOOL BOXES)

1. Generation of square, triangular, exponential, sinusoidal signals and step, Impulse and RAMP functions.
2. Verification of time shifting, time scaling and reflections on square, triangular, exponential, sinusoidal, ramp, impulse and step signal.
3. Evaluation of convolution of finite –duration discrete time signals and verification of convolution properties.
4. Evolution of convolution integral of given signals.
5. Compute the discrete time Fourier transform of given sequence.
6. Frequency response of LTI Systems from Impulse response.
7. Frequency response of LTI systems Describes by differential or difference Equations.
8. Generation of AM wave and analysing its frequency content.
9. Determination of frequency response from Poles and Zeros.
10. . Pole- Zero Plot in the Z-plane and determination of magnitude response.
11. Find the impulse response of a system described by Z-transform function.
12. Implementation of Decimation and Interpolation concepts

**Course Outcomes:** Upon completion of this course, students will demonstrate the ability to

| | |
|---|---|
| CO1 | Write Matlab programing to generate different basic signals and apply time shifting, time scaling and reflections operations on them. |
| CO2 | Implement convolution for continuous & discrete time signals and apply convolution properties. |
| CO3 | Evaluate DTFT, frequency response of LTI system from Impulse response/ differential/ difference Equation representation. |
| CO4 | Evaluate frequency response from Poles and Zeros in S-plane ,for discrete time system using Z-transform and apply Matlab programing to find inverse Z- transform . |
| CO5 | Implement the concept of Decimation and Interpolation on signals. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | 1 |

# MEASUREMENT AND INSTRUMENTATION LAB (BEL04006)

**Syllabus:**

**List of Experiments**

1. Study the role of various sensors and actuators in measuring physical / electrical parameters or variables and able to distinguish between conventional and smart sensors.
2. Study of a linear system simulator and learn about linear approximations of a non-linear functions or a system.
3. Measurement of unknown resistance, inductance and capacitance using bridges and its realizations using breadboard or using NI cRIO platforms.
4. To plot the displacement- voltage characteristics of the LVDT.
5. Study and plot the characteristics of different temperature sensors/ transducers namely RTD, Thermistor and Thermocouples and its calibration with soft temperature sensors using LM 34/35 or AD 220.

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Comprehend the basic principles and design requirements of smart / modern measurement schemes. |
| CO2 | Able to design necessary signal conditioning circuits for the measurement of resistance, inductance and capacitance. |
| CO3 | Able to perform the principles of operations of displacement measurement using inductive method. |
| CO4 | Perform the linear system simulation and linear approximation. |
| CO5 | Competent to understand the principles of operations of temperature sensors. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 2 | 3 | 3 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# Fifth Semester

## POWER SYSTEM-I (BEL05001)

**SYLLABUS:**

**MODULE-I (8 HOURS)**

Introduction to different sources of energy and general discussion on their application to generation, general introduction to power transmission by DC and AC overhead lines & underground cables, Per unit system, Single line diagram, Choice of size and number of generating units. Review of the terms maximum demand, load factor, diversity factor, plant capacity and use factor, load & load duration curve and their effect on the generating capacity, Reserve units (hot, cold and spinning- reserve).Different types of power tariffs, brief idea about national grid and its operational problems.

**MODULE-II (8 HOURS)**

**Hydro Power:** classification of plants, base load and peak load station, Turbines, head gate, penstock, surge tank, scroll case, draft tube and tailrace, power plant auxiliaries.

**Thermal Power:** Block diagrams, Boilers, steam turbines, super heater, economizer, air preheater, dust collection, draft fans and chimney; condensers, feed water heaters, cooling water system; Governors, plant layout and station auxiliaries.

**MODULE-III (8 HOURS)**

**Nuclear Power:** Fission & fusion, reactor construction, controlled chain reaction, operational control of reactors, Reactors (Boiling water, pressurized water, sodium graphite, breeder), layout of nuclear power plant.

**Electrical Systems:** excitation system. AVR: magnetic amplifier and thyristor converter type/DVR. Main transformer, unit transformer and station reserve transformer, commissioning tests of alternators and transformers.

**MODULE-IV (10 HOURS)**

**Distribution Systems:** types of distributors and feeders (radial & ring), voltage drop and load calculation, Primary and secondary distribution network, Capacitor placement in distribution network, Distribution system planning, Service area calculation.

**MODULE-V (5 HOURS)**

**Substation & Earthing:** Types of substations, arrangement of bus-bars and control equipments, Solid earthing, resistance earthing and Peterson coil.

**Books:**

**[1]** A course in Power Systems- J.B. Gupta (S. K. Kataria& Sons)

**[2]** Principles of Power System- V.K. Mehta &Rohit Mehta (S. Chand Pub)

**[3]** Electrical Power Systems ($5^{th}$ Edition) – Ashfaq Husain (CBS Pub and Distributors Pvt Ltd)

**[4]** Power Station Engg. &Economy–S. Krotizki&Vopat(T.M.H.)

**[5]** Elements of Power System Analysis – William D. Stevension (McGraw-Hill)

**Course Outcomes:**

Upon completion of the subject, the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Evaluatethe conventional energy sources understand basic concepts of power system. |
| CO2 | Define the components and operation of hydro and steam power plants. |
| CO3 | Analyze and operation of nuclear power plants and electrical systems in a power plant. |
| CO4 | Demonstrate competence on performance of primary and secondary distribution system. |
| CO5 | Develop different types of sub-station, construct earthing schemes and bus-bar schemes. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | 1 |

# COMMUNICATION SYSTEM-I (BEL05003)

**Syllabus:**

**Module-I (7 Hours)**
Elements of Communication System-Analogue System, Digital System, Distinguishing features. Electromagnetic Spectrum. Bandwidth. Comparison between Analogue & Digital Communication Systems. Baseband Signals, Analogue Signal, Digital Signal. Converting an analogue signal to Digital Signal: Sampling, Nyquist Criteria. Information and Sampled value. Quantization and Binary Coding of sampled values,Quantization error.

**Module-II (8 Hours)**
Transformation of Base band signal from Time domain to Frequency domain and Vice-versa. F.T. of few simple baseband signals. Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM). Inter Symbol Interference and Crosstalk. Digital Baseband Signal Formats-Unipolar, Bipolar, NRZ and RZ, Pulse Code Modulation, Companding.

**Module-III (8 Hours)**
Analog Modulation Techniques: Amplitude Modulation (AM), Depth of Modulation, Modulated Waveform, Powers in Carrier, and Sidebands, Generation of DSBC, VSB and SSB, Balanced Modulator, AM Demodulators. Frequency Modulation (FM) - Frequency Deviation, Frequency Modulated Waveform, Spectrum. Narrow Band FM and Wideband FM. Generation of FM; Narrow Band FM Modulator, Wideband FM Modulator, FM Discriminator, Pre-emphasis and De-emphasis.

**Module-IV (8 Hours)**
Digital Modulation Techniques: Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), Frequency Shift Keying (FSK), Differentially- Encoded PSK, QPSK– their Basic Principle, Waveform, Generation and Detection.

**Module-V (8 Hours)**
Noises in Communication Systems: Sources of Noise, White noise, Narrow Band Noise. Spectral Density Function of Noise (no derivation explaining its utility in noise performance
a Communication System). Noise bandwidth, Available Power, Noise temperature Two port noise Bandwidth, Input Noise Temperature, Noise Figure, Equivalent noise temperature of a cascade. An example of a receiving system.

**Books**
**Text Books**
[1] S. Haykin, Communication systems, John Wiley.
[2] B. P. Lathi, Modern Digital and Analog Communication Systems, Oxford University

**Reference Books**
[1] Communication Systems by R. P. Singh and S. D. Sapre. TMH
[2] Principle of Communication System by H. Tanb and D. L. Shilling.

**Course Outcomes**

Upon completion of the course, the students will:

| | |
|---|---|
| CO1 | Express the basic concept of communication system. |
| CO2 | Apply principles of multiplexing technique and their working. |
| CO3 | Implement principle of various analog modulation and demodulation techniques. |
| CO4 | Implement principle various digital modulation and demodulation techniques. |
| CO5 | Analyze the concept of the noise in communication systems. |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# POWER ELECTRONICS (BEL05002)

**Module-I (8 hours)**

Static and Dynamic characteristics of Power Diodes, Power BJTs, Power MOSFETs, Insulated Gate Bipolar Transistors (IGBT), Thyristor Family (SCR, DIAC, TRIAC, GTO, MCT). Thermal viewpoint. Thyristor Protection, cooling and mounting techniques. Safe Operating Area and different current and voltage ratings. Triggering and basics of driver circuits of thyristors, Different types of commutation schemes: Natural and Forced commutation.

**Module-II (8 hours)**

Uncontrolled rectifiers. 1-Phase Half & Full Wave Controlled Rectifier with various kinds of loads (R, R-L-E (motor)). Midpoint and Bridge type converters. Half Controlled and Fully Controlled Bridge circuits, different waveforms, Input Line Current Harmonics, Power factor, current distortion and displacement factors- Inverter Mode of Operation. Continuous and discontinuous modes, Effect of source inductance assuming constant load current. Effect of freewheeling diode. Three phase bridge converters for different types of load with constant load current, different waveforms.

**Module-III (8 hours)**

**DC-DC converter:** Classification of types of choppers, One, Two and Four quadrant operations, Step up and down choppers, concepts of duty ratio and average voltage, power circuit of buck & boost converter, analysis and waveforms at steady state, duty ratio control of output voltage.

**AC-AC Converters:** Single-phase mid-point and bridge types of step-up and step-down Cycloconverter. Single-phase AC Voltage regulators and its basic analysis.

**Module IV (7 hours)**

DC-DC Regulators,Generic Linear Regulator. Different Topologies: Shunt, series, modified shunt, negative voltage regulator, protection.

Switch Mode Power Supply: Basic scheme of SMPS and its difference & advantages over linear regulators. Different types of SMPS with single and bidirectional core excitation. Basic steady state operation and analysis of Forward and Flyback converters.

**Module-V (8 hours)**

Single-phase Half and Full bridge Inverter, Pulse Width Modulated (PWM) technique for voltage control, SPWM Technique 1-phase inverters, Three-phase Voltage Source Bridge type of Inverters. (120 and 180 Degree conduction modes), Current Source Inverter (Single-phase CSI with ideal switches, Single-phase capacitor commutated CSI and Single-phase auto-sequential commutated CSI).

Applications: UPS, Induction Heating, Electronic Ballast, AC/DC drives speed control.

**Text Books:**

1. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.
2. P. S. Bimbhra, Power Electronics, Khanna Publishers.

**Reference Books:**

2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
3. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Describe power switching devices and their drive circuits. |
| CO2 | Analyze and evaluate the performance of thyristor rectifiers. |
| CO3 | Express and evaluate the performance of AC-AC and DC-DC converters |
| CO4 | Analyze and evaluate the performance of DC-DC linear regulators and SMPS. |
| CO5 | Analyze and evaluate the performance of single phase and three phase inverters. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

**MICROPROCESSOR & MICROCONTROLLER THEORY & APPLICATIONS (BELPE501)**

**Syllabus**

**MODULE-I (9 HOURS)**

Microprocessor Architecture: Introduction to Microprocessor and Microcomputer Architecture, Pins & Signals, Register Organization, Timing & Control Module, 8085 Instruction Timing & Execution.

Instruction Set and Assembly Language Programming of 8085: Instruction set of 8085, Memory & I/O Addressing, Assembly language programming using 8085 Instruction Set.

**MODULE-II (6 HOURS)**

Use of Stack & Subroutines, Data transfer techniques, 8085 interrupts.

Interfacing & support chips: Interfacing EPROM & RAM Memories, 2716, 2764, 6116 & 6264, Interfacing of I/O devices with 8085, Partial address decoding for memory and I/O devices.

**MODULE-III (6 HOURS)**

Microprocessor Based System Development Aids, Programmable Peripheral Interface: 8255, Programmable DMA Controller: 8257, Programmable Interrupt Controller: 8259

Application: Delay calculation, square wave generation, Interfacing of ADC & DAC, Data Acquisition System.

**MODULE-IV (9 HOURS)**

Advanced Microprocessor: Basic features of Advance Microprocessors, Intel 8086 (16 bit processors): 8086 Architecture, Register organization, signal descriptions, Physical Memory Organization, Addressing Modes, Instruction Formats, Instructions Sets & Simple Assembly language programs, 8086 Interrupts.

**Module – V (9 HOURS)**

Microcontroller: Introduction for Microcontrollers, Microcontrollers & Microprocessors, 8051 Microcontrollers. MCS-51 Architecture, Registers, Stack Pointer & Program Counter. 8051 Pin Description, Connections, Parallel I/O ports, Memory Organization, 8051 Addressing Modes & Instructions, 8051 Assembly Language Programming Tools. Simple application: Delay calculation, square wave generation.

**Text Books:**


1. 0000 to 8085 Introduction to Microprocessor for Scientists & Engineers by Ghosh & Sridhar, PHI
2. Fundamentals of Microprocessor & Microcontroller by B.RAM, Dhanpat Rai Publications.
3. Advanced Microprocessor and Peripherals (Architecture, Programming & Interfacing) by A.K. Roy & K.M. Bhurchandi- TMH Publication.
4. Microcontrollers, theory and applications, TMH, Ajay V. Deshmukh.


**Reference Books:**


1. Microprocessor and Microcontroller by N Senthil Kumar, M. Saravanan and S. Jeevananthan, Oxford University Press.

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Demonstrate knowledge on microprocessor and microcontroller. |
| CO2 | Demonstrate an ability to write assembly language programming. |
| CO3 | Implement the basic idea about the data transfer schemes and its applications. |
| CO4 | Analyse the design of different interfacing circuits and troubleshoot interactions between software and hardware. |
| CO5 | Plan the design of microprocessor/microcontroller-based systems. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# MEMS and NEMS (BELPE502)

**Syllabus:**

**MODULE-I (5 Hours)**

Introduction to Micro-machining and Micro-electronics/ Nano-electronics Physics. Micro-machining and Micro-electronics/ Nano-electronics Technologies. Mechanical-Electronic Transitions in Sensing. Integration of Micro-machining and Micro-electronics.

**MODULE-II (9 Hours)**

Micromachining Technology: Bulk micromachining, Wafer bonding, Si-to-Si bonding, Anodic bonding, Si fusion bonding; Surface micromachining; Other techniques: LIGA, Dry-etching processes, Micro-milling, Use of lasers in micromachining; Chemical etching and IC technology, Material types and Property; Films on micro/Nano structure, Micro-machining Metal structures.

**MODULE-III (8 Hours)**

Applications and Case studies on Sensor Output: Sensor output characteristics, Wheatstone Bridge, Static vs Dynamic operation; Capacitive sensing, Piezoelectric sensing, Piezo-resistive sensing, Hall effect sensors, Gas sensors, Chemical sensors, Digital output of sensors, Need of Calibrating the sensors measurement, Noise/Interference aspects, Low-power, low-voltage sensors, Impedance measurement.

**MODULE-IV (9 Hours)**

Micro/Nano-Electronics Technology: Amplification and Signal conditioning, Instrumentation amplifier, SLEEPMODE OPAMP, rail-to-rail OPAMP, Switched – capacitor amplifier, Industry Current-and-Voltage Standard Signal Transmitters and Receivers; Integrated Passive and Active Elements, Onboard A/D and D/A conversions.

**MODULE-V (8 Hours)**

Advances in Signal Conditioning Technology: DSP control, PWM control, Communication links, Network Protocol, Networked Sensors/Actuators. Optical sensing. RFID technology.
Packaging, testing and reliability Implications of Smart/Intelligent Sensors: Hybrid packaging, Ceramic packaging, Multi-Chip modules, Dual-chip packaging. Forming Sensing Arrays.

**Books:**


1. Randy Frank, "Understanding Smart Sensors",2nd edition, Artech House, 2000.
2. "Handbook on Smart sensor and MEMS – Intelligent devices and Microsystems for industrial applications", Edited by StoyanNihtianov and Antonio Luque, Woodhead Publishing Ltd., 2014.
3. S. E. Lyshevski. "MEMS and NEMS: Systems, Devices, and Structures (Nano- and Microscience, Engineering, Technology and Medicine), CRC Press, 2002.


**References books:**


1. S. C. Mukhopadhyay and T. Islam, "Wearable Sensors- Applications, Design and Implementation", 1st edition, IOP Publishing, Bristol, UK, 2017.
2. James W. Dally, William F. Riley, and Kenneth G. McConnell, "Instrumentation for Engineering Measurements", Wiley student edition, Second edition, 2013.
3. M. Bhuyan, "Intelligent Instrumentation –Principles and Applications", CRC Press, 2012.

**Course Outcome:**

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

| | |
|---|---|
| CO1 | Conceptualize the technological developments in micromachining technologies and micro/nano-electronics technologies; |
| CO2 | Apply a specific method of micromachining technology for designing a smart sensor/actitation system to measure the predefined physical parameters; |
| CO3 | Apply and incorporate a micromachining technology for a particular applications / case study, and thereby, able to select suitable signal conditioning circuits to complete the IC package. |
| CO4 | Implement a specific method of micro/ nano electronics technology for designing the necessary signal conditioning circuits to complete the package in IC form, and |
| CO5 | Use of appropriate software tools (LabVIEW, COMSOL/ ANSIS, VISIO and /or Mentor Graphics) or equivalent open platform for the mathematical modelling of smart devices and packaging technology. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# VLSI THEORY & DESIGN (BELPE503)

**SYLLABUS:**

**MODULE-I (08 HOURS)**

Introduction, Historical perspective, VLSI Design methodologies, VLSI Design Flow, Design, Hierarchy, Design Styles, CAD Technology, Fabrication of MOSFETS. Fabrication processes, NMOS Fabrication, CMOS n-well process, Layout Design rules Stick Diagrams, Full Custom Mark Layout Design, MOS Transistor, Review of structure and operation of MOSFET (n-MOS enhancement type), CMOS, MOSFET v-I characteristics, MOSFET scaling and small geometry effects. MOSFET capacitances, Modeling of MOS Transistors-Basic concept the SPICE level-1 models, the level-2 and model equations.

**MODULE-II (08 HOURS)**

MOS Inverters: Basic NMOS inverters, characteristics, Inverters with resistive load and with n-type MOSFET load CMOS inverter and characteristics. MOS Inverters: Switching characteristics and interconnect effects: Delay time definitions and calculation, inverter design with delay constraints, estimation of parasites switching power dissipation of CMOS inverters.

**MODULE-III (08 HOURS)**

Combinational MOS logic circuits, CMOS logic circuits, state style, complete logic circuits, pass transistor logic, sequential logic circuit –introduction, SR latch, clocked latch and flip-flop circuits, CMOS D latch and edge triggered flip- flop. Dynamics logic circuits: Dynamic logic, basic principles, high performance dynamics CMOS circuits, Dynamic Ram, SRAM, flash memory.

**MODULE-IV (08 HOURS)**

Systems Design method, design strategies, concept of FPGA, standard cell based design, design capture tools hardware definition languages such as VHDL, and packages, Xlinx (introduction),introduction to IRSIM and GOSPL (open source packages), design verification and testing, simulation of various levels including timing verification, faults models, Design strategies for testing chip level and system level test techniques.

**MODULE –V (07 HOURS)**

SRAM, DRAM, ROM, Serial Access Memory, Content Addressable Memory, Field, Programmable Gate Array.

**Text Books**

[1]. Sung Mo-Kang &YussufLeblebici, "CMOS Digital integrated Circuits – Analysis & Design", TMH Publisher.
[2]. Perry, "VHDL Programming", TMH Publisher.

**Reference Books**

[1]. Rabey et al., "Digital Integrated Circuits: A Design Perspective", PHI Publisher.

[2]. Geiger et.al., "VLSI design Techniques for analog and digital circuits", TMH Publisher.

R. Johnson, "Introduction of Digital Signal Processing", PHI Publisher

**Course Outcomes:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Define the trends in semiconductor technology, and how it impacts scaling and performance |
| CO2 | Plan the Layout, Stick diagrams, Fabrication steps, Static and Switching characteristics of inverters. |
| CO3 | Apply the MOS transistor as a switch and its capacitance. |
| CO4 | Evaluate the Synthesis of digital VLSI systems from register-transfer or higher-level descriptions in hardware design languages. |
| CO5 | incorporate different memory types like dynamic ram, static ram and flash memory. |

**Course Articulation Matrix**

| | **PO1** | **P1** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |
| **CO2** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |
| **CO3** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |
| **CO4** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |
| **CO5** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |

# EMBEDDED SYSTEM (BELPE504)

**Syllabus**

**MODULE – I** **( 8 hours )**

Introduction to Embedded System: What is embedded system, History of embedded systems, classification of embedded system, Major application area of embedded system, Purpose of embedded system, Typical Embedded sys: Core of embedded system, Memory, Sensors ,Actuators ,Communication Interface, Embedded Firmware Other system component, PCB and Passive components.

**MODULE – II** **( 8 hours )**

Hardware Software co-design and programming model, Fundamental Issues in Hardware – Software co design, Computational model Embedded System, Hardware software trade off, Embedded Hardware design and development: Analog design components, Digital Electronics component, Embedded Firmware design and development, Embedded Firmware design approach

**MODULE –III** **( 8 hours )**

Introduction to unified modelling language (UML), VLSI and Integrated Circuit design, Embedded firmware development language, Programming in Embedded C.

**MODULE – IV** **( 8 hours )**

Real Time operating system (RTOS) based embedded system design, Types of operating systems, Task process and threads, Multiprocessing and multi-tasking, Task scheduling, Thread and process scheduling, Putting task communication, Task synchronization, Device drivers, Task synchronization, Task scheduling, Thread and process scheduling, Putting task communication, Task synchronization, Device drivers, How to choose RTOS.

**MODULE – V** **( 8 hours )**

Embedded system Development environment (IDE), Types of files generated on cross compilation, Dissembler / De compiler, Simulators, Emulator, Debugging, Design Case studies, Digital Clock, Battery operated smart card Reader, Automated meter reading system (AMR), Digital Camera.

**Text Books:**

[1] Introduction to embedded system: by SHIBU K.V., TMH Publication

[2] Embedded Systems – Architecture , Programming and Design – by RAJKAMAL , TMH Publication

**Course Outcomes:**

Upon completion of the course, the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Implement the basics of embedded system, Processor, memory, sensor, actuator. |
| CO2 | Evaluate design and programming model. |
| CO3 | Develop UML programming, VLSI programming, Embedded C programming. |
| CO4 | Develop real time programming. |
| CO5 | Plan Integrated development environment, awareness of Example of embedded system design environment and their applications. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# Sessional

## COMMUNICATION SYSTEM LAB-I (BEL05004)

**1.** Write MATLAB code to find convolution, autocorrelation, cross- correlation and power spectral density of different functions.
**2.** Write MATLAB program for generation and detection of
i) DSB-SC
ii) SSB-SC.
Or To study amplitude modulated waveforms for different modulation depths and measure the value of modulation index (using H/W Kit)

**3.** To generate and detect frequency modulation (FM) signals using MATLAB.
Or
To detect FM signal using Foster-Seely discriminator (using H/W Kit).

**4.** Write MATLAB code to generate and detect PM.
**5.** TDM (MATLAB Simulation).
**6.** Performance of any digital mod/demod. scheme in the presence of noise (MATLAB simulation).
**7.** Study of PLL using MATLAB code and detection of FM signal (using H/W Kit).
**8.** Study of Voltage Controlled Oscillator (using H/W Kit)

**9.** Generation of PSK, DPSK and QPSK signal.
**Or** Generation of ASK and QAM signal.

**10.** Generation of FSK and MSK signal.

**Books**
**Text Books**
[1] S. Haykin, Communication systems, John Wiley.

**Course Outcomes**
Upon completion of the course, the students will:

| | |
|---|---|
| CO1 | Apply the basics of MATLAB coding in communication system. |
| CO2 | Analyze and develop amplitude modulation and demodulation circuit. |
| CO3 | Analyze and develop frequency modulation and demodulation circuit. |
| CO4 | Analyze the PLL and Voltage Controlled Oscillator circuit. |
| CO5 | Implement principle of various digital modulation and demodulation techniques. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# MICROPROCESSOR & MICROCONTROLLER LAB (BEL05006)

**List of Experiments:**

1. Verification of basic instruction set of 8085 microprocessor.
2. Verification of additional instruction set of 8085 microprocessor.
3. Addition and subtraction of two 8-bit numbers resulting in 8/16-bit number using 8085.
4. Multiplication and division of two 8-bit numbers resulting in 8/16-bit number using 8085.
5. (a) Find smallest and largest number among 'n' numbers in a given data array using 8085.

   (b) Write an assembly language program of binary to gray code conversion in 8085.
6. Write a program to generate square waves of different frequencies on all lines of 8255 by the help of delay program.
7. Study of stepper motor and its operations (clockwise, anti-clockwise, angular movement and rotation in various speeds).
8. Study of different addressing modes of 8051 microcontroller.
9. Addition and subtraction of two 16-bit numbers using 8051.
10. Multiplication and division of two 16-bit numbers using 8051.

**Course Outcomes:** Upon completion of the course, students will be able to:

| | |
|---|---|
| CO1 | Demonstrate different mathematical operations using microprocessor. |
| CO2 | Demonstrate an ability to write assembly language programming. |
| CO3 | Demonstrate different tasks using programmable devices and work with different interfacing circuits. |
| CO4 | Implement running of stepper motor using microprocessor. |
| CO5 | Demonstrate generation of different types of waveforms using microprocessor. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 3 | 2 | - | - | - | - | - | 1 |

# POWER ELECTRONICS LABORATORY (BEL05005)

**Syllabus:**

1. Familiarization with power electronics components. (SCR, IGBT, MOSFET, GTO, BJT) & Draw the V-I Characteristics of BJT, MOSFET, SCR.
2. Study of Single phase Full and Half wave converters with R and R-L-E(Motor) loads with and without freewheeling action
3. Study of Three Phase Full and Half wave converters with R and R-L-E(Motor) loads
4. To study different triggering circuits for thyristors (Cosine Law & UJT Triggering)
5. To study single phase AC regulator using Triac (R & R-L Loads)
6. To study the single phase cycloconverter with R and R-L Loads
7. To study IGBT based PWM Inverter.
8. To study the speed control of DC motor using single-phase full wave converter.
9. DC Motor speed control by single quadrant chopper circuit.
10. To study a transistorized PWM Inverter.

**Course Outcomes**

Upon completion of the subject the students will be able to:

| | |
|---|---|
| CO1 | Familiarized with power electronics components and their V-I Characteristics. |
| CO2 | Apply fundamental knowledge about different types of waveforms obtained across the loads and switches. |
| CO3 | Construct different triggering circuits for thyristors. |
| CO4 | Understand different types of AC-DC and AC-AC converters. |
| CO5 | Express different types of Inverter circuits. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 3 | 2 | - | - | - | - | - | 1 |

# Sixth Semester

## POWER SYSTEM-II (BEL06001)

**SYLLABUS**

**MODULE-I (8 HOURS)**

Lines Constants: Resistance, inductance and capacitance of single and three phase lines with symmetrical and unsymmetrical spacing transposition, charging current, skin effect and proximity effect, Performance of transmission Lines: Analysis of short, medium and long lines, equivalent circuit, representation of the lines and calculation of transmission parameters.

**MODULE-II (8 HOURS)**

Power flow through transmission line, Power circle diagram, Series and shunt compensation.
Corona: Power loss due to corona, practical importance of corona, use of bundled conductors in E.H.V. transmission lines and its advantages.

**MODULE-III (8 HOURS)**

Overhead line Insulators, voltage distribution in suspension type insulators, string efficiency, grading. Sag and stress calculation of overhead conductors, vibration dampers Under Ground Cable: Type and construction, grading of cables, capacitance in 3 core cables and dielectric loss in cables.

**MODULE-IV (8 HOURS)**

Definition of the load flow problem, Network model formulation, A load flow sample study, Computational aspect of the load flow problem. Gauss siedel and Newton Raphson method for power flow fast decoupled load flow, On load tap changing transformer and block regulating transformer, effects of regulating transformers.

**MODULE-V (8 HOURS)**

Economic Operation of Power System: Distribution offload between units within a plant, Transmission losses as function of plant generation, Calculation of loss coefficients, Distribution of loads between plants with special reference to steam and hydel plants, Automatic load dispatching. Introduction to Flexible AC Transmission System (FACTS), SVC, TCSC, SSSC, STATCOM and UPFC

**TEXT BOOKS**

[1] John J Grainger, W. D. Stevenson, “Power System Analysis”, TMH Publisher

[2] I. J. Nagrath & D. P. Kothari, “Power System Analysis”, TMH Publisher

REFERENCE BOOKS

[1] S.N. Singh, “Electrical Power Generation Transmission and Distribution”, PHI Publishers.

[2] Abhijit Chakrpabati, Sunitha Halder, “Power System Analysis, Operation and Control”, PHI Publishers.

**COURSE OUTCOMES:**

Upon completion of the subject the students will:

| | |
|---|---|
| CO1 | Evaluate the line parameters and performance of the short, medium and long lines transmission line. |
| CO2 | Analyze the effect of corona in transmission line. |
| CO3 | Develop competency the mechanical design, types of line insulators and underground cables. |
| CO4 | Compile load flow problem in power system. Also, apply different regulating transformers in power system. |
| CO5 | Plan economic operation of transmission system. In addition, demonstrate strength on compensation in transmission line and application of FACTS devices in transmission line. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 1 |

# CONTROL SYSTEMS ENGINEERING (BEL06002)

| Course Name | CONTROL SYSTEM ENGINEERING |
|---|---|
| Course code | UPC |
| Session of Course | Jan-June |
| L:T:P | 3 :0 : 0 |
| Semester | VI |
| Credits | 3 |

**MODULE-I (9 HOURS)**

Introduction: Basic concept of control systems, Open loop and closed loop systems, Difference between Open loop and closed loop systems, classifications. Mathematical model of physical systems, transfer function, block diagram algebra, signal flow graph (SFG), Mason's gain formula. Feedback theory: Types of feedback, effect of degenerative feedback on control system, Regenerative feedback.

**MODULE-II (8 HOURS)**

Time domain analysis: Standard test signals (step, ramp, parabolic and impulse signals), Time response of 1st order system to unit step and unit ramp inputs, time response of 2nd order system to unit step input, time response specification, steady state errors and error constants of different types of control systems, generalized error series method.

**MODULE-III (8 HOURS)**

Concept of stability: Necessary condition of stability, Hurwitz stability criterion, Routh stability criterion, application of Routh stability criterion to linear feedback systems, relative stability. Root locus techniques: construction, determination of stability from root locus, determination of roots from root locus, root contour. Frequency domain analysis: Introduction, Bode plot, determination of stability from Bode plot, polar plot, Nyquist stability criterion, application of Nyquist stability criterion to linear feedback systems.

**MODULE-IV (8 HOURS)**

Controllers: Introduction, proportional, derivative and integral, control actions, PD, PI, PID controllers and their applications to linear feedback control systems, Zeigler-Nichols method of tuning of PID controller for known dynamic model of the plant.

State variable analysis: concept and analysis of state and state variable of homogeneous systems, state model for linear continuous time invariant SISO systems.

**MODULE-V (6 HOURS)**

Digital control systems: Advantages and disadvantages of digital control systems, representation of sampled process, Shannon's sampling theorem, signal reconstruction. Z-transfer function: Types and properties of Z-transform, transfer function of ZOH, relation between s and Z-transfer function, Inverse Z-transfer function, pulse Z-transfer function of sampled data closed loop control system, solution of difference equation.

TEXT BOOKS

[1]. K. Ogata, “Modem Control Engineering”, PHI Publisher.
[2]. I.J. Nagrath, M. Gopal, “Control Systems Engineering”, New Age International Publishers.

REFERENCE BOOKS

[3]. D. R. Chaoudhury, “Modern Control Engineering”, PHI
[4]. J.J. Distefano, III, A.R. Stubberud, I.J. Williams, “Feedback and Control Systems”, TMH Publisher.
[5]. K. Ogata, “Discrete Time Control System”, Pearson Education Asia Publisher.

**Course Outcomes:**

Upon completion of the course, the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | develop mathematical model of a physical system and its transfer function. |
| CO2 | compute steady state error for different standard test signals and estimate time domain performance indices. |
| CO3 | Performstability analysis using time domain and frequency domain methods. |
| CO4 | design different controllers including PI, PD and PID controllers and apply state variable techniques. |
| CO5 | Analyze digital control systems |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# Professional Elective -II

## COMMUNICATION SYSTEM-II (BELPE601)

**Syllabus:**

**Module I (8 Hours)**

Elements of Optical Fiber Communication System, Basic Optical Laws and Definitions, Optical FiberModes and Configurations, Single Mode Fiber, Graded Index Fiber Structure, Attenuation and Distortion in Optical Fibers,Optical Fiber System Link Budget.

**Module II (8 Hours)**

Sources: Light Emitting Diodes (LEDs), LED Structures, Light Source Materials, Internal Quantum Efficiency, Modulation Capacity, Laser Diodes, Laser Diode Modes and Threshold Conditions, Resonant Frequencies, Laser Diode Structures and Radiation Patterns.

**Module III (8 Hours)**

Detectors: PIN Photo-Detector, Avalanche Photodiodes, Photo-Detector Noise, Depletion Layer Photocurrent, Response Time, Avalanche Multiplication Noise, Photodiode Materials.

**Module IV (8Hours)**

Kepler's Law, Satellite Orbits, Spacing and Frequency Allocation, Look Angle, Satellite Launching, Earth Station, Satellite Subsystems, Satellite System Link Models, Link Equations.

**Module V (7 Hours)**

Multiple Access, Direct Broadcast Satellite Services, Application of LEO, MEO and GEO Satellites.

**Text Books:**

1. Optical Fiber Communications by Gerd Keiser, 4th Edition, McGraw-Hill International Editions.

2. Satellite Communications by Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, Wiley Student Edition.

**Course Outcomes**

Upon completion of the course, the students will:

| | |
|---|---|
| CO1 | Express the basic concept of optical fiber communication system. |
| CO2 | Create basic communication system using principles of optical sources and its working. |
| CO3 | Apply basic principles of optical detector in construction of basic communication system. |
| CO4 | Analyze the basic principles of the satellite systems. |
| CO5 | Demonstrate various application of satellite systems. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# MOBILE COMMUNICATION (BELPE603)

**SYLLABUS**

**Module – I(8 Hours)**
Cellular Communications : The Cellular Engineering Fundamentals : Introduction, Cell, Frequency Re-use, Channel Assignment Strategies, Fixed and Dynamic Channel Assignment Strategies, Handoff Process, Factors affecting Handoff Process, Handoff Strategies, Few practical cases of Handoff Scenario, Interference and System Capacity, Co-channel Interference (CCI), Adjacent Channel Interference (ACI), Cell Splitting, Sectoring, Microcell Zone concept, Repeaters, Trunked Radio System.

**Module –II(8 Hours)**
Wireless Communications and Diversity, Fast Fading Wireless Channel Modelling, Rayleigh/Rican Fading Channels, BER Performance in Fading Channels, Diversity modelling for Wireless Communications, BER Performance Improvement with diversity.

**Module – III(8 Hours)**
Types of Diversity – Frequency, Time, Space Broadband Wireless Channel Modelling ,WSSUS Channel Modelling, RMS Delay Spread Doppler Fading, Jakes Model, Autocorrelation Jakes Spectrum Impact of Doppler Fading.

**Module – IV(8 Hours)**
Multiple Access Technologies: Narrowband Systems, Wideband Systems, Frequency Division Multiple Access, Time Division Multiple Access, Spread Spectrum Multiple Access, Space Division Multiple Access, Code Division Multiple Access, OFDM.

**Module – V(7 Hours)**
Cellular networks: Global system for mobile telecommunication, general packet radio service, edge technology, CDMA based standards: IS-95 CDMA 2000, wireless local loop, IMT – 2000 and UMTS, long term evaluation, mobile satellite communication

**Text Books:**
**1.**Wireless Communications., by T. S. Rappaport, Pearson.
2. Wireless Communication Networks, 1st Edition by Upenadalal, Oxford university press.

**Reference Books:**
1. Mobile Cellular Communication, 1st Edition by Gottapu Sasibhushana Rao, Pearson publication.

**Course Outcomes**
Upon completion of the course, the students will:

| | |
|---|---|
| CO1 | Express the basic concept of mobile communication. |
| CO2 | Demonstrate principles of wireless channels and modelling. |
| CO3 | Analyze the concept of diversity and fading. |
| CO4 | Apply basic principles of multiple access technologies. |
| CO5 | Implement principles of various cellular networks. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# WIRELSS COMMUNICATION (BELPE602)

**Module I (8 Hours)**

Wireless communication fundamentals: Fundamental terms of communication, General model for wireless digital communication link, bandwidth, types of signals, types of communications systems, wired versus wireless media, Types of wireless system, cellular systems, cellular networks, existing technologies, and evaluation of wireless systems, licensed and unlicensed bands for existing wireless systems.

**Module II (8 Hours)**

Cellular theory: Introduction, cellular infrastructure, cellular systems components, antennas for cellular systems, operation of cellular systems, channel assignment, cellular interference, sectorization, mobile traffic calculation, spectrum efficiency of cellular systems, location management.

**Module III (8 Hours)**

Wireless channels and modelling: Radio propagation over wireless channel, Radio communication cases, free Space propagation model, Ground wave propagation, Ionospheric propagation, Torospheric propagation, channel noises and losses, fading in land mobile systems, fading effects on signal and frequency components, shadowing, signal outages and fading margin.

**Module IV (8 Hours)**

Networking fundamentals: Wireless networks, open system interconnection reference model, transmission control protocol/internet protocol stack, peer to peer communication, transmission control protocol/internet protocol headers, medium access control, routing algorithms, transport control mechanisms, security aspects, application layers, mobile computing

**Module V(7 Hours)**

Cellular networks: Global system for mobile telecommunication, general packet radio service, edge technology, CDMA based standards: IS-95 CDMA 2000, wireless local loop, IMT – 2000 and UMTS, long term evaluation, mobile satellite communication

**Text Books:**

**1.**Wireless Communications., by T. S. Rappaport, Pearson.

2. Wireless Communication Networks, 1st Edition by Upenadalal, Oxford university press.

**Reference Books:**

1. Mobile Cellular Communication, 1st Edition by Gottapu Sasibhushana Rao, Pearson publication.

**Course Outcomes**

Upon completion of the course, the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Express the fundamental concept of wireless communication. |
| CO2 | Demonstrate cellular concept of wireless communication. |
| CO3 | Analyze the principles of wireless channels and modelling. |
| CO4 | Apply fundamentals of wireless networking. |
| CO5 | Implement principles of various cellular networks. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 2 | 1 | 2 | - | - | - | - | - | 1 |

# OPTICAL AND SATELLITE COMMUNICATION (BELPE604)

**SYLLABUS**

**Module I (9 Hours)**

Overview of optical fiber communications: Optical spectral bands, Fundamental of data communication concepts, WDM concepts, Key elements of optical fiber systems, Standards for optical fiber communications.

Optical fiber modes and configurations: Single-mode fibers, Graded-index fiber structure, Fiber materials.

**Module II (9 Hours)**

Signal degradation in optical fibers: Attenuation, Signal distortion of single- mode fibers, Characteristics of single-mode fibers.

Optical sources: LED and LASER Diodes, PIN Photo Detector, Avalanche Photo Diode, Optical Fiber System Link Budget.

**Module III (6 Hours)**

Orbital mechanics and launchers: Orbital mechanics, Look angle determination, Orbital perturbations, Orbital determination, Launches and launch vehicles, Orbital effects in communications systems performance.

**Module IV (9 Hours)**

Satellite Launching, Earth Station, Satellite Subsystems, Satellite System Link Models, Link Equations.

**Module V (6 Hours)**

Multiple Access, Direct Broadcast Satellite Services, Application of LEO, MEO and GEO Satellites.

**Text Books:**

1. Optical Fiber Communications by Gerd Keiser, 4th Edition, Mc Graw-Hill International Editions.

2. Satellite Communications by Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, Wiley Student Edition.

**Course Outcomes:**

Upon the completion of the course, the students will able to:

| | |
|---|---|
| CO1 | Express the basic structures of optical fiber and types. |
| CO2 | Create basic communication system using principles of optical sources and detectors. |
| CO3 | Analyze the basic principles of the satellite systems. |
| CO4 | Analyze theprinciples of the satellite launching and Link Model. |
| CO5 | Demonstratevarious application of satellite systems. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 2 | 1 | 2 | - | - | - | - | - | 1 |

# Professional Elective – III

## SIGNALS & SYSTEMS-II (BELPE605)

| **Course Name** | **SIGNALS & SYSTEMS-II** |
|---|---|
| Course code | UPE-III |
| Session of Course | Jan-June |
| L:T:P | 3 : 0 : 0 |
| Semester | VI |
| Credits | 3 |

**Module-I (8 hours)**

**Discrete time signal and system:** discrete- time signals (some elementary examples, classification of discrete-time signals), discrete- time system (block diagram representation, classification and interconnection of discrete time system), analysis of discrete time linear time-invariant system (response of LTI systems to arbitrary inputs, properties of convolution and interconnection of LTI systems, casual linear time-invariant systems, stability of linear time-invariant system), discrete-time systems described by difference equations, structure of LTI system, recursive and non-recursive realization of FIR systems, correlation of discrete time system.

**Module-II (8 hours)**

**The Z-transform:**The Z-transform, properties of Z-transform, inverse of Z-transform, the one-sided Z-transform.

**The Discrete Fourier transform:** frequency domain sampling, the DFT, relationship of DFT to other transforms, properties of the DFT, circular convolution, circular correlation, circular correlation by convolution, method linear convolution by overlap save method and by overlap add method.

**Module-III (8 hours)**

**Fast Fourier transform:** operation counts by direct computation of DFT, divide and conquer approach to computation of the DFT, radix-2 FFT algorithm, decimation-in-time (DIT) and decimation-in frequency (DIF) algorithm, efficient computation of the DFT of real sequences and a 2N-point real sequence.

**MODULE-IV (7 hours)**

**Design of digital filter:** causality and its implementation, design of linear phase FIR filters using different windows, design of IIR impulse response method and bilinear transformation method.

**MODULE-V (8 hours)**

**Power spectrum estimation:**Estimation of spectral from finite duration signals, Non-parametric method of power spectrum estimations. The Bartieff method and the Blackman and Tukey method. Implementation of Discrete Time System structure of FOR Systems-Direct form, cascaded form. Structure IIR Systems - Direct form 1&11 realizations.

**TEXT BOOKS**

[1]. J.G. Proakis and D.G.Manolakis, "Digital Signal Processing - Principles, Algorithms and Applications", PHI Publisher.

[2]. SanjitMitra "Digital Signal Processing – A Computer based approach" TMH Publisher.

**REFERENCE BOOKS**

[1]. S.Salivahanan, "Digital Signal Processing", TMH Publisher.

[2]. J.R.Johnson, "Introduction of Digital Signal Processing", PHI Publisher.

**Course Outcomes:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Define the basic concept of Discrete Time Signal, System and characterize Discrete Time LTI system. |
| CO2 | Incorporate the fundamental principles of Z transform and Discrete Fourier Transform along with their properties. |
| CO3 | Implement new concept of computing DFT with Fast Fourier Transform |
| CO4 | Plan various designing techniques and implementation of IIR/FIR Digital Filters. |
| CO5 | Analyze the concept of Power Spectrum Estimation of Discrete Time Signal. |

**Course Articulation Matrix**

| | **PO1** | **P1** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |
| **CO2** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |

# DIGITAL IMAGE PROCESSING (BELPE606)

| Course Name | DIGITAL IMAGE PROCESSING |
|---|---|
| Course code | UPE-III |
| Session of Course | Jan-June |
| L:T:P | 3 : 0 : 0 |
| Semester | VI |
| Credits | 3 |

**SYLLABUS:**

**Module I** **(9 Hours)**

Digital Image Fundamentals: Components of image processing system, image fundamentals, image sampling and quantization, basic relationships between pixels, color image fundamentals – RGB, YC bCr, HSI models, 2D-transforms – DFT, DCT, KLT, slant transform, Hough transform, Properties of transforms and applications, Fundamentals on wavelet transform.

**Module II** **(9 Hours)**

Image Enhancement: Enhancement in spatial domain: basic gray level transformations, histogram processing, smoothing and sharpening of spatial filters. Enhancement in frequency domain: Introduction to filtering in frequency domain, smoothing and sharpening of frequency domain filters.

**Module III** **(6 Hours)**

Image Restoration: Degradation model, restoration in presence of noise only – spatial filtering, linear, position invariant degradations, estimating degradation functions, inverse filtering, Wiener filtering.

**Module IV** **(9 Hours)**

Image compression: Redundancy and compression models, Lossless coding – Run length coding, Huffman coding, vector quantization, JPEG, concepts of fractals, fractal image compression.

**Module V** **(6 Hours)**

Image segmentation: Edge detection, Boundary description, Morphological image processing, Region based segmentation – region growing, region merging and splitting.

**Text Books:**


1. Rafael C. Gonzalez, Richard E. Woods, ‘Digital Image Processing', Pearson, Second Edition,2004.
2. Anil K. Jain, ‘Fundamentals of Digital Image Processing', Pearson 2002.


**Reference Books:**


1. Rafael C. Gonzalez, Richard E. Woods,' Digital Image Processing usingMATLAB', Pearson Education, Inc., 2004.
2. William K. Pratt, ‘Digital Image Processing’, John Wiley, New York, 2002.

**Course Outcomes:**

Upon completion of the subject the students will:

| | |
|---|---|
| CO1 | Analyse general terminology of digital image processing. |
| CO2 | Analyse various types of images, wavelet transformations and compression techniques. |
| CO3 | Analyse the methodologies for image segmentation, restoration, etc. |
| CO4 | Implement image process and analysis algorithms. |
| CO5 | Apply image processing algorithms in practical applications |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 2 |

# INDUSTRIAL AUTOMATION AND CONTROL (BELPE608)

| Course Name | INDUSTRIAL AUTOMATION AND CONTROL |
|---|---|
| Course code | UPE-III |
| Session of Course | Jan-June |
| L:T:P | 3 : 0 : 0 |
| Semester | VI |
| Credits | 3 |

**Syllabus:**

**MODULE-I (7 Hours)**

Introduction to process dynamics, its type and classifications. Control actions and controller tuning: Basic control actions-on/off, P, P+I, P+I+D, floating control, pneumatic and electronic controllers, controller tuning.

**MODULE-II (7 Hours)**

Introduction to PLC, PAC, DCS and SCADA. IEDs, RTUs, HMI, Smart Sensors and Actuators. Communication Networks for PLC. The Instrument Lists of PLC and HMI. System Architecture, Programming languages of PLC, Relay logic and Ladder logic, Ladder Diagram Elements.

**MODULE-III (9 Hours)**

Computer controlled processes: PLC based control of different types of processes such as liquid level system and flow control, open-and-closed chamber pressure control, temperature control, different types of heat exchangers.

**MODULE-IV (9 Hours)**

Physical Ladder Diagram and Programmable Ladder Diagram.Case Studies: frost free refrigerator / freezer system; composite discrete / continuous control; conveyor system; oven system; elevator system; uniformly heated liquid control system, and hydro-phonic system.

**MODULE-V (7 Hours)**

Advances in Automation: Programmable Automation Controllers. NI my-DAQ, my-RIO, c-RIO, and ELVIS. IEEE 802.11 / 15 Standards, IEEE 1451.5 Std. Role of Internet of Things and Cyber Physical System in Industry Automation, MQTT protocol.

**Books:**


1. Peter D. Harriot, "Process Control", Tata McGraw-Hill, New Delhi, 2009.
2. Liptak, H. "Process Control: Instruments Engineer's Handbook", Butterwirth Heinemann, 1995.
3. Curtis D. Johnson, "Process Control and Industrial Technology", Pearson India, 8th ed., 2012.


**Reference books:**


1. Norman A Anderson, "Instrumentation for Process Measurement and Control", CRC Press, 2018.
2. B. Wayne Bequette, "Process Control – Modeling, Design, and Simulation", Pearson India, 2015.
3. John W. Webbs, "Programmable Logic Controllers – Principals and Applications", fifth Edition, Pearson India /PHI (Old edition), 2012.


**Course Outcomes:**

Upon completion of the subject the students will:

| | |
|---|---|
| CO1 | Understand the basic principles and importance of process control applications using automation; |
| CO2 | Enlist the required instrumentation, knowledge of the P&ID, the Instrumentation Lists, and final elements to ensure that well-tuned control is achieved; |
| CO3 | Demonstrate the student's ability to pursue a career in electrical engineering, control systems, automation platforms through a diverse range of theoretical skills and practical experience of real time applications; |
| CO4 | Plan, design, install, operate, control and maintain different process and automated applications using PLCs/PACs. Further, PLC / PAC algorithm using Ladder Logic Diagram or equivalent languages while handling a plant process; |
| CO5 | Implement an automation platform such as PACs and IoT while handling a plant process. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 3 | 2 | 1 | - | - | - | - | - | 2 |

# ELECTROMAGNETIC FIELD THEORY (BELPE607)

**Syllabus**

**MODULE I(10 Hours)**

Fields due to Different Charge Distributions, Gauss Law and Applications, Electric Potential, Relations Between E and V, Energy Density.

Convection and Conduction Currents. Continuity Equation, Polarization of Dielectrics, Boundary Conditions. Poisson's and Laplace's Equations; Capacitance.

**MODULE II(8 Hours)**

Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Flux Density. Magnetic Scalar and Vector Potentials. Forces due to Magnetic Fields. Magnetic Boundary Conditions. Inductance& Mutual Inductance.

Faraday's Law and Transformer EMF, Displacement Current Density, Maxwell's Equations.

**MODULE III(8 Hours)**

Uniform Plane Waves, Wave Equations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics. Wave Polarization.

Reflection and Refraction of Plane Waves – Normal and Oblique Incidences for both Perfect Conductor and Perfect Dielectrics.

**MODULE IV(8 Hours)**

Poynting Vector and Poynting Theorem – Applications. Types, Parameters, Transmission Line Equations, Primary &Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts.

**MODULE V(6 Hours)**

Introduction To Waveguides, TE Modes, Waveguide Equation, Cut-Off Frequency. Elements of Antenna Theory.

**TEXT BOOKS:**


1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 4th Edition, Oxford University Press Inc. First India edition, 2009.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill 8th Revised edition, 2011.


**REFERENCE BOOKS**


1. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.
2. Bhag Singh Guru and Hüseyin R. Hiziroglu "Electromagnetic field theory Fundamentals", Cambridge University Press; Second Revised Edition, 2009.

**Course Outcomes:**

Upon completion of the course, the students will:

| | |
|---|---|
| CO1 | Implement the concepts of electrostatics, electrical potential, energy density and their applications |
| CO2 | Implement the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications. |
| CO3 | Apply the concepts of Faraday's law, induced emf and Maxwell's equations. |
| CO4 | Express concepts of Poynting theorem and operation of transmission lines |
| CO5 | Compile the basic principles of waveguides and antenna. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# Sessional

## SIGNALS & SYSTEMS LAB-II (BEL06003)

(Use MATLAB CONTROL SYSTEM and SIGNAL PROCESSING TOOL BOXES)

1. Computation of DFT and IDFT using MATLAB.
2. Computation of NDFT and inverse INDFT using FAST FOURIER TRANSFORM.
3. Prove the general properties of DFT: a) Linearity (b) Circular time shifting (c) Circular frequency shifting, (d) duality (e) N-Point Circular Convolution(f) Modulation and (g) Parseval's relation.
4. Structure Simulation and Verification.
5. Design of FIR filters (high and low pass) and plot their gain responses.
6. Design of second order IIR band pass and IIR notch filter and plot their magnitude responses.
7. Realization of G (z) in Cascade and parallel forms.
8. Design of Butterworth, low pass filter and Chebyshev low pass filter using the bilinear transformation method.

**Course Outcomes:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Write programe to compute the N-point DFT and IDFT using Discrete Fourier Transform. |
| CO2 | Write programe to compute the N-point DFT and IDFT using Discrete Fourier Transform. |
| CO3 | Define and execute the basic properties of DFT. |
| CO4 | Design and implement IIR filter using bilinear transformation and Impulse Invariant Technique. |
| CO5 | Plan the construction of FIR and IIR filter. |

**Course Articulation Matrix**

| | **PO1** | **P1** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |
| **CO2** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |

# CONTROL SYSTEM LABORATORY (BEL06004)

**Syllabus:**

**List of Experiments**

1. Study of a two-phase AC servomotor and its transfer function parameters.
2. Find the frequency response of a Lag and Lead compensator.
3. To observe the time response of a second order process with P, PI, PID control and apply PID control to a DC servomotor.
4. To study the characteristic of a relay and analyze the relay control system (Phase Plane).
5. Study of a linear system simulator.
6. Study of feedback characteristic using Amplidyne.
7. To study digital control of a simulated system using an 8-bit microprocessor.
8. Study of a Data Acquisition System.
9. Study of Synchro-transmitter & synchro-transformer.

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Incorporate the tuning of analog and digital PID controller |
| CO2 | Analyze the servo problem and able to find out the transfer function of a system experimentally. |
| CO3 | Demonstrate frequency response of a Lag and Lead compensator and analyze the relay control system experimentally. |
| CO4 | Analyze linear system and feedback characteristic using Amplidyne. |
| CO5 | Analyze the working of data acquisition systems ,Synchro-transmitter & synchro-transformer. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | 1 |

## CAD OF ELECTRICAL APPARATUS (BEL06005)

**Syllabus:**

**List of Experiments**

1. Design and simulation of DC generator system.
2. Design and simulation of DC motor system.
3. Design and simulation of three-phase induction motor system with variable mechanical torque/speed.
4. Design and simulation of an alternator.
5. Design and simulation of synchronous motor.
6. Design and simulation of a single-phase transformer (both in normal operation and in fault condition).
7. Design and simulation of 1-phase bridge rectifier (un-controlled and controlled) in MATLAB.
8. Design and simulation of 3-phase bridge rectifier (un-controlled and controlled) in MATLAB.
9. Design and simulation of Buck/Boost DC-DC converter.
10. Design and simulation of single-phase inverter with PWM control.
11. Design and simulation of three-phase inverter with PWM control.
12. Design and simulation of single-phase AC voltage controller.

**Course Outcomes:**

Upon completion of the subject the students will:

| | |
|---|---|
| CO1 | Define function of basic block sets of different simulation platform used in electrical system design. |
| CO2 | Demonstrate capability to model electrical circuits. |
| CO3 | Construct and implementexperiments, as well as to analyse and interpret results. |
| CO4 | Apply knowledge for design different converter circuits using soft computing techniques. |
| CO5 | Develop and incorporate power electronics to different drives. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 2 |

# Seventh Semester

## POWER SYSTEM-III (BEL07001)

**SYLLABUS:**

**MODULE-I (8 HOURS)**

Philosophy of protection, Nature, Causes and consequences of faults, Zone of protection, Requirements of a protective scheme, Basic terminology components of protection scheme.

Circuit Breakers: Formation of arc during circuit breaking, theories of arc Interruption, recovery and re-striking voltage, interruption of capacitive and inductive currents, current chopping, circuit breaker rating

**MODULE-II (8 HOURS)**

Different types of circuit breakers, air break and air blast circuit breaker, Plain break and controlled break all circuit breakers, minimum oil circuit breakers, vacuum circuit breaker, SF6circuit breaker. D.C. Circuit breaker.

Relay: classification, principle of different types of electromagnetic relay, general equation of phase and magnitude comparators, Duality of comparators, Electromagnetic relays, over current relays Directional relays, Distance relay- impedance, Reactance and Mho type, Differential relays.

**MODULE-III (8 HOURS)**

Concept of static and numerical relay, Feeder Protection, Generator Protection, Transformer Protection, Bus Zone Protection.

Z bus Algorithm, Symmetrical and unsymmetrical fault analysis for power system, Z bus method in fault analysis.

**MODULE-IV (8 HOURS)**

Arrangement of Bus bar, Arrangement of Circuit breaker and isolator, Current limiting reactors in power system and their arrangement calculation of fault MVA for symmetrical short circuits. Circuit breaker capacity.

**MODULE-V (8 HOURS)**

Power System Stability, Steady State Stability, Transient stability, Swing equation, Equal area criterion for stability, Critical clearing angle, point by point Methods of improvement of transient stability, Voltage stability, concept, causes and counter measures, Load frequency control, PF versus QV control

**Books:**

[1] Ravindranath, M. Chander, "Power System Protection and SwitchGear", Wiley Eastern Ltd. New Delhi.

[2] John J Grainger, W. D. Stevenson, "Power System Analysis", TMH Publication.

[3] P. Kundur, "Power System Stability and Control", TMH Publication.

[4] Van C Warrington, "Protective Relays", Vol.-I & II.

## COURSE OUTCOMES:

Upon completion of the subject, the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Express the basics of power system protection and demonstrate working of different types of switchgear equipment's like circuit breaker and relays. |
| CO2 | Incorporatedifferent types of circuit breakers and relays according to the requirement. |
| CO3 | Apply suitable protection scheme according to the system requirements. |
| CO4 | Organizethe placement of different switch gear equipment and analyze the system fault. |
| CO5 | Define the stability of power system. |

### Course Articulation Matrix

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

### Program Articulation Matrix row for this Course

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 1 |

# HIGH VOLTAGE ENGINEERING (BEL07002)

**Syllabus:**

**MODULE-I (9 HOURS)**

*Conduction and breakdown in gases*: Ionisation processes. Townsend current growth equation. Current growth in the presence of secondary processes. Townsend's criterion for breakdown. Experimental determination of ionization coefficients. Breakdown in electronegative gases, time lags for breakdown, streamer theory of breakdown in gases, Paschen's law, Breakdown in non-uniform field and corona discharges, Penning effect, Vacuum breakdown.

**MODULE-II (7HOURS)**

*Conduction and breakdown in liquid dielectrics*: Pure liquids and commercial liquids, conduction and breakdown in liquids.

*Breakdown in solid dielectrics*: Introduction, Intrinsic brakdown. Electromechanical breakdown, Thermal breakdown. Solid dielectrics in practice. Applications of nanofilled materials for outdoor and indoor insulation

**MODULE-III (8 HOURS)**

*Generation of high voltages and currents*: Generation of high D.C, voltages, Generation of high alternating voltages, Generation of Impulse voltages. Tripping and control of impulse generators. Generation of Impulse currents.

**MODULE-IV (7 HOURS)**

*Measurements of high voltages and currents*: Measurement of high D.C. voltages. Measurement of high D.C. and impulse voltages. Introduction.. Measurement of high D.C. A.C. and impulse currents, cathode ray oscillographs for impulse voltages and currents measurements.

**MODULE-V (8 HOURS)**

*High voltage testing of electrical power apparatus*: Testing of insulators and bushings. Testing of isolators and circuit breakers, cables. Testing of transformers, surge diverter

*Non destructive testing of materials and electrical apparatus*: Introduction. Measurement of D.C. resistivity. Measurement of dielectric constant and loss factor. Partial discharge measurements.

Radio Interference measurements.

**BOOKS**

1. M.S. Naidu and V. Kamaraju, *High Voltage Engineering*, Tata McGraw-Hill, 5th Edition, 2018.

2.E.Kuffel, W.S. Zaengl, and J.Kuffel "High Voltage Engineering Fundamentals", Second edition 2000, published by Butterworth-Heinemann

3.C.L.Wadhwa, "High Voltage Engineering", Third Edition, New Age International Publishers, 2012

**References**

1.Hugh M.Ryan,(ed) "High Voltage Engineering & Testing", 3rd Edition, The Institution of Engineering and Technology, IET series. 2001

2. M. Abdel-Salam, H. Anis, A. El-Morshedy, R. Radwan, High-Voltage Engineering – Theory and Practice, 2nd edition, Marcel Dekker, Inc,(Special Indian Edition) 2010.

**Course Outcomes:**

After successful completion of this course, the students will be able to:

| | |
|---|---|
| CO1 | Estimate various types of insulating materials (gaseous, liquids, solids, vacuum, composites) and their applications in high-voltage equipment. |
| CO2 | Compute the breakdown strength of air, solid and liquid insulation |
| CO3 | Describe the principles behind generating high voltage and high current. |
| CO4 | Develop equivalent circuit diagram for measurement of high voltage and current for testing purposes. |
| CO5 | Perform testing high voltage electrical equipments with various testing devices |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# PROFESSIONAL ELECTIVE-IV

## POWER QUALITY (BELPE702)

**SYLLABUS**

**MODULE-I (8 HOURS)**

Introduction to power quality, PQ Definitions, PQ Phenomena Classification Identification and localization of PQ problems Different PQ classification techniques and case studies . Voltage Sag, Swell and Interruptions, Transient Over-voltages, Sources of Sags and Interruptions.

**MODULE-II (8 HOURS)**

Harmonic Sources, Effects, Analysis, and Modeling, Harmonic Distortion Mitigation Voltage vs. Current Distortion, Harmonics vs. Transients Harmonic Sources from Commercial and Industrial Loads, Time domain versus frequency domain Different Harmonic filters (passive, active and hybrid); and case studies.

**MODULE-III (8 HOURS)**

Standards General Classification of PQ Phenomena IEEE and IEC PQ Standards, PQ Monitoring and Measuring Available monitoring techniques and their drawbacks Commercial power quality monitors, Power quality monitors sensitivity PQ Problems Identification.

**MODULE-IV (8 HOURS)**

Fundamental Principles of Protection, Motor-Starting Sags, Utility System Fault-Clearing. Issues, and Case Studies, Sources of Transient Overvoltages; Principles of Overvoltage Protection and Switching Transient Problems with Loads.

**MODULE-IV (8 HOURS)**

Voltage Flicker, Voltage Unbalance, Voltage Regulation Sources of voltage flicker; Effects and mitigation techniques Sources of voltage unbalance; Effects and mitigation techniques Devices for Voltage Regulation; Utility Voltage Regulator Application and End-User Capacitor Application.

**BOOKS**

[1]. R. Dugan, M. Mc Granaghan, S. Santoso and H. Beaty, Electrical Power System Quality, Second Edition, McGraw-Hill, 2002, ISBN 0-07-138622-X.

[2]. J. Arrillaga, B. Smith, N. Watson and A. Wood, Power System Harmonic Analysis, John Wiley, 1997, ISBN 0-471-97548-6.

[3]. Understanding Power Quality Problems by Math H. Bollen

[4]. J. Arrillaga, Power System Quality Assessment., John wiley, 2000

[5]. R. SastryVedam, M. S. Sarma , " Power Quality: VAR Compensation in Power System " CRC Press , Taylor and Francis group , 2008

**Course Outcomes:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Evaluate the reasons for increased concern for power quality issues in power systems |
| CO2 | Express the benchmarking process in power quality sector |
| CO3 | Analyze and solve the issues in power quality improvement |
| CO4 | Implement the various monitoring methods used in power quality issues |
| CO5 | Compile Plan of controlling the power quality issues. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# ELECTRICAL& ELECTRONICS ENGINEERING MATERIALS (BELPE705)

**Syllabus**

**MODULE-I (8HOURS)**

**Conductivity of Metal:** Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, energy levels of a molecule, emission of electrons from metals, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials, thermal properties, thermal conductivity of metals, thermoelectric effects

**MODUL-II (8HOURS)**

**Dielectric properties:** Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, significance of the loss tangent, dipolar relaxation, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulation materials, ferroelectricity, piezoelectricity.

**MODUL-III (8HOURS)**

**Magnetic properties of Materials:** Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance.

**MODUL-IV (8HOURS)**

**Semiconductors:** energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, the Einstein relation, hall effect, thermal conductivity of semiconductors, electrical conductivity of doped materials.

**MODUL-V (7HOURS)**

**Measurement of Electrical and Magnetic Properties:** Introduction, Conductivity measurement, Dielectric measurement, Magnetic measurement, Measurement of semi-conductor parameters.

**TEXT BOOK**

[1]. C.S.Indulkar and S.Thiruvengadam, S, An introduction to Electrical Engineering Materials S.Chand and Company Ltd. Publisher.
[2]. Kenneth g.Budinski', Engineering Materials PHI. Publisher.

**REFERENCE BOOKS**

[1]. S.P.Seth, A Course in Electrical Engineering Materials Dhanpat Rai Publisher.
[2]. Technical Teachers Training institute, Madras, Electrical Engineering Materials TMH Publisher.

**Course Outcomes**

Upon completion of the course, the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Define various aspects of conductivity of material. |
| CO2 | Understand dielectric properties of material. |
| CO3 | Understand magnetic properties of material. |
| CO4 | Define factors affecting properties of material. |
| CO5 | Apply the measurement techniques for properties of materials. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# ALTERNATIVE ENERGY SOURCES (BELPE703)

**Syllabus**

## MODULE-I (6 HOURS)

The energy portfolio, aspects of energy production and consumption; the energy life cycle; Local, regional and global environmental effects of energy; Measures of Sustainability. Energy carriers: Electricity and Hydrogen Fuel; Energy Management, Technologies for energy storage.

## MODULE-II (10 HOURS)

**Solar thermal energy conversion technologies:** Nature of solar radiation; Isolation; Measurements and estimation; Physical principles of conversion of solar radiation into heat; energy balance equation and collector efficiency, concentrating collectors and flat plate collectors, solar thermal electric power generation.

**Solar photo voltaic systems:** System components and configurations, cells, modules, and arrays, batteries, charge controllers, inverters, system sizing, mechanical integration, electrical integration, utility interconnection.

## MODULE-III (10 HOURS)

**Wind energy:** Wind characteristics, data analysis and resource estimation; Wind turbine power curves; Measurement of wind velocity and direction; Wind turbine configurations- drag and lift types; Wind Energy Conversion System Topologies; Wind turbine control; Wind turbine sitting considerations.

**Bio mass energy:** Possibilities of energy provision from biomass; generations of biomass, Thermo-chemical conversion, Physical-chemical conversion, Bio-chemical conversion; Classification of biogas plants– floating drum type and fixed dome type; Biomass gasifiers; Gasification process, application of gasifiers for electricity generation.

## MODULE-IV (7 HOURS)

**Tidal power:** Tidal phenomena, historical background, basic aspects of tidal power development and tide mills; Tidal power project components; Design considerations- Selection of tidal power sites, feasible tidal range, preliminary design and productivity considerations; Tidal barrier construction techniques-dikes, types of float in modules, concrete caissons.

**Energy from Ocean Waves and Ocean thermal energy conversion technologies:** Basic principle, Resource Estimation, System components.

## MODULE-V (6 HOURS)

Geothermal energy sources, geothermal exploitation, prime-movers for geothermal energy conversion system, material selection for geothermal power plants, flashed steam and total flow concept, geothermal power plant layout, other sources and latest trends.

**TEXT BOOKS**

[1] Sustainable Energy- J.W. Tester, E.M. Drake, M. J. Driscoll, M. W. Golay, W. A. Peters, MIT Press, 2nd Edition.

[2] Renewable Energy Resources by John Twidell, Tony Weir, Routledge, 3rd Edition.

**REFERENCE BOOKS**

[1] Renewable energy technologies - R. Ramesh, Narosa Publication.

[2] Non-Conventional Sources of Energy- G.D. Rai, Khanna Publishers.

[3] Renewable energy sources and emerging technologies-D.P. Kothari, K.C. Singal, and R. Ranjan, PHI Learning Pvt. Ltd.

**Course Outcomes**

Upon completion of the subject the students will:

| | |
|---|---|
| CO1 | Incorporate the measures of sustainability and energy management concept. |
| CO2 | Aware about solar PV and solar thermal systems. |
| CO3 | Implement the wind and biomass energy systems |
| CO4 | Analyze the tidal and wave energy systems. |
| CO5 | Compile the data about Geothermal energy systems and latest developments. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 3 | 3 | - | - | - | - | 2 |

# ILLUMINATION ENGINEERING (BELPE704)

**SYLLABUS**

**Module-I(8 hours)**

Radiation, colour, eye & vision; different entities of illuminating systems; Light sources: daylight, incandescent, electric discharge, fluorescent, arc lamps and lasers

**Module-II(8 hours)**

Luminaries, wiring, switching & control circuits.

Laws of illumination; illumination from point, line and surface sources. Photometry and spectrophotometry; photocells. Environment and glare. General illumination design.

**Module-III(8 hours)**

Interior lighting – industrial, residential, office departmental stores, indoor stadium, theater and hospitals.

Exterior lighting- flood, street, aviation and transport lighting, lighting for displays and signaling- neon signs, LED-LCD displays beacons and lighting for surveillance.

**Module IV (8 hours)**

Utility services for large building/office complex & layout of different meters and protection units. Different type of loads and their individual protections.

**Module-V (8 hours)**

Selection of cable/wire sizes; potential sources of fire hazards and precautions. Emergency supply – standby& UPS. A specific design problem on this aspect.

**Text Books:**

1. Electrical Illuminating Engineering by William Edward Barrows, McGraw Hill.
2. Industrial Power Distribution and Illuminating System by Kao Chen, CRC Press.

**Course Outcomes:**

Upon completion of the course, the students will:

| | |
|---|---|
| CO1 | Implement basics of light technology. |
| CO2 | Develop different laws of illumination. |
| CO3 | Express the interior and exterior light system. |
| CO4 | Implement different lighting system design and its protection. |
| CO5 | Implement specific design problem of lighting system and precautions. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | 3 | - | - | - | - | 2 |

# HVDC TRANSMISSION (BELPE701)

## SYLLABUS

**Module-I (8 Hours)**

Introduction, Comparison of AC and DC transmission, Application of HVDC Transmission, Description of HVDC transmission systems, Planning of HVDC transmission, Power carrying capability of AC and DC lines, Modern trends in HVDC transmission, Research and development.

HVDC Converters: Basic conversion principle, Selection of converter configuration, Rectifier operation, Converter bridge characteristics, Inverter operation, twelve pulse converter, Converter harmonics.

**Module-II (8 Hours)**

Converter and HVDC control: Principle of DC link Control, Converter control characteristics, System control Heirarchy, Firing angle control, Current and extinction angle control, Reversal of dc power flow, Modification to the basic characteristics, Tap changer control, different control levels, power flow control, Telecommunication requirements.

**Module-III (7 Hours)**

Muliterminal HVDC: Application, Types of MTDC systems, Control and protection of MTDC systems, Study of MTDC systems.

**Module-IV (8 Hours)**

Converter Faults and Protection: Introduction, Converter faults, Protection against over currents, Over voltages in Converter station, Surge arresters, Protection against over voltages.

**Module-V (8 Hours)**

Harmonics and Filter: Introduction, Generation of Harmonics, Design of AC filters, Design criteria, design factors, network impedance, circuit modeling, Tuned filter, self-tuned filters, High pass filters, Type C damped filters, DC filters, Alternative methods of harmonic elimination, Magnetic flux compensation, Harmonic injection, Ripple injection, Carrier frequency and RI Noise.

**Text Book**

[1]. Padiyar K. R., "HVDC power transmission System", Willey Eastern Ltd. Publisher.

**Reference Books**

[1]. Arrillaga J., "High Voltage direct current transmission", Peter Peregrinus Publisher, London.

[2]. Kimbark E. W., "Direct Current transmission", vol. 1, John Wiley Publisher.

**Course Outcomes:**

Upon completion of the subject the students will:

| | |
|---|---|
| CO1 | Develop the knowledge of HVDC transmission and HVDC converters and the applicability and advantage of HVDC transmission over conventional AC transmission |
| CO2 | Analyze the different control strategy of converters for HVDC power flow control. |
| CO3 | Analyze the Multi terminal HVDC transmission. |
| CO4 | Study and understand the Converter Faults and Protection. |
| CO5 | Formulate and solve the AC and DC filters for harmonic elimination. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 2 | 1 | 2 | - | - | - | - | - | 2 |

# SEMINAR ON INTERNSHIP

| **Course Name** | **SEMINAR ON INTERNSHIP** |
|---|---|
| Course code | USI |
| Session of Course | Jul-Dec |
| L:T:P | 0 : 0 : 3 |
| Semester | VIII |
| Credits | 1.5 |

**Course Outcomes**

Upon completion of the subject the students will have:

| | |
|---|---|
| CO1 | An ability to work in actual working environment |
| CO2 | An ability to utilize technical resources. |
| CO3 | An ability to identify, analyze engineering problems. |
| CO4 | An ability to learn the skills to use modern engineering tools, software's and equipment to analyze problems. |
| CO5 | An ability to write technical documents and give oral presentations related to the work completed. |

**Course Articulation Matrix**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

# PROJECT-I

| Course Name | PROJECT-I |
|---|---|
| Course code | UPR |
| Session of Course | July-December |
| L:T:P | 0 : 0 : 3 |
| Semester | VII |
| Credits | 3 |

**Course Outcomes**

Upon completion of the subject the students will be:

| | |
|---|---|
| CO1 | Demonstrate a sound technical knowledge of their selected project topic. |
| CO2 | Undertake problem identification, formulation and solution. |
| CO3 | Design engineering solutions to complex problems utilizing a systems approach, and conduct an engineering project. |
| CO4 | Communicate with engineers and the community at large in written and oral forms. |
| CO5 | Demonstrate the knowledge, skills and attitudes of a professional engineer or technocrat. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 1 |

# Sessional

## POWER SYSTEM LABORATORY (BEL07003)

| **Course Name** | **POWER SYSTEM LABORATORY** |
|---|---|
| Course code | UPL |
| Session of Course | July-December |
| L:T:P | 0 : 0 : 3 |
| Semester | VII |
| Credits | 1.5 |

**Syllabus:**

1. Determination of operating characteristics of biased differential relay.
2. Determination of operating characteristics of an induction type overcurrent relay.
3. Study of Ferro resonance phenomenon of no-load, light load & critical load conditions.
4. Determination of A, B, C, D parameters of an artificial transmission line a transmission line.
5. Determination of transient and sub-transient reactance of a 3-phase alternator.
6. Calibration of different surface gaps for measurement of high voltage (Sphere-sphere, Pin-pin, Disc-disc) and Dry flash over test on different types of insulators by 100 kV AC and 280 kV DC
7. Study of impulse generator and generating standard impulse wave shape.
8. Measurement of loss tangent and dissipation factor using high voltage Schering bridge. Testing of insulating oil.
9. Parallel operation of two alternators and effect of its load sharing

**Course Outcomes:** Upon completion of the subject the students will be able to:

| | |
|---|---|
| CO1 | Incorporate differential and induction relays. |
| CO2 | Analyze ferro resonance phenomenon. |
| CO3 | Evaluate A, B, C, D parameters of transmission line experimentally. |
| CO4 | Apply short circuit test on an alternator and express the change in reactances. |
| CO5 | Applyhigh voltage tests in laboratory for insulators and transformer oil. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 1 | 2 |

# Eighth Semester

# Professional Elective - V

## WIDE AREA MONITORING AND CONTROL (BELPE801)

| Course Name | WIDE AREA MONITORING AND CONTROL |
|---|---|
| Course code | UPE-V |
| Session of Course | Jan-June |
| L:T:P | 3 : 0 : 0 |
| Semester | VIII |
| Credits | 3 |

## Syllabus

**Module 1 (LECTURES-5)**

**INTRODUCTION TO WIDE AREA MEASUREMENT SYSTEM (WAMS)**:Need of WAMS, Architecture, Components of WAMS, Applications: Voltage Stability Assessment, Frequency stability Assessment, Power Oscillation Assessment, Communication needs of WAMS

**Module 2 (LECTURES-10)**

**POWER SYSTEM AUTOMATION**:Introduction, Evolution of Automation Systems, SupervisoryControl and Data Acquisition (SCADA) Systems, Components of SCADA Systems, SCADA in Power Systems, SCADA Basic Functions,Advantages of SCADA in Power Systems, Deferred Capital Expenditure, OptimizedOperation and Maintenance Costs, Equipment Condition Monitoring (ECM), Sequence of Events(SOE) Recording, Power Quality Improvement

**Module 3 (LECTURES-10)**

**SCADA FUNDAMENTALS**: Introduction, Open System: Need and Advantages, Building Blocks of SCADA Systems, Remote Terminal Unit (RTU), Evolution of RTUs, Components of RTU, Communication Subsystem, Logic Subsystem, Termination Subsystem, Testing and Human Machine Interface(HMI) Subsystem, Power Supplies, Advanced RTU Functionalities, Intelligent ElectronicDevices (IEDs), Evolution of IEDs, IED Functional Block Diagram, Hardware and SoftwareArchitecture of the IED, IED Communication Subsystem, IED Advanced Functionalities

**Module 4 (LECTURES-5)**

**SUBSTATION AUTOMATION**: Substation Automation: Technical Issues, System Responsibilities, System Architecture,Substation Host Processor, Substation LAN, User Interface, Communications Interfaces,Protocol Considerations. The New Digital Substation, Process Level, Protection and Control Level, Station Bus and Station Level, Substation Automation Architectures, Legacy Substation Automation System, Digital Substation Automation Design, New versus Existing Substations.

**Module 4 (LECTURES-9)**

**VOLTAGE STABILITY & SMALL SIGNAL STABILITY**:Basic concepts, Voltage collapse – general characterization, classification, Voltage stability analysis – modeling, dynamic analysis, static analysis, shortest distance to instability,continuation power flow analysis, prevention of voltage collapse – design measures, operating measures

**Textbook:**

[1]. A. R. Messina, '*Wide Area Monitoring of Interconnected Power Systems'* IET, Power& Energy Series, 2005.
[2] Allen J. Wood and Bruce Woolenberg, '*Power System Generation, Operation and Control*', John Wiley and Sons, 1996.

**Reference Book:**

[1] P. Kundur, '*Power System Stability and Control*', McGraw Hill.

[2] A.R. Messina, '*Inter-area Oscillations in Power Systems*' Springer

[3] D. K. Mohanta& M. Jaya Bharata Reddy, '*Synchronized Phasor Measurements for Smart Grids*' IET, Power & Energy Series.

[4] Mini S. Thomas and John Douglas McDonald, '*Power System SCADA and Smart Grids*', CRC Press, 2015.

**Course Outcome:**

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

| | |
|---|---|
| CO1 | Describe necessity of wide area measurement system and its basic concept. |
| CO2 | Demonstrate different automation systems. |
| CO3 | Incorporate fundamentals of SCADA and its importance in real time power Systems. |
| CO4 | Express Substation Automation, New Digital Substation and traditional approach and IED-based approach of Integrated Protective Functions. |
| CO5 | Analyze Voltage stability, produce methods of prevention of voltage collapse, analyze dynamic stability and small signal stability.. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | 1 | - | - | - | - | 1 |

# ROBUST AND OPTIMAL CONTROL (BELPE802)

**MODULE-I (8 hours)**

Overview and Preliminaries: Overview on robust control, basics from matrix algebra, norms of signals and systems ($\boldsymbol{L_2}$, $\boldsymbol{H_2}$,$\boldsymbol{L_\infty}$, $\boldsymbol{H_\infty}$), robust performance and limitations due to physical constraints, Small-gain theorem, structured and unstructured uncertainty, robust stability for structured uncertainty (M-Δ structure).

**MODULE-II (8 hours)**

H∞ Control: Generalized H-infinity controller synthesis problem, full information control, mixed sensitivity design, H-infinity loop shaping design: four-block problem, loop shaping concept, choice of weighting filters, Mu analysis and synthesis.

**MODULE-III (8 hours)**

Introduction, static and dynamic optimization, parameter optimization. Calculus of variations: problems of Lagrange, Mayer and Bolza, Euler-Language equation and transversality conditions, Lagrange multipliers, Pontryagins maximum principle; theory; application to minimum time, energy and control effort problems, and terminal control problem.

**MODULE-IV (8 hours)**

Linear regulator problem: matrix Riccati equation and its solution, tracking problem, computational methods in optimal control, Different techniques for solution of algebraic Riccati equation, Stability and robustness properties of LQR design. Linear quadratic Gaussian design, loop transfer recovery design

**MODULE-V(7 hours)**

Dynamic programming: principle of optimality, principle of optimality, Computation of Optimal Control using Dynamic Programming, Bellman's principle of optimality, Hamilton-Jacobi-Bellman Equation,

**TEXT BOOKS**


1. Sigurd Skogestad, Ian Postlethwaite, Multivariable Feedback Control: Analysis and Design, Wiley publication.
2. Donald E. Kirk, Optimal Control Theory, Prentice-Hall, New Jersey.


**REFERENCE BOOKS**


1. B.C.Kuo, F. Golnaraghi, "Automatic Control Systems", John Willey & Sons.
2. Frank L. Lewis, Optimal control, John Wiley & Sons.

**Course Outcomes:**

Upon completion of the course, the students will:

| | |
|---|---|
| **CO1** | Analyze the uncertainty of a system for robust design. |
| **CO2** | Competent of representing a H-infinity design problem in the form of a generalized plant, and of using standard software tools for solving it. |
| **CO3** | Comprehend the requirement of optimality. |
| **CO4** | Competent of designing and tuning LQR, LQG controllers. |
| **CO5** | Analyze and synthesize optimal feedback laws using the Hamilton-Jacobi-Bellman equation |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 1 | 2 | 1 | - | 1 | - | - | 1 |

# DIGITAL CONTROL (BELPE803)

## SYLLABUS:

**Module 1: Discrete Representation of Continuous Systems (6 hours)**
Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

**Module 2: Discrete System Analysis (10 hours)**
The Z-transform, Z-transform of Elementary functions, Important properties and Theorms of the Z-transform. The inverse Z transform, Z Transform method for solving Difference Equations.
Z-Plane Analysis of Discrete Time Control Systems: Impulse sampling & Data Hold, Pulse Transfer function: Starred Laplace Transform of the signal involving Both ordinary and starred Laplace Transforms; General procedures for obtaining pulse Transfer functions, Pulse Transfer function of open loop and closed loop systems. Mapping between the s-plane and the z-plane, Solution of Discrete time systems. Time response of discrete time system.

**Module 3: Stability of Discrete Time System (4 hours)**
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.

**Module 4: State Space Approach for discrete time systems (10 hours)**
State Variables and Linear Discrete – Time Systems: State Models from Linear Difference Equations/z-transfer Functions, Solution of State Equations (Discrete Case), An Efficient Method of Discretization and Solution, Derivation of z-Transfer Function from Discrete-Time State Model. Liapunov stability analysis (discrete time) Controllability , observability,design via pole placement-state observers(discrete time).

**Module 5: Design of Digital Control System(9 hours)**
Z-domain root locus , root locus design (P-control, PI -control, PD,PID controller) Design of Discrete PID Controller, Design of Discrete compensator, z-domain root locusdesign-digital implementation of analog controller design (differencing methods forward and backward), frequency response design.

## TEXT BOOKS

[1] Katsuhiko Ogata, 'Discrete Time Control Systems', Pearson Education Publications, 2nd Edition,2005.
[2] M. Gopal, 'Digital Control Engineering', New Age International (ltd) Publishers, 1st Edition Reprint (2003), 1998.

## REFERENCE BOOKS

[1] B.C. Kuo, "Digital Control System", Holt, Rinehart and Winston, 1980.

[2] G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems", Addison-Wesley, 1998.

**COURSE OUTCOMES:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Produce discrete representation of continuous time systems. |
| CO2 | Demonstrate transfer function model of digital control system and do its Z-transform analysis. |
| CO3 | Analyse stability of open loop and closed loop discrete-time systems. |
| CO4 | Produce state space model of Digital control system, solve the state space dynamical systems to get the transient response with different inputs, design pole placement controller and/or observer for the given system to achieve desired specifications. |
| CO5 | Design PID controller and compensator. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | 1 | - | - | - | - | 1 |

# OPTIMIZATION TECHNIQUES (BELPE804)

**SYLLABUS:**

**Module-I (10 Hours)**

Introduction to linear and non-linear programming formulation of different models, equality constraints, inequality constraints, penalty functions

Linear Programming: Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex and revised simplex methods, Exceptional cases in LP, Duality theory, Dual Simple method, Sensitivity analysis.

**Module-II (8 Hours)**

Network Analysis: Transportation problem (with transshipment), Assignment problem, Traveling-salesman problem, Shortest route problem, Minimal spanning tree, Maximum flow problem.
Integer Programming: Branch and bound algorithm, Travelling salesman problem.
Dynamic programming: Forward recursions, General problem, Reliability problem, Capital budgeting problem, Cargo-loading problem.
Classical optimization techniques: Single variable Optimization, Unconstrained multivariable optimization: Direct and indirect search methods, Gradient-based methods, Conjugate direction and quasi-Newton methods.

**Module-III (7 Hours)**

Non-Linear Programming:Characteristics, Concepts of convexity, maxima and minima of functions of n-variables using Lagrange multipliers and Kuhn-Tuker conditions, FONC, SONC, and SOSC conditions, one dimensional search methods, Fibonacci, golden section method and gradient methods for unconstrained problems. Non-linear constrained optimization models, KKT conditions.

**Module-IV (7 Hours)**

Derivative-free Optimization, Genetic algorithms: Basic concepts, encoding, fitness function, reproduction, differences of GA and traditional optimization methods, basic genetic programming concepts applications, multiobjective decision making.

**Module-V (7 Hours)**

Evolutionary Computing, Simulated Annealing, introduction to new swarm based techniques for optimizations and applications.

**TEXT Books**


[1]. Optimization in Operations research- L. Rardin Ronald, Pearson Education.

[2]. Operation Research: Principles and Practice- A. Ravindran, D.T. Phllips and J.J. Solberg John Wiley.

[3]. An introduction to Optimization by Edwin P. K. Chong, Stainslaw H. Zak, John Wiley & Sons, Inc

[4]. Nonlinear Programming-Dimitri Bertsekas

[5]. Neural Networks, Fuzzy Logic, and Genetic Algorithms, Synthesis & Applications, S. Rajasekaran & G.A. Vijayalakshmi Pai, PHI

[6]. Modern heuristic optimization techniques: theory and applications to power systems K.Y. Lee and M.A. El-Sharkawi (Vol. 39). John Wiley & Sons.


**REFERENCE BOOKS**


[1]. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley Publisher.

[2]. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence-PC Tools", AP Professional Publishers.


**Course Outcomes**

Upon completion of the subject the students will:

| | |
|---|---|
| CO1 | Enumerate the fundamental knowledge of cast engineering minima/maxima problems into optimization framework. |
| CO2 | Study the efficient computational procedures to solve optimization problems. |
| CO3 | Enumerate fundamentals of genetic algorithm and derivative free optimization. |
| CO4 | Describe the basics of different evolutionary algorithms |
| CO5 | Employ and concern evolutionary and heuristic techniques for engg. problem solving |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | - | - | 1 |

# AI AND MACHINE LEARNING (BELPE805)

**Syllabus**

**Module 1:( 8 hours)**

Introduction to AI and Search Techniques Introduction to AI, production system, production rules, State-space problem, Problem Solving by Intelligent search: BFS, DFS, Iterative Deepening Search, Hill Climbing, Simulated Annealing, heuristic Search: A*,AO* , Adversary Search: MIN-MAX Algorithm, Alpha-Beta Cut-off algorithm.

**Module 2 (8 hours)**

Knowledge and Reasoning Propositional Logic, Theorem Proving by Propositional Logic, Resolution principle, Predicate Logic, wff conversion to clausal form, Dealing with Imprecision and Uncertainty: Probabilistic Reasoning, Dempster-Shafer Theory for Uncertainty Management.

**Module 3 (8 hours )**

Machine Learning Machine Learning: Supervised learning, unsupervised learning, Reinforcement learning, Artificial Neural Net, perceptron model, feed-forward neural network, Back propagation.

**Module 4 (8 hours )**

Computational learning tasks for predictions, learning as function approximation, generalization concept.
Linear models and Nearest-Neighbors (learning algorithms and properties, regularization).
Neural Networks (MLP and deep models, SOM).

**Module 5(8 hours )**

Probabilistic graphical models. Principles of learning processes: elements of statistical learning theory, model validation. Support Vector Machines and kernel-based models. Introduction to applications and advanced models.

**Text books:**

1. Fu, Gonzales and Lee, Robotics, McGraw Hill
2. Robotics and Control Mittal and Nagrath Tata McGraw-Hill Education
3. Artificial Intelligence and Soft Computing: Behavioral and Cognitive Modeling of the Human Brain, Amit Konar, CRC Press
4. Artificial Intelligence, Dan W Patterson, Prentice Hall of India
5. S. Russel and P. Norvig, “Artificial Intelligence – A Modern Approach”, Second Edition, Pearson Education

**Reference Books:**

1. Robert Shilling, Fundamentals of Robotics-Analysis and control, PrenticeHall of India
2. Artificial Intelligence, Nils J.Nilsson, ELSEVIER.
3. E.Rich and K.Knight, Artificial Intelligence, - TMH

**Course Outcomes**

Upon completion of the subject the students will:

| | |
|---|---|
| CO1 | Analyze AI and searching methods. |
| CO2 | Plan knowledge management, uncertainty management. |
| CO3 | Apply neural network learning. |
| CO4 | Construct and implement extended neural network learning methods. |
| CO5 | Develop probabilistic and statistical learning. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |

# Professional Elective – VI

## RELIABILITY ENGINEERING (BELPE809)

**SYLLABUS**

**Module-I (6 hours)**

Types of System, Qualitative and Quantitative assessment, Use of quantitative assessment, Reliability Definition and Concepts, Reliability Indices and Criteria, Reliability and Availability, Absolute and Relative Reliability, Reliability Evaluation Technique, Reliability Improvement, Reliability Activities in System Design & its Economics, Basic Probability Theory, Binomial Distribution and its engineering applications.

**Module-II (10 hours)**

Network modeling concepts, Series & Parallel Systems, Series-Parallel System, Partially Redundant & Standby redundant System. Modeling and Evaluation Concept, Conditional Probability Approach, Cut Set Method, Application and Comparison of Previous Technique, Tie Set Method, Connection Matrix Technique, Event Trees, Fault Tree, Multi-Failure Mode.

**Module-III (8hours)**

Distribution Concept & terminologies, General ReliabilityFunction& their evaluation techniques, Shape of Reliability Function. The Poison Distribution & the Normal Concept, Exponential, Weibull, Gamma, Rayleigh,Lognormal and rectangular distributions, Data Analysis, System Reliability Evaluation of differentkinds of Using Probability Distributions, Mean Time to Failure, Wear out And ComponentReliability, Maintenance And Component Reliability.

**Module-IV (8hours)**

Discrete Markov Chains: General Modeling Concept, Stochastic Transitional Probability Matrix, Time Dependent Probability Evaluation, Limiting State Probability Evaluation, Absorbing States, Application of Discrete Markov Technique.

Continuous Markov Process: General Modeling Concept, State Space Diagrams, Stochastic Transitional Probability Matrix, Evaluating Limiting State Probabilities, Evaluating Time Dependent State Probabilities, Reliability Evaluation in Repairable System, Mean Time to Failure, Application of Technique To Complex System.

**Module-V (7 hours)**

Frequency andDuration Technique: Application to Multistate Problems, Frequency Balance Approach, Two StageRepair and Installation Process. Approximate System Reliability Evaluation. System with Non-Exponential Distribution. Monte Carlo Simulation.

**Text Book**

Roy Billinton, Ronald N. Allan. “Reliability Evaluation of Engineering Systems”Second Edition.

**Reference Books:**

Gupta A.K., Reliability, Maintenance and Safety Engineering. University Science Press.

**Course Outcomes:**

Upon completion of the course, the students will:

| | |
|---|---|
| CO1 | Define the basic terms in reliability engineering concepts. |
| CO2 | Construct and implementthe network modelling of simple and complex systems. |
| CO3 | Evaluate probability distribution for reliability of a system. |
| CO4 | Incorporate discrete and continuous Markov processes for reliability evaluation. |
| CO5 | Express competence on approximate reliability evaluation techniques. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 |

# FORECASTING METHODS IN ENGINEERING (BELPE808)

## SYLLABUS

### Module-I (8 hours)

Nature of time series data, time series statistical models, measures of dependence, stationary time series, estimation of correlation. Classical regression, exploratory data analysis, smoothing. Basics of R Programming.

### Module-II (8 hours)

ARIMA Models: Autoregressive Moving Average Models, difference equations, autocorrelation and partial autocorrelation. Forecasting, estimation. Building ARIMA models. R programs.

### Module-III (8 hours)

Spectral Analysis and Filtering: Cyclical behavior and periodicity. Spectral Density. Periodogram and Discrete Fourier Transform, Nonparametric and parametric spectral estimation, Multiple series and cross-spectra. Linear filters. Lagged regression models. Signal extraction and Optimal filtering. R programs.

### Module-IV (8 hours)

Long memory ARMA and fractional differencing, Unit Root testing, GARCH models. Threshold models. Lagged regression and transfer function modelling. ARMAX models. R programs.

### Module-V (8 hours)

State Space Models: Linear Gaussian model. Filtering, smoothing and forecasting. Maximum Likelihood estimation, Signal extraction and Forecasting, State space models with correlated errors. Bootstrapping. Smoothing Splines and Kalman Smoother. Hidden Markov Models. Stochastic Volatility. Bayesian analysis. R programs.

**Text Book:** Robert H. Shumway, David S. Stoffer. "Time Series Analysis and its Applications", Fourth Edition.,Springer.

**Course Outcomes:**Upon completion of the course, the students will:

| | |
|---|---|
| CO1 | Analyse the characteristics of time series and exploratory data analysis. |
| CO2 | Create ARIMA models. |
| CO3 | Evaluate signals by spectral analysis and filtering. |
| CO4 | Construct and implement GARCH and ARMAX model |
| CO5 | Express system in terms of state space models. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |

# BIO-MEDICAL INSTRUMENTATION (BELPE810)

## SYLLABUS:

### Module-I (10 Hours)

Basic physiological system of the body::Problems encountered in measuring living systems, bioelectric potentials, biomaterials, Basic Transducer Principles::Active and passive transducers, Transducers for biomedical applications, Generation, propagation and distribution of bioelectric potentials (ECG, EEG and EMG)

Bio potential electrodes::Basic types (micro, skin surface and needle electrodes), biochemical transducers(PH, blood, gas and specific ions electrodes)

### Module-II (5 Hours)

The cardiovascular system and measurements::Heart and cardiovascular system and circulation block diagram, blood pressure and measurement ,characteristics of blood flow and heart sounds, Electrocardiography, ECG lead configurations, ECG recording and their types

### Module-III (10 Hours)

The Nervous System::The anatomy of nervous system, Neuronal communication EPSP & IPSP Organization of the brain, Measurements from the nervous system

Systemic Body & Skin Temperature Measurement::Temperature measurements, Brief idea about ultrasonic measurements

### Module-IV (10 Hours)

Patient care monitoring::Elements of intensive care: Organization of the Hospital for patient care monitoring, Pace-makers types, systems, modes and generators, Defibrillators types, Bio telemetry and applications of telemetry in patient care.

### Module-V (4 Hours)

Automation of chemical tests, Instrumentation for diagnostic X Rays, Interfacing computer with medical instrumentation and other equipments, biomedical computer applications, Shock hazards from electrical equipments, methods of accident prevention.

### TEXT Books

[1] R.S.Khanpur,"Handbook of Biomedical Instrumentation", TMH Publisher.

[2] Cromwell, F.J.Weibell&F.A.Pfieffer, "Biomedical Instrumentation & Measurements", PHI Publisher.

**REFERENCE Books**

**[1]** Webster J S –Medical instrumentation-Application & Design
[2] Astor B R–Introduction to Biomedical instrumentation & measurement, McMillan.
[3] Mandeep Singh-Introduction to Biomedical Instrumentation, 2nd Edition, PHI

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**Course Outcomes**

Upon completion of the course students will:

| | |
|---|---|
| CO1 | Analyze the concept about human physiology system and electrodes & transducers used in human body |
| CO2 | Expressthe principle and basic function of cardiovascular system in humans& measurement of ECG. |
| CO3 | Develop knowledge about the nervous system of human body , Systemic Body & Skin Temperature Measurement |
| CO4 | Express the health care workers' dependence on technology to administer care or treatment or to make a diagnosis. |
| CO5 | Express knowledge of principles, applications of X Rays imaging,design of the medical instruments most commonly used in the hospital, biomedical computer applications and methods of accident prevention. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | 1 | - | - | - | - | 1 |

# ELECTRIC AND HYBRID VEHICLES (BELPE807)

**Module-I (5 hours)**

Introduction to Hybrid Electric Vehicles: History of hybrid and electricvehicles, social and environmental importance of hybrid and electricvehicles, impact of modern drive-trains on energy supplies.Conventional Vehicles: Basics of vehicle performance, vehicle powersource characterization, transmission characteristics, mathematicalmodels to describe vehicle performance. Architectures of HEVs,series and parallel HEVs, complex HEVs.

**Module-II (10hours)**

Hybrid Electric Drive-trains: Basic concept of hybrid traction,introduction to various hybrid drive-train topologies, power flow controlin hybrid drive-train topologies, fuel efficiency analysis.Electric Drive-trains: Basic concept of electric traction, introduction tovarious electric drive-train topologies, power flow control in electricdrive-train topologies, fuel efficiency analysis.

**Module-III (10 hours)**

Electric Propulsion unit: Introduction to electric components used inhybrid and electric vehicles, Configuration and control of DC Motordrives, Configuration and control of Induction Motor drives. Energy Storage: Introduction to Energy Storage Requirements in Hybridand Electric Vehicles, Battery based energy storage and its analysis, FuelCell based energy storage and its analysis, Hybridization of differentenergy storage devices.

**Module-IV (7 hours)**

Power Electronics in HEVs: Rectifiers used in HEVs, voltageripples; Buck converter used in HEVs, non-isolated bidirectionalDC-DC converter, regenerative braking, voltage source inverter, Current source inverter, isolated bidirectional DC-DC converter,PWM rectifier in HEVs, EV and PHEV battery chargers.

Electric Machines and Drives in HEVs: Induction motor drives,Field oriented control of induction machines; Permanent magnetmotor drives; Switched reluctance motors; Doubly salientpermanent magnet machines. Case studies.

**Module-V (7 hours)**

Communications, supporting subsystems: In vehicle networks- CAN,Energy Management Strategies: Introduction to energy managementstrategies used in hybrid and electric vehicles, classification of differentenergy management strategies, comparison of different energymanagement strategies

**Recommended Books**

[1]. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

[2]. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

[3]. Mi Chris, Masrur A., and Gao D.W., " Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives".

**Course Outcomes:**

Upon completion of the course, the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Describe the requirements and architecture of EVs and HEVs.. |
| CO2 | Produce drive trains used in EVs and HEVs. |
| CO3 | Organize electric propulsion unit and storage systems for EVs and HEVs. |
| CO4 | Compile and design drive systems for EVs and HEVs. |
| CO5 | Incorporate various communication systems used in EVs and HEVs. |

**Course articulation matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | - | - | 1 |

# SMART POWER GRIDS (BELPE806)

**Module-I (6 hours)**

Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust & Self-Healing Grid, Present development & International policies in Smart Grid.

**Module-II (8hours)**

Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation.

**Module-III (7 hours)**

Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

**Module-IV (10 hours)**

Concept of micro-grid, need & applications of micro-grid, Formation of micro-grid, Issues of interconnection, Integration of renewable energy sources, Protection & control of micro-grid. Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

**Module-V (7 hours)**

Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols.

Suggested reading:

1. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications", Wiley 2012.

2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009.

3. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley-IEEE, 2011.

4. Stuart Borlas'e, "Smart Grid: Infrastructure, Technology and solutions", CRC Press.

5. A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer.

**Course Outcomes:**

Upon completion of the course, the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Compile and express the difference between smart grid & conventional grid. |
| CO2 | Apply smart metering concepts to industrial and commercial installations. |
| CO3 | Express and evaluate solutions in the areas of smart substations, distributed generation and wide area measurements |
| CO4 | Produce the problems associated with integration of distributed generations & incorporate with their solutions through smart grid |
| CO5 | Develop smart grid solutions using AMI and modern communication technologies |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 3 | 2 | 1 | - | - | - | - | 1 |

# SEMINAR ON PROJECT

**Course Outcomes**

Upon completion of the subject the students will have:

| | |
|---|---|
| CO1 | Produce ideas to work in field of electrical engineering |
| CO2 | Develop methods to utilize technical resources. |
| CO3 | Express and analyze engineering problems. |
| CO4 | Implement the learned skills to use modern engineering tools, software's and equipment to analyze problems |
| CO5 | Compile technical documents and produce oral presentations related to the work completed |

**Course Articulation Matrix:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

# PROJECT-II

| **Course Name** | **PROJECT-II** |
|---|---|
| Course code | UPR |
| Session of Course | Jan-June |
| L:T:P | 0 : 0 : 6 |
| Semester | VIII |
| Credits | 6 |

**Course Outcomes**

Upon completion of the subject the students will:

| | |
|---|---|
| CO1 | Demonstrate a sound technical knowledge of their selected project topic. |
| CO2 | Undertake problem identification, formulation and solution. |
| CO3 | Design engineering solutions to complex problems utilizing a systems approach, and conduct an engineering project. |
| CO4 | Communicate with engineers and the community at large in written and oral forms. |
| CO5 | Demonstrate the knowledge, skills and attitudes of a professional engineer or technocrat. |

**Course Articulation Matrix**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**OPEN ELECTIVE-I (FIFTH SEMESTER)**

# MEMS and NEMS (BELOE501)

**Syllabus:**

**MODULE-I ( Lectures 5)**

Introduction to Micro-machining and Micro-electronics/ Nano-electronics Physics. Micro-machining and Micro-electronics/ Nano-electronics Technologies. Mechanical-Electronic Transitions in Sensing. Integration of Micro-machining and Micro-electronics.

**MODULE-II( Lectures 9)**

Micromachining Technology: Bulk micromachining, Wafer bonding, Si-to-Si bonding, Anodic bonding, Si fusion bonding; Surface micromachining; Other techniques: LIGA, Dry-etching processes, Micro-milling, Use of lasers in micromachining; Chemical etching and IC technology, Material types and Property; Films on micro/Nano structure, Micro-machining Metal structures.

**MODULE-III( Lectures 8)**

Applications and Case studies on Sensor Output: Sensor output characteristics, Wheatstone Bridge, Static vs Dynamic operation; Capacitive sensing, Piezoelectric sensing, Piezo-resistive sensing, Hall effect sensors, Gas sensors, Chemical sensors, Digital output of sensors, Need of Calibrating the sensors measurement, Noise/Interference aspects, Low-power, low-voltage sensors, Impedance measurement.

**MODULE-IV( Lectures 9)**

Micro/Nano-Electronics Technology: Amplification and Signal conditioning, Instrumentation amplifier, SLEEPMODE OPAMP, rail-to-rail OPAMP, Switched – capacitor amplifier, Industry Current-and-Voltage Standard Signal Transmitters and Receivers; Integrated Passive and Active Elements, Onboard A/D and D/A conversions.

**MODULE-V( Lectures 8)**

Advances in Signal Conditioning Technology: DSP control, PWM control, Communication links, Network Protocol, Networked Sensors/Actuators. Optical sensing. RFID technology.
Packaging, testing and reliability Implications of Smart/Intelligent Sensors: Hybrid packaging, Ceramic packaging, Multi-Chip modules, Dual-chip packaging. Forming Sensing Arrays.

**Books:**


[1] Randy Frank, "Understanding Smart Sensors",2nd edition, Artech House, 2000.

[2] "Handbook on Smart sensor and MEMS – Intelligent devices and Microsystems for industrial applications", Edited by StoyanNihtianov and Antonio Luque, Woodhead Publishing Ltd., 2014.

[3] S. E. Lyshevski. "MEMS and NEMS: Systems, Devices, and Structures (Nano- and Microscience, Engineering, Technology and Medicine), CRC Press, 2002.


**References books:**


[1] S. C. Mukhopadhyay and T. Islam, "Wearable Sensors- Applications, Design and Implementation", 1st edition, IOP Publishing, Bristol, UK, 2017.

[2] James W. Dally, William F. Riley, and Kenneth G. McConnell, "Instrumentation for Engineering Measurements", Wiley student edition, Second edition, 2013.

[3] M.Bhuyan, "Intelligent Instrumentation – Principles and Applications", CRC Press, 2012.

**Course Outcome:**

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

| | |
|---|---|
| CO1 | Conceptualize the technological developments in micromachining technologies and micro/nano-electronics technologies; |
| CO2 | Apply a specific method of micromachining technology for designing a smart sensor/actitation system to measure the predefined physical parameters; |
| CO3 | Apply and incorporate a micromachining technology for a particular applications / case study, and thereby, able to select suitable signal conditioning circuits to complete the IC package. |
| CO4 | Implement a specific method of micro/ nano electronics technology for designing the necessary signal conditioning circuits to complete the package in IC form, and |
| CO5 | Use of appropriate software tools (LabVIEW, COMSOL/ ANSIS, VISIO and /or Mentor Graphics) or equivalent open platform for the mathematical modelling of smart devices and packaging technology. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# MICROPROCESSOR AND MICROCONTROLLER THEORY AND APPLICATIONS (BELOE502)

| Course Name | MPMC THEORY & APPLICATIONS |
|---|---|
| Course code | UOE-I |
| Session of Course | July-December |
| L:T:P | 3 :0 : 0 |
| Semester | V |
| Credits | 3 |

**Syllabus**

**Module-I (9 hours)**

Microprocessor Architecture: Introduction to Microprocessor and Microcomputer Architecture, Pins & Signals, Register Organization, Timing & Control Module, 8085 Instruction Timing & Execution.

Instruction Set and Assembly Language Programming of 8085: - Instruction set of 8085, Memory & I/O Addressing, Assembly language programming using 8085 Instruction Set,

**Module-II (6 hours)**

Use of Stack & Subroutines, Data transfer techniques, 8085 interrupts.

Interfacing & support chips: Interfacing EPROM & RAM Memories, 2716, 2764, 6116 & 6264, Interfacing of I/O devices with 8085, Partial address decoding for memory and I/O devices.

**Module-III (6 hours)**

Microprocessor Based System Development Aids, Programmable Peripheral Interface: 8255, Programmable DMA Controller: 8257, Programmable Interrupt Controller: 8259

Application: Delay calculation, square wave generation, Interfacing of ADC & DAC, Data Acquisition System.

**Module-IV (9 hours)**

Advanced Microprocessor: Basic features of Advance Microprocessors, Intel 8086 (16 bit processors): 8086 Architecture, Register organization, signal descriptions, Physical Memory Organization, Addressing Modes, Instruction Formats, Instructions Sets & Simple Assembly language programmes, 8086 Interrupts.

Simple application: Delay calculation, square wave generation

**MODULE – V(9 hours)**

Microcontroller: - Introduction for Microcontrollers, Microcontrollers & Microprocessors, Embedded verses External Memory devices, CISC & RISC Processors, Havard& Von Neumann Architectures, 8051 Microcontrollers. MCS-51 Architecture, Registers, Stack Pointer & Program Counter. 8051 Pin Description, Connections, Parallel I/O ports, Memory Organization, 8051 Addressing Modes & Instructions, 8051 Assembly Language Programming Tools.Simple application: Delay calculation, square wave generation, Interfacing of LCD unit.

**Text Books**

[1]. 0000 to 8085 Introduction to Microprocessor for Scientists & Engineers by Ghosh & Sridhar, PHI

[2]. Fundamentals of Microprocessor & Microcontroller by B.RAM, Dhanpat Rai Publications.

[3]. Advanced Microprocessor and Peripherals (Architecture, Programming & Interfacing) by A.K.Roy&K.M.Bhurchandi- TMH Publication.
[4]. Microcontrollers, theory and applications, TMH, Ajay V. Deshmukh.

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Demonstrate knowledge on microprocessor and microcontroller. |
| CO2 | Demonstrate an ability to write assembly language programming. |
| CO3 | Implement the basic idea about the data transfer schemes and its applications. |
| CO4 | Analyse the design of different interfacing circuits and troubleshoot interactions between software and hardware. |
| CO5 | Plan the design of microprocessor/microcontroller-based systems. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# ELECTROMAGNETIC FIELD THEORY (BELOE503)

## PREREQUISITES

Coordinate Systems, Vector Algebra, Vector Calculus.

## Syllabus

### MODULE I(10 Hours)

Fields due to Different Charge Distributions, Gauss Law and Applications, Electric Potential, Relations Between E and V, Energy Density.

Convection and Conduction Currents.

Continuity Equation, Polarization of Dielectrics, Boundary Conditions.

Poisson's and Laplace's Equations; Capacitance.

### MODULE II(8 Hours)

Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Flux Density.Magnetic Scalar and Vector Potentials.Forces due to Magnetic Fields.Magnetic Boundary Conditions.Inductance& Mutual Inductance.

Faraday's Law and Transformer EMF, Displacement Current Density, Maxwell's Equations.

### MODULE III(8 Hours)

Uniform Plane Waves, Wave Equations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics. Wave Polarization.

Reflection and Refraction of Plane Waves – Normal and Oblique Incidences for both Perfect Conductor and Perfect Dielectrics.

### MODULE IV(8 Hours)

Poynting Vector and Poynting Theorem – Applications.

Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts.

### MODULE V(6 Hours)

Introduction To Waveguides, TE Modes, Waveguide Equation, Cut-Off Frequency.Elements Of Antenna Theory.

**TEXT BOOKS:**


1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 4 thEdition ,Oxford University Press Inc. First India edition, 2009.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill 8th Revised edition, 2011.


REFERENCE BOOKS:


3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.
4. Bhag Singh Guru and Hüseyin R. Hiziroglu "Electromagnetic field theory Fundamentals", Cambridge University Press; Second Revised Edition, 2009.


**Course Outcomes:**

Upon completion of the course, the students will:

| | |
|---|---|
| CO1 | Evaluate the reasons for increased concern for power quality issues in power systems |
| CO2 | Express the benchmarking process in power quality sector |
| CO3 | Analyze and solve the issues in power quality improvement |
| CO4 | Implement the various monitoring methods used in power quality issues |
| CO5 | Compile Plan of controlling the power quality issues. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# Open Elective-II (Sixth Semester)

## SIGNAL & SYSTEMS (BELOE603)

**SYLLABUS**

**Module-I (7 hours)**

**Introduction of Signal and System:** Introduction of Signals, Classification of Signals, General Signal Characteristics, Energy & Power Signal, Continuous-Time Signals, Discrete-Time Signals. Basic System Properties, Systems with and without memory, Invertibility, Casuality, Stability, Time invariance, Linearity.

**Module-II (10 hours)**

**Convolution:** Linear Time Invariant (LTI) Systems, Discrete Time LTI Systems, Convolution representation of Linear Time-Invariant Discrete-Time Systems, Convolution Representation of Linear Time-Invariant Continuous-Time Systems, Properties of convolution, Properties of LTI Systems.

**Fourier Representations for Signals:** Representation of Discrete Time Periodic signals, Continuous Time Periodic Signals, Discrete Time Non Periodic Signals, Continuous Time Non-Periodic Signals, Properties of Fourier Representations.

**Module-III (8hours)**

**Frequency Response of LTI Systems:** Frequency Response of LTI Systems, Fourier Transform representation for Periodic and discrete time Signals, Sampling, reconstruction, Discrete Time Processing of Continuous Time Signals, Fourier Series representation for finite duration Non-periodic signals.

**Modulation:** Modulation Types and Benefits, Full Amplitude Modulation, Pulse Amplitude Modulation, Multiplexing, Phase and Group delays

**MODULE-IV (7 hours)**

**Representation of Signals using Continuous Time Complex Exponentials:** Laplace Transform, Unilateral Laplace Transform, its inversion, Bilateral Laplace Transform, Transform Analysis of Systems.

**MODULE-V (7 hours)**

**Representation of Signals using Discrete Time Complex Exponentials:** The Z-Transform, Properties of Region of convergence, Inverse Z-Transform, Transform Analysis of LTI Systems, Unilateral Z-Transform.

**TEXT BOOKS**

[1]. Simon Haykin and Barry Van Veen, “Signals and Systems”, John Wiley & Sons Publisher.

[2]. Alan V. Oppenheim, Alan S. Willsky, with S. Hamid, S. Hamid Nawab, “Signals and Systems”, PHI Publisher.

**REFERENCE BOOKS**

[1]. Hwei Hsu, “Signals and Systems”, Schaum's Outline TMH Publisher.

[2]. Edward w. Kamen and Bonnie S. Heck, “Fundamentals of Signals & systems using Web and MATLAB”, PHI Publisher

**Course Outcomes:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Analyze the basic definition of different types of signals and systems. |
| CO2 | Demonstrate the concept of convolution of LTI system and Fourier representation of signal. |
| CO3 | Express the basics of modulation and frequency response of LTI system. |
| CO4 | Incorporate the knowledge how to use the Laplace Transform for representing signal. |
| CO5 | Develop the the knowledge of the Z Transform and its properties. |

**Course Articulation Matrix**

| | **PO1** | **P1** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 1 |
| **CO2** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 1 |
| **CO3** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 1 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 1 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 1 |

# DIGITAL CIRCUITS & DESIGN (BELOE602)

**Syllabus:**

**Module-I (08 hours)**

Number system& codes: Binary Number base conversion, Octal &hexadecimal numbers, complements, signed binary numbers, binary codes-BCD codes, gray codes, ASCII Character Code, Codes for serial data transmission & storage. Boolean Algebra & Logic gates: Axiomatic definition of Boolean Algebra .Property of Boolean Algebra, Boolean functions, Canonical & standard form; min terms & max terms, standard forms; Digital Logic Gates, Multiple inputs.

**MODULE-II (08 HOURS)**

Gate level Minimization: The Map Method, K Map up to five variables, Product of Sum simplification, Sum of Product simplification, Don't care conditions. NAND and NOR Implementation, AND-OR inverter, OR-AND inverter implementation, Ex-OR Function, parity generation& checking, Hardware Description Language (HDL). Combinational Logic: Combinational Circuits, Analysis &Design procedure; Binary Adder- subs tractor, Decimal Adder, Binary Multiplier, Magnitude comparator, Multiplexers and demultiplexers, Decoders, Encoders, Multipliers, Combinational Circuits design

**MODULE-III (08 HOURS)**

Synchronous Sequential logic: Sequential Circuit, latches, Flip-flop, Analysis of Clocked Sequential circuits, HDL for Sequential Circuits, State Reduction &Assignment, Design procedure.

Register &Counters: Shift Register, Ripple Counters, Synchronous Counter, Asynchronous Counter, Ring Counters, Module-n Counters, HDL for Register & Counters

**MODULE-IV (08 HOURS)**

Memory & Programmable logic: Random Access Memory (RAM),Memory , Decoding, Error detection & correction, Read only Memory, Programmable logic array ,Sequential Programmable Devices.

Digital Integrated Logic Circuits: RTL, DTL, TTL, ECL, MOS & C-MOS Logic circuits.

MODULE-V(07 HOURS)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, 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 converters.

**Books**

[1] Digital Design,3rd edition by M. Morris Mano, Pearson Education

[2] R.P. Jain, “Modern Digital Electronics”, TATA McGraw-Hill Publishers

**References Books:**

[1] D. P. Kothari | J. S. Dhillon, "Digital Circuit and Design", PEARSON
[2] Fredriac J. Hill and Gerald R. Peterson "Introduction to Switching Theory and Logic Design", John Wiley & Sons Publishers.

**Course Outcomes:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Develop the common forms of number systems, number representation, conversion and arithmatics. |
| CO2 | Incorporate the fundamental principles of minimization of complex Boolean expressions. |
| CO3 | Design and implementation of different combinational circuits |
| CO4 | Analyze sequential logic design and its realization. |
| CO5 | Plan various design techniques of ICs in the form of logic families and memory devices. |

**Course Articulation Matrix**

| | **PO1** | **P1** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |
| **CO2** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |
| **CO3** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |
| **CO4** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |
| **CO5** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |

# VLSI THEORY & DESIGN (BELOE601)

**SYLLABUS:**

**MODULE-I (08 HOURS)**

Introduction, Historical perspective, VLSI Design methodologies, VLSI Design Flow, Design, Hierarchy, Design Styles, CAD Technology, Fabrication of MOSFETS. Fabrication processes, NMOS Fabrication, CMOS n-well process, Layout Design rules Stick Diagrams, Full Custom Mark Layout Design, MOS Transistor, Review of structure and operation of MOSFET (n-MOS enhancement type), CMOS, MOSFET v-I characteristics, MOSFET scaling and small geometry effects. MOSFET capacitances, Modeling of MOS Transistors-Basic concept the SPICE level-1 models, the level-2 and model equations.

**MODULE-II (08 HOURS)**

MOS Inverters: Basic NMOS inverters, characteristics, Inverters with resistive load and with n-type MOSFET load CMOS inverter and characteristics. MOS Inverters: Switching characteristics and interconnect effects: Delay time definitions and calculation, inverter design with delay constraints, estimation of parasitic switching power dissipation of CMOS inverters.

**MODULE-III (08 HOURS)**

Combinational MOS logic circuits, CMOS logic circuits, state style, complete logic circuits, pass transistor logic, sequential logic circuit –introduction, SR latch, clocked latch and flip-flop circuits, CMOS D latch and edge triggered flip- flop. Dynamics logic circuits: Dynamic logic, basic principles, high performance dynamics CMOS circuits, Dynamic Ram, SRAM, flash memory.

**MODULE-IV (08 HOURS)**

Systems Design method, design strategies, concept of FPGA, standard cell based design, design capture tools hardware definition languages such as VHDL, and packages, Xlinx (introduction),introduction to IRSIM and GOSPL (open source packages), design verification and testing, simulation of various levels including timing verification, faults models, Design strategies for testing chip level and system level test techniques.

**MODULE –V (07 HOURS)**

SRAM, DRAM, ROM, Serial Access Memory, Content Addressable Memory, Field Programmable Gate Array.

**TEXT BOOKS**

[1]. Sung Mo-Kang &Yussuf Leblebici, “CMOS Digital integrated Circuits – Analysis & Design”, TMH Publisher.

[2]. Perry, “VHDL Programming”, TMH Publisher.

**REFERENCE BOOKS**

[1]. Rabey et al., "Digital Integrated Circuits: A Design Perspective", PHI Publisher.

[2]. Geiger et.al., "VLSI design Techniques for analog and digital circuits", TMH Publisher.

R. Johnson, "Introduction of Digital Signal Processing", PHI Publisher

**COURSE OUTCOMES:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Define the trends in semiconductor technology, and how it impacts scaling and performance |
| CO2 | Plan the Layout, Stick diagrams, Fabrication steps, Static and Switching characteristics of inverters. |
| CO3 | Apply the MOS transistor as a switch and its capacitance. |
| CO4 | Evalute the Synthesis of digital VLSI systems from register-transfer or higher level descriptions in hardware design languages. |
| CO5 | incorporate different memory types like dynamic ram, static ram and flash memory. |

**Course Articulation Matrix**

| | **PO1** | **P1** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |
| **CO2** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |
| **CO3** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |
| **CO4** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |
| **CO5** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 |

# Open Elective-III (Seventh Semester)

## DIGITAL SIGNAL PROCESSING (BELOE701)

### SYLLABUS

**Module-I (8 hours)**

**Discrete time signal and system:** discrete- time signals (some elementary examples, classification of discrete-time signals), discrete- time system (block diagram representation, classification and interconnection of discrete time system), analysis of discrete time linear time-invariant system (response of LTI systems to arbitrary inputs, properties of convolution and interconnection of LTI systems, casual linear time-invariant systems, stability of linear time-invariant system), discrete-time systems described by difference equations, structure of LTI system, recursive and non-recursive realization of FIR systems, correlation of discrete time system.

**Module-II (8 hours)**

**The Z-transform:**The Z-transform, properties of Z-transform, inverse of Z-transform, the one-sided Z-transform.
**The Discrete Fourier transform:** frequency domain sampling, the DFT, relationship of DFT to other transforms, properties of the DFT, circular convolution, circular correlation, circular correlation by convolution, method linear convolution by overlap save method and by overlap add method.

**Module-III (8 hours)**

**Fast Fourier transform:** operation counts by direct computation of DFT, divide and conquer approach to computation of the DFT, radix-2 FFT algorithm, decimation-in-time (DIT) and decimation-in frequency (DIF) algorithm, efficient computation of the DFT of real sequences and a 2N-point real sequence.

**Module-IV (7 hours)**

**Design of digital filter:** causality and its implementation, design of linear phase FIR filters using different windows, design of IIR impulse response method and bilinear transformation method.

**MODULE-V (8 hours)**

**Power spectrum estimation:** Estimation of spectral from finite duration signals, Non-parametric method of power spectrum estimations. The Bartieff method and the Blackman and Tukey method. Implementation of Discrete Time System structure of FOR Systems-Direct form, cascaded form. Structure IIR Systems - Direct form 1&11 realizations.

**TEXT BOOKS**

[1]. J.G. Proakis and D.G. Manolakis, "Digital Signal Processing - Principles, Algorithms and Applications", PHI Publisher.

[2]. Sanjit Mitra "Digital Signal Processing – A Computer based approach" TMH Publisher.

**REFERENCE BOOKS**

[1]. S. Salivahanan, "Digital Signal Processing", TMH Publisher.

[2]. J.R. Johnson, "Introduction of Digital Signal Processing", PHI Publisher.

**Course Outcomes:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Define the basic concept of Discrete Time Signal, System and characterize Discrete Time LTI system. |
| CO2 | Incorporate the fundamental principles of Z transform and Discrete Fourier Transform along with their properties. |
| CO3 | Implement new concept of computing DFT with Fast Fourier Transform |
| CO4 | Plan various designing techniques and implementation of IIR/FIR Digital Filters. |
| CO5 | Analyze the concept of Power Spectrum Estimation of Discrete Time Signal. |

**Course Articulation Matrix**

| | **PO1** | **P1** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | 1 |
| **CO2** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | 1 |
| **CO3** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | 1 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | 1 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | 1 |

# DIGITAL IMAGE PROCESSING (BELOE702)

**SYLLABUS:**

**Module I (9 Hours)**

Digital Image Fundamentals: Components of image processing system, image fundamentals, image sampling and quantization, basic relationships between pixels, color image fundamentals – RGB, YC bCr, HSI models, 2D-transforms – DFT, DCT, KLT, slant transform, Hough transform, Properties of transforms and applications, Fundamentals on wavelet transform.

**Module II (9 Hours)**

Image Enhancement: Enhancement in spatial domain: basic gray level transformations, histogram processing, smoothing and sharpening of spatial filters. Enhancement in frequency domain: Introduction to filtering in frequency domain, smoothing and sharpening of frequency domain filters.

**Module III (6 Hours)**

Image Restoration: Degradation model, restoration in presence of noise only – spatial filtering, linear, position invariant degradations, estimating degradation functions, inverse filtering, Wiener filtering.

**Module IV (9 Hours)**

Image compression: Redundancy and compression models, Lossless coding – Run length coding, Huffman coding, vector quantization, JPEG, concepts of fractals, fractal image compression.

**Module V (6 Hours)**

Image segmentation: Edge detection, Boundary description, Morphological image processing, Region based segmentation – region growing, region merging and splitting.

**TEXT BOOKS**

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Second Edition,2004.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson 2002.

**REFERENCES**

1. Rafael C. Gonzalez, Richard E. Woods,' Digital Image Processing usingMATLAB', Pearson Education, Inc., 2004.
2. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002.

**Course Outcomes:**

Upon completion of the subject the students will:

| | |
|---|---|
| CO1 | Analyse general terminology of digital image processing. |
| CO2 | Analyse various types of images, wavelet transformations and compression techniques. |
| CO3 | Analyse the methodologies for image segmentation, restoration, etc. |
| CO4 | Implement image process and analysis algorithms. |
| CO5 | Apply image processing algorithms in practical applications |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 2 |

# MODELLING & SIMULATION (BELOE703)

## MODULE-I (8 HOURS)

System: concept, environment, stochastic activities, continuous and discrete time systems, system modelling and types of system models, Cobweb model, Distributed lag model. Subsystems, corporate models and their segments, type of system studies, analysis, design and postulation.

## MODULE-II (8 HOURS)

Continuous system simulation: system models, differential equations, analog methods, CSMP, feedback and interactive simulation, real time simulation. System dynamics: Exponential growth and decay models, logistic curves, system dynamic diagram, multisegmented models, time delays, feedback in socio-economic system, world models.

## MODULE-III (8 HOURS)

Random number generators and output data analysis for a single system, statistical techniques for comparing attentive systems, Variable reduction techniques

## MODULE –IV (8 HOURS)

Probability concepts in simulation, Queuing system, arrival of patterns, exponential, erlang and hyper exponential distributions, service time, queuing disciplines, measures of queues, mathematical solutions.

## MODULE-V (8 HOURS)

Discrete system simulation: discrete events, representation of time, generation of arrival patterns, simulation programming tasks, gathering statistics, counters and summary of statistics, measuring utilization and occupancy, recording distributions and transit times. Bond graphs for simple electrical and mechanical engineering systems modeling and simulation of hydraulic, thermal and manufacturing systems.

## TEXT BOOK

[1]. A.M. Law and W.D. Kelton, “Simulation Modelling and Analysis”, TMH Publishers.

## REFERENCE BOOKS

[1]. G. Gordon, “System Simulation”, PHI Publishers.

[2]. A. Mukherjee and R. Karmakar, “Modeling and Simulation of Engineering Systems through Bond Graphs”, Narosa Publishing House, CRC Press

**Course Outcomes:**

Upon completion of the subject the students will:

| | |
|---|---|
| CO1 | Analyze the concept of system modelling and types of system models. |
| CO2 | Implement the system concept and apply functional modeling method to model the continuous time system |
| CO3 | Express the behavior of a dynamic system and create an analogous model for a dynamic system. |
| CO4 | Compile variable reduction techniques and Probability concepts in simulation. |
| CO5 | Simulate the operation of a dynamic system and make improvement according to the simulation results. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 3 |

# Open Elective-IV (Eight Semester)

## PROCESS CONTROL AND INSTRUMENTATION (BELOE803)

**Syllabus:**

**MODULE-I (7 hours)**

Introduction to process dynamics, its type and classifications. Process Characteristics: process lag and self-regulation. Control system parameters. Control actions and controller tuning: Basic control actions-on/off mode, multi position mode, floating control mode; Analog and Discrete Control modes: P, P+I, P+I+D, pneumatic and electronic controllers, pneumatic vs hydraulic control, controller tuning.

**MODULE-II (7 hours)**

Introduction to PLC, PAC, DCS and SCADA. IEDs, RTUs, HMI, Smart Sensors and Actuators. IEEE 802.11 / 15 Standards, IEEE 1451.5 Std. Communication Networks for PLC. The Instrument Lists of PLC and HMI. Sequential and Programmable controllers, System Architecture, Programming languages of PLC, Relay logic and Ladder logic, Ladder Diagram Elements.

**MODULE-III (10 hours)**

Computer controlled processes: PLC based control of different types of processes such as liquid level system and flow control, open-and-closed chamber pressure control, temperature control, different types of heat exchangers, control of pressurized gases.

**MODULE-IV (10 hours)**

Discrete State Process Control: Physical Ladder Diagram and Programmable Ladder Diagram. Different Modules of the System Architecture of PLC. Applications of PLC in frost free refrigerator / freezer system; composite discrete / continuous control; conveyor system; oven system; elevator system; uniformly heated liquid control system.

**MODULE-V(5 hours)**

Advances in Automation: Programmable Automation Controllers. NI my-DAQ, my-RIO, c-RIO, and ELVIS. Role of Internet of Things and Cyber Physical System in Industry Automation, MQTT protocol.

**Books:**


1. Peter D. Harriot, "Process Control", Tata McGraw-Hill, New Delhi, 2009.
2. Curtis D. Johnson, "Process Control and Industrial Technology", Pearson India, 8th ed., 2012.
3. Liptak, "Process Control: Instruments Engineer's Handbook", Butterwirth Heinemann, 1995.


**Reference books:**


1. Norman A Anderson, Instrumentation for Process Measurement and Control, CRC Press, 2008.
2. B. Wayne Bequette, "Process Control – Modeling, Design, and Simulation", Pearson India, 2015.
3. John W. Webbs, "Programmable Logic Controllers – Principals and Applications", Fifth Edition, Pearson India /PHI (Old edition), 2012.

**Course Outcomes:**
Upon completion of the course, students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Understand the basic principles and importance of process control applications using automation; |
| CO2 | Enlist the required instrumentation, knowledge of the P&ID, the Instrumentation Lists, and final elements to ensure that well-tuned control is achieved; |
| CO3 | Demonstrate thestudent'sability to pursue a career in electrical engineering, control systems, automation platforms through a diverse range of theoretical skills and practical experience of real time applications; |
| CO4 | Plan, design, install, operate, control and maintain different process and automated applications using PLCs/PACs. Further, PLC / PAC algorithm using Ladder Logic Diagram or equivalent languages while handling a plant process; |
| CO5 | Implement an automation platform such as PACs and IoT while handling a plant process. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 3 | 2 | 1 | - | - | - | - | - | 2 |

# MOBILE COMPUTING (BELOE801)

**Syllabus**

**Module-I (8 Hours)**
Introduction, Mobile computing architecture, Global system for Mobile Communication (GSM) System overview: GSM Architecture, mobility management, Networks signalling.Personal Communications Services: PCS architecture, Mobility management, Network signaling. General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes.

**Module-II (8Hours)**
Mobile Data Communication; WLANs (Wireless LANs) IEEE 802.II standard, Mobile IP,Short Message Service (SMS).

**Module-III (8 hours)**
Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, Wireless Mark-up Languages (WML), Wireless Local Loop (WLL): Introduction to WLL Architecture, Wireless Local Loop Technologies.

**Module-IV (8 hours)**
Global Mobile Satellite Systems: Case studies of the IRIDIUM and GLOBALSTAR systems. Third Generation (3G) Mobile Services: Introduction to international Mobile Telecommunications 2000 (IMT 2000) Vision, Wideband Code division Multiple Access (WCDMA), and CDMA 2000, Quality of services in 3G.

**Module-V (7 hours)**
Introduction to4G ,Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols.

**Text Books:**
1. Mobile Computing Asoke K Talukder, Roopa Yavagal
2. “Mobile Communication”, J. Schiller, Pearson

**Course Outcomes**
Upon completion of the course, the students will:

| | |
|---|---|
| CO1 | Express the basic concept of mobile computing. |
| CO2 | Demonstrate principles of WLAN. |
| CO3 | Analyze the Wireless Application Protocol. |
| CO4 | Apply basic of Third Generation (3G) Mobile Services. |
| CO5 | Implement Blue tooth and Virtual Networks. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 2 |

# UTILIZATION OF ELECTRICAL ENERGY (BELOE802)

**SYLLABUS:**

**Module – I ILLUMINATION FUNDAMENTALS (8hour)**

Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

**Module – II ELECTRIC HEATING AND WELDING(8hour)**

Advantages and methods of electric heating, resistance heating induction heating and dielectric heating. Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

**Module – III ELECTRIC DRIVES (8hour)**

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

**Module – IV ELECTRIC TRACTION (8hour)**

System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

**MODULE –V APPLICATION (8hour)**

Methods of electric braking-plugging rheostatic braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves.

**TEXT BOOKS:**

1. Utilisation of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab, Dhanpat Rai & Sons.

**REFERENCE BOOKS:**

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

**COURSE OUTCOMES:**

Upon completion of the subject the students will demonstrate the ability to:

| | |
|---|---|
| CO1 | Implement the application of electricity for lighting. |
| CO2 | Plan the application of electricity due to heating and welding. |
| CO3 | Incorporate the application of electric drives |
| CO4 | Express application in electric traction. |
| CO5 | Implement speed control and braking applications. |

**Course Articulation Matrix**

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | 3 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 2 |