

**Third Year B.Tech. Sem. V & VI**  
**Electrical Engineering**  
**Credit System And Course Content**  
**Year: 2017-18**

<b>SEMESTER - V</b>	<b>CLASS: T.Y.B.Tech. Electrical</b>		
<b>CODE : BTE 301</b>	<b>COURSE: Electromagnetic Fields and Waves</b>		
Period per week (each of 60 minutes)	Lecture	03	
	Laboratory	---	
	Tutorial	02 per batch	
Scheme of Evaluation		Hours	Marks
	In Semester	01	20*2
	End Semester*	03	100
	Practical	---	---
	Laboratory Work (Journal)/Tutorial	---	25
	Total	---	125

\*60% Weight age for end semester

**Course Objectives:**

1. To introduce the basic mathematical concepts related to electromagnetic vector fields.
2. To impart knowledge on concepts of electrostatics, electric potential, energy density and its applications.
3. To impart knowledge on concepts of magneto statics, magnetic flux density, scalar and vector magnetic potential and its applications.
4. Explain time varying electric and magnetic fields and wave theory

**Course Outcomes:**

1. Ability to understand applies basic science, circuit theory, and electromagnetic theory to electrical engg. problems.
2. Able to demonstrate basics of machines and power system through field theory approach.
3. Use numerical techniques and computerized tools to investigate the performance of power system and machine component at different conditions through field theory.

**Course Contents**

Module	Details	Hrs
1.	<b>Vector Basics:</b> Introduction to Coordinate System: Rectangular, Cylindrical and Spherical Coordinate System, Differential length, area and volume. Introduction to line, Surface and Volume Integrals, Definition of Curl, Divergence and Gradient.	
2.	<b>Static Electric Fields:</b> Coulomb's Law in Vector Form, Definition of Electric Field Intensity, Principle of Super position, Electric Field due to discrete charges, Electric field due to continuous charge distribution, Electric Field due to line charge, Electric Field on the axis of a uniformly charged circular disc, Electric Field due to an infinite uniformly charged sheet. Electric Scalar Potential, Relationship between potential and electric field, Potential due to infinite uniformly charged line Potential due to electrical dipole, Electric Flux Density, Gauss Law and Applications.	
3.	<b>Static Magnetic Fields:</b> Biot Savart Law in vector form, Magnetic Field intensity due to a finite and infinite wire carrying a current I, Magnetic field intensity on the axis of a circular and rectangular loop carrying a current I, Ampere's circuit allow and simple applications. Magnetic flux density, The Lorentz force equation for a moving charge and applications, Force on a wire carrying a current I placed in a magnetic field, Torque on a loop carrying a current I, Magnetic moment, Magnetic Vector Potential.	

4.	<p><b>Electric and Magnetic Fields in Materials:</b>                  Poisson's and Laplace's equation, Electric Polarization, Nature of dielectric materials, Definition of Capacitance, Capacitance of various geometries using Laplace's equation, Electrostatic energy and energy density, Boundary conditions for electric fields, Electric current, Current density, point form of ohm's law, continuity equation for current. Definition of Inductance, Inductance of loops and solenoids, Definition of mutual inductance, simple examples. Energy density in magnetic fields, Nature of magnetic materials, magnetization and permeability, magnetic boundary conditions.</p>	
5.	<p><b>Time varying Electric and Magnetic Fields:</b>                  Faraday's law, Maxwell's Second Equation in integral form from Faraday's Law, Equation expressed in point form. Displacement Current, Ampere's circuit law in integral form, Modified form of Ampere's circuit law as Maxwell's first, equation in integral form, Equation expressed in point form. Maxwell's four equations in integral form and differential form.</p>	
6	<p><b>Wave Theory and power flow :</b>                  Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors. The importance of characteristic impedance and the propagation constant. The wave travel, the concept of phase velocity and group velocity in wave travel. The voltage standing wave ratio. Travelling wave in transmission lines. <b>Power Flow:</b> Poynting Vector and the flow of power, Power flow in a co-axial cable, Instantaneous average and complex Poynting vector</p>	
7	<p><b>Introduction to computational Electromagnetic:</b>                  Introduction to finite difference method (FDM) and finite element method (FEM)</p>	

**Term work:**

Termwork consists of minimum eight tutorials (at least one on each module) and two Computer programs.

**Text books:**

1. W.Hayt, "Engineering electromagnetic", McGraw Hill, 4<sup>th</sup> edition, 1987.
2. Edminister, "Schaum's series in electromagnetic", McGraw Hill publications, 3<sup>rd</sup> edition.
3. N.NarayanRao, "Elements of electromagnetic", PHI publication, 4<sup>th</sup> edition, 2001.
4. E.C.Jordan & K.G.Balmain, "Electromagnetic Waves and Radiating Systems", Prentice
5. Hall of India 2<sup>nd</sup> edition 2003. (Unit IV, V). McGraw Hill

**Reference books:**

1. Fenmann, "Lectures on physics", Vol-2, Addison Wesley, 1965
2. S.seely, "Introduction to electromagnetic fields", McGraw Hill, 1958.
3. David K. cheng, "Field and electromagnetic", Addison Wesley, 2<sup>nd</sup> edition, 1999.
4. Corson and Ierrain, "Electromagnetic", CBS publications, 2<sup>nd</sup> edition, 1986.
5. Ramo, Whinnery and Van Duzer, "Fields and Waves in Communications Electronics", JohnWiley & Sons (3<sup>rd</sup> edition 2003)
6. M.N.O.Sadiku, "Elements of Engineering Electromagnetic", Oxford University Press, Third edition
7. David K, Cherp "Field and Wave Electromagnetics", Second Edition, Pearson Edition
8. David J. Grithiths, "Introduction to Electrodynamics", III Edition, PHI



<b>Sr. No.</b>	<b>Examination</b>	<b>Module</b>
1	T 1	1 , 2
2	T 2	3, 4
3	END SEMESTER	1 to 7

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<b>SEMESTER - V</b>	<b>CLASS: T.Y.B.Tech. Electrical</b>		
<b>CODE: BTE 302</b>	<b>COURSE : Control System- I</b>		
Period per week (each of 60 minutes)	Lecture	03	
	Laboratory	--	
	Tutorial	--	
Scheme of Evaluation		Hours	Marks
	In Semester	01	20*2
	End Semester*	03	100
	Total	---	100

\*60% Weightage for end semester

**Course Objective:**

Student should learn to;

1. Understand and appreciate the philosophy of control system and difference between manual and automatic control system. Distinguish between open loop and closed loop control system.
2. Represent simple physical system into Linear Time Invariant (LTI) mathematical models for analysis in control system context and identify the various specification used in time domain analysis
3. Comment on the different stability criterion for LTI systems and analyse the system from root locus.
4. Understand the idea of compensator and specifically PID, Lead, Lag and Lag-Lead compensator using the Sketch the root locus.
5. Apply root locus technique to design the various compensators as per the system requirements.

**Course Outcomes:**

Student shall be able to;

1. Convincingly identify the difference between open loop, closed loop, automatic and manual control system. Transform simple physical system into the LTI models and shall be able to quantify system performance in terms of time domain specifications.
2. Comment on the stability of the system given to them by applying various stability criterions.
3. Draw the root locus sketch of the given LTI system and analyse them for various specifications. Explain the need of compensator and appreciate the use of compensator to improve the performance of the LTI system.
4. Design the various compensators for the LTI system as per the given required specifications through root locus sketch and test the designed compensators performance through simulations.

**Course Contents:**

Module	Details	Hrs
	<b>Pre requisite:</b> Electrical Network.	
<b>1.</b>	<b>Concept of Open loop and Closed loop Systems:</b> Examples and applications of open and closed loop systems. Control system components, Examples	
<b>2.</b>	<b>Mathematical Modelling:</b> Representation of physical system by differential equations. Transfer Function, Block diagram reduction technique, Signal flow graph	

	method	
3.	<b>Time response analysis:</b> Time response Analysis of first order and second order systems. Steady state error and error constants. Design specifications in time domain.	
4.	<b>Stability of the System:</b> Absolute stability and relative stability, Routh Hurwitz's stability criterion.	
5.	<b>Root Locus:</b> Definition, Properties, and Sketching Rules, stability analysis from root locus. Effect of addition of poles and zeros, Sensitivity and root locus	
6.	<b>Compensator / Controller:</b> Elementary ideas of compensating network, PID, Lag, Lead and Lag, lead.	
7.	<b>Design via root locus techniques:</b> Cascade compensation (P, PI, PD, PID, Lag, Lead) and Feedback compensation Design.	

**Term Work:**

Term work shall consist of minimum 8 Simulations / Practical /demonstrations based on topics such as-

1. Mathematical model of physical systems
2. Time response analysis
3. Stability analysis
4. Design of compensators

**Text Books:**

1. Norman Nise, "Control Systems Engineering", 4<sup>th</sup> Edition 1995
2. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt.Ltd
3. I.G. Nagrath & M. Gopal, "Control Systems Engineering", Wiley Eastern Ltd 5<sup>th</sup> Edition, 2000.

**Reference Books:**

1. J.J. D'Azzo, C.H.Houpis and S.N. Sheldon, "Linear Control System Analysis and Design with MATLAB", Marcel Dekker, 2003.
2. G.F Franklin, "Feedback Control of Dynamic Systems", Pearson higher Education.

Sr. No.	Examination	Module
1	T1	1 , 2, 3
2	T2	4, 5
3	END SEMESTER	1 to 7

<b>SEMESTER-V</b>	<b>CLASS: T.Y. B.Tech. (Electrical)</b>		
<b>CODE:BTE351</b>	<b>COURSE: Control System I Lab</b>		
Period per week (each of 60 minutes)	Lecture	-	
	Laboratory	02perbatch	
	Tutorial	---	
Scheme of Evaluation		Hours	Marks
	In Semester	-	
	End Semester*	-	-
	Practical	02	25
	Laboratory Work(Journal)		
	TOTAL		25

**Course Objective:**

Student should learn to;

1. Simulate the First Order, Second order and higher order system for time response analysis.
2. Analyse system properties by simulating system in MATLAB through root locus.
3. Design PI, PD and PID controller as per the given specification through root locus by simulating system in MATLAB.
4. Design Lag, Lead and Lag-Lead controller as per the given specification through root locus by simulating system in MATLAB.

**Course Outcomes:**

Student shall be able to;

1. Analyse dynamical system through MATLAB simulation and quantify its specifications.
2. Analyse given system through root locus technique by using MATLAB.
3. Decide and design PI or PD or PID or Lag, Lead or Lag-Lead controller depending on the required specification through root locus technique by using MATLAB.

**List of Experiments:**

1. Simulate the various first order, second order and higher order open loop system and observe the performance of the systems.
2. Simulate the simple open loop and closed loop transfer functions and observe the effect of feedback on system performances and comment on the difference.
3. Simulate the typical second order system for various combinations of damping ratio and natural frequency of oscillations. Note down the various observations and verify them with hand calculations.
4. Simulate to plot the root locus of different transfer functions representing various systems and note down the observations from the root locus. Verify them by plotting them in time scale.
5. Design the PI, PD and PID controller for meeting the required specifications through Root Locus and verify them through time domain simulations.
6. Design the Lag, Lead and Lag-Lead compensator for meeting the required specifications through Root Locus and verify them through time domain simulations.
7. Observe through simulations effect of changing gains if PID controller and comment on the observations.

<b>SEMESTER - V</b>	<b>CLASS: T.Y.B.Tech. Electrical</b>		
<b>CODE : BTE 303</b>	<b>COURSE: Electrical Machines II</b>		
Period per week (each of 60 minutes)	Lecture	03	
	Laboratory	--	
	Tutorial	---	
Scheme of Evaluation		Hours	Marks
	In Semester	01	20*2
	End Semester*	03	100
	Total	---	100

\*60% Weightage for end semester

**Course Objectives:**

1. Discuss the principle and operation of generating machine both 1-phase and 3-phase
2. Demonstrate the behaviour of generating and motoring machine for different operating conditions.
3. Demonstrate the principle of fractional kilowatt machine
4. Discuss the special types of machines and applications (motors and generators)

**Course Outcomes**

1. Able to illustrate the fundamental concept of electrical machine in electrical power generation
2. Able to analyse synchronous machine performance using trigonometry, complex algebra, and phasors to find correct solutions.
3. Able to apply the knowledge of basic machines to understand the operation of single phase induction machines and special machines

**Course Contents**

Module	Details	Hrs
1.	<b>Synchronous Machines:</b> Construction, emf induced, winding factors, Armature reaction, Phasor diagrams of cylindrical pole synchronous generator at different power factor	
2.	Methods of voltage regulation of alternator.	
3.	(i) Principle of operation of Synchronous Motor, starting methods. Power flow and maximum power of synchronous machines, (ii) Excitation & power circles, V & O curves, power angle characteristics, synchronizing power and torque, hunting, synchronous condenser	
4.	Operation on infinite bus for a change in excitation for motors and generators, Parallel operation of alternators, Load sharing	
5.	<b>Salient pole machine:</b> Blondel's two reaction theory, Measurement of $X_d$ & $X_q$ , Power flow equation.	

<b>6.</b>	<b>Fractional kW machines:</b> Construction, principle of operation. and applications of Single phase induction motor, capacitor start, capacitor run motor, Shaded pole motor.	
<b>7.</b>	<b>Special purpose Machines:</b> Construction, principle of operation and applications of Stepper motor and their types, Permanent Magnet Synchronous Motor, Brushless DC motor.	

**Term-work:-**

Term work shall consist of minimum six practicals and one mini project/seminar ( in group of maximum 5 students).

**Text Books:**

- 1.Nagrath and Kothari, “Electrical Machines”, TMH Publication, 4<sup>th</sup> edition, 2010.
- 2.Sen P. C., “Principles of Electric Machines & Power Electronics”, 2<sup>nd</sup> edition, 2007.
- 3.Bimbhra P.S, “Electrical Machinery”, Khanna Publisher, VII Edition.
- 4.Bimbhra P.S., “Generalized Theory of Electrical Machines”, Khanna Publisher, 5<sup>th</sup> Edition.
- 5.Gross Charles A., “Electrical Machines”, CRC Press, 2007.

**Reference Books:**

- 1.M. G. Say, “Performance and Design of AC Machines”, CBS Publisher
- 2.Fitzgerald et. al, “Electrical Machinery”, Mc Hill Publication, 6<sup>th</sup> edition
- 3.Theodore Wildi, “Electrical Machines, Drives, and Power System”, Pearson Education,
4. 6<sup>th</sup> edition, 2007

Sr. No.	Examination	Module
1	T1	1 , 2, 3(i)
2	T2	3(ii), 4, 5
3	END SEMESTER	1 to 7

<b>SEMESTER-V</b>	<b>CLASS: T.Y. B.Tech. (Electrical)</b>		
<b>CODE:BTE352</b>	<b>COURSE: Electrical Machines–II Lab</b>		
Period per week (each of 60 minutes)	Lecture	-	
	Laboratory	02perbatch	
	Tutorial	---	
Scheme of Evaluation		Hours	Marks
	In Semester	-	
	End Semester*	-	-
	Practical	02	25
	Laboratory Work(Journal)		
	TOTAL		25

Distribution of marks for in semester evaluation will as under, Attendance - 20 %, practical Performed during semester and graded assignment submission/ – 40 %, /Practical Examination/mini project – 40 %

**Course objectives:**

1. To conduct experiment to carry out Voltage Regulation on synchronous Generator by different methods
2. To conduct experiment to draw V and inverted v curves for synchronous motor
3. To calculate  $X_d$  and  $X_q$  of a salient pole synchronous motor
4. To learn testing of single phase Induction Motor

**Course outcomes:**

The student will be able to

1. Perform experiments on synchronous machines with defined procedures and safety.
2. Understand the voltage regulation in synchronous generator and different methods to find it.
3. Analyze the V curve and inverted V-curve for synchronous machine from the collected data under various load conditions.
4. Observe the voltage and current behaviour of salient pole synchronous machine during slip test and to find  $X_d$  and  $X_q$  from measurements.

**List of Experiments:**

1. Voltage Regulation of synchronous generator by EMF/MMF method
2. Voltage Regulation of synchronous generator by ZPF method
3. Voltage Regulation of synchronous generator ASA Method
4. Voltage regulation of synchronous generator by direct loading
5. Slip Test on salient pole synchronous generator
6. V-curves and inverted V- Curves F-curves of synchronous motor
7. Performance characteristics of single phase induction motor

<b>SEMESTER - V</b>	<b>CLASS: T.Y. B. Tech. Electrical</b>		
<b>CODE : BTE 304</b>	<b>COURSE: Power System Analysis</b>		
Period per week (each of 60 minutes)	Lecture	03	
	Laboratory	---	
	Tutorial	02 per batch	
Scheme of Evaluation		Hours	Marks
	In Semester	01	20*2
	End Semester*	03	100
	Practical	---	---
	Laboratory Work (Journal)	---	25
	Total	---	125

\* 60% Weightage for end semester

### Course Objectives:

1. Discuss an unbalanced three phase power system.
2. Understand the behavior of the system under symmetrical and unsymmetrical fault condition.
3. Discuss load flow studies in the system.
4. Understand the steady state and transient stability of the system.
5. Understand travelling wave phenomena.

### Course Outcomes

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

1. Compare the fault current for different types of the fault on the system.
2. Formulate  $Y_{bus}$  for a connected system and classify different types of buses and implement different methods of performing load flow studies.
3. Implement different methods classify and analyze system stability issues.
4. Analyze behavior of the power system during high frequency transient.

### Course Contents

Module	Details	Hrs
	<b>Pre-requisite:</b> Graph Theory, Numerical Techniques, Per Unit system	
1.	<b>Symmetrical Components:</b> Unbalanced system Analysis using symmetrical components, Power in terms of symmetrical components, Sequence circuits of transmission lines, transformer and Synchronous Machines, Phase shift in star delta transformer, Formation of Sequence Networks.	
2.	<b>Symmetrical and Unsymmetrical Fault Analysis:</b> (i) 3 phase Short circuit of a synchronous machine: no load and loaded conditions, 3 phase fault on a transmission line, Short circuit MVA Capacity of a bus. (ii) Fault analysis using symmetrical components, Single line to ground (SLG) fault, Line to line (LL) fault, Double line to ground (LLG) fault, Open conductor fault.	

<b>3.</b>	<b>Admittance Model, Impedance Model and Network Calculation:</b> Nodal admittance matrix, Network incidence matrix and $Y_{bus}$ , Review of Gaussian Elimination, Triangular Factorization (LU Decomposition), Sparsity and Optimal ordering, Bus Admittance and Impedance Matrices, Calculation of $Z_{bus}$ from $Y_{bus}$	
<b>4.</b>	<b>Load Flow Studies:</b> Power Flow Problem, Gauss Seidel (GS) method, Newton Raphson (NR) method, Decoupled & Fast Decoupled method, Comparison of different load flow methods.	
<b>5.</b>	<b>Power System Stability:</b> Classification of Stability, Dynamics of synchronous machine, Power angle equation, Node elimination technique, Stability study of simple systems, Steady state stability.	
<b>6.</b>	<b>Transient stability:</b> Equal area criteria and its applications, Numerical Solution of Swing Equation. Factors affecting Transient Stability.	
<b>7.</b>	<b>Travelling waves in transmission lines:</b> wave equation, reflection and refraction of waves, Bewely Lattice Diagram, typical cases of line terminations.	

**Term-work:-**

Term work shall consist of six tutorials covering the entire syllabus and minimum two computer programs or simulations.

Recommended Simulation software: MATLAB, ETAP, Virtual Lab.

For Virtual Lab access refer web link [www.vlab.co.in](http://www.vlab.co.in)

**TextBooks:**

1. Kothari D. P Nagrath I. J., "Modern Power System Analysis", TMH Publications, 3<sup>rd</sup> Ed. 2008.
2. Wadhawa C. L., "Electrical Power Systems", New Age International, 4<sup>th</sup> Edition, 2007.
3. Grainger J. J., Stevenson Jr W. D., "Power System Analysis", McGRAW-HILL International
4. George Kausic., "Computer Aided Power System Analysis", Prentice Hall Pub.2008.

**ReferenceBooks:**

1. Saadat Hadi, "Power System Analysis, "TMH Edition, 2003.
2. Prabha Kundur, "Power System Stability and Control", TMH Publication, 2008
3. [www.cdeep.iitb.ac.in/nptel/Electrical\\_Engineering/Power\\_System\\_Protection](http://www.cdeep.iitb.ac.in/nptel/Electrical_Engineering/Power_System_Protection)

Sr. No.	Examination	Module
1	T1	1, 2(i)
2	T2	2(ii), 3
3	END SEMESTER	1 to 7

<b>SEMESTER - V</b>	<b>CLASS: T.Y. B. Tech. Electrical</b>		
<b>CODE : BTE 305</b>	<b>COURSE: Digital Signal Processing</b>		
Period per week (each of 60 minutes)	Lecture	03	
	Laboratory	---	
	Tutorial		
Scheme of Evaluation		Hours	Marks
	In Semester	01	20*2
	End Semester*	03	100
	Practical	---	---
	Laboratory Work (Journal)	---	
	Total	---	100

\* 60% Weightage for end semester

**Course Objectives:**

In this course students are expected to:

1. Get familiarized with representation of real world signals in digital format and understand transform-domain (Fourier and z-transforms) representation of the signals;
2. Learn the relationship between transforms such as ZT, DTFT, DFT, and calculate those for various signals;
3. Learn designing and applications of different types of filters and their real-time implementation.
4. Understand simulation of various signal processing operations and systems using programming languages such as MATLAB;

**Course Outcomes:**

After completion of this course students are expected to be able to:

1. Analysis of signals & systems in time domain and transform domain.
2. Apply signal processing operations such as DTFT, DFT, FFT, etc. required in various practical electrical, electronics systems such as speech processing, image processing etc.
3. Design various electrical filters suitable for each real world application.
4. Implement various signal processing systems in high level programming languages such as
5. MATLAB.

Unit	Contents	Hrs.
<b>1</b>	Review of Discrete-time signals and systems Review of time-domain analysis of discrete-time systems	
<b>2</b>	<b>Frequency domain analysis of LTI Systems</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Frequency domain representation of discrete-time signals and systems.</li> <li>• Relation between difference equations, z-transform and Fourier transform.</li> <li>• DTFT</li> <li>• Frequency domain analysis of systems using analytical and graphical techniques.</li> <li>• Plotting magnitude and phase response of discrete-time LTI systems.</li> <li>• System classification such as LPF, HPF, BPF, BSF, etc based on pass-band characteristics.</li> <li>• System classification such as Minimum phase, Maximum phase, mixed phase, linear phase based on phase response.</li> </ul>	
<b>3</b>	<b>Discrete Fourier Transform</b> <ul style="list-style-type: none"> <li>• Introduction</li> </ul>	

	<ul style="list-style-type: none"> <li>• Discrete Fourier series and its properties.</li> <li>• Relation between z-transform, DTFT and DFT.</li> <li>• DFT, IDFT definition and calculations of DFT and IDFT coefficients.</li> <li>• Introduction to twiddle factor, zero padding.</li> <li>• Properties of DFT</li> <li>• Circulation convolution, comparison between linear and circulation convolution, circulation convolution using graphical and analytical method.</li> <li>• Circulation convolution using DFT / IDFT</li> <li>• Response of LTI system (linear convolution or linear filtering) using circulation convolution</li> <li>• Response of LTI system (linear convolution or linear filtering) using DFT / IDFT</li> </ul>	
<b>4</b>	<b>Fast Fourier Transform Algorithms</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Comparison of computation complexity of direct computation of DFT and FFT.</li> <li>• Radix-2 Decimation in Time algorithm, 4-point and 8-point DFT</li> <li>• Radix-2 Decimation in Frequency algorithm, 4-point and 8-point DFT</li> <li>• IDFT using FFT algorithms.</li> <li>• Circular convolution using FFT algorithms.</li> </ul>	
<b>5</b>	<b>Linear Phase FIR Systems</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Condition for linear phase, need, advantages, properties.</li> <li>• Systems having symmetric and antisymmetric impulse response.</li> <li>• Frequency response of four types linear phase FIR systems having symmetric and antisymmetric impulse response with even and odd lengths.</li> <li>• Location of zeros for linear phase FIR systems.</li> </ul>	
<b>6</b>	<b>FIR Filter Designing</b> <ul style="list-style-type: none"> <li>• Introduction: Linear Phase FIR Filters, Frequency response of different types of linear phase FIR Filters, Locations of definite zeros of different types of FIR Filters.</li> <li>• Designing of FIR filters using windowing technique, Gibbs Phenomenon (Hamming, Hanning, Rectangular, Bartlett window functions)</li> <li>• Designing of FIR filters using Kaiser Window Function</li> <li>• Designing of FIR filters using frequency sampling technique, frequency sampling realization of FIR Filters,</li> <li>• Half Band FIR Filers.</li> </ul>	
<b>7</b>	<b>IIR Filter Designing</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Designing of analog IIR filters using Butterworth, Chebyshev and inverse Chebyshev approximation</li> <li>• Analog to analog spectral transformations,</li> <li>• Designing of IIR digital filters using impulse invariance method, stability properties, effects of aliasing. Designing IIR digital filters using step invariance method, ramp invariance method.</li> <li>• Designing of IIR digital filters using bilinear transformation method, stability properties. Designing of IIR digital filters using matched z-transformation method, backward difference algorithm.</li> </ul>	

**Books Recommended:**

1. Digital Signal Processing, Oppenheim & Scaffer, Prentice Hall of India, 2<sup>nd</sup> Ed.
2. Digital Signal Processing, Proakis, Manolakis, Tata McGraw Hill, 3<sup>rd</sup> Ed.
3. Digital Signal Processing, P. Ramesh Babu, Scietch Pub., 3<sup>rd</sup> Ed.
4. Digital Signal Processing, S. Salivahanan, et. al., Tata McGraw Hill, 2<sup>nd</sup> Ed.

<b>Sr. No.</b>	<b>Examination</b>	<b>Module</b>
1	T1	1 , 2, 3
2	T2	4, 5
3	END SEMESTER	1 to 7

<b>SEMESTER-V</b>	<b>CLASS: T.Y. B.Tech. (Electrical)</b>		
<b>CODE:BTE353</b>	<b>COURSE: Digital signal Processing Lab</b>		
Period per week (each of 60 minutes)	Lecture	-	
	Laboratory	02/batch	
	Tutorial	---	
Scheme of Evaluation		Hours	Marks
	In Semester	-	--
	End Semester*	-	-
	Practical	02	25
	Laboratory Work(Journal)		
	TOTAL		25

### **Course Objective**

In this course students are expected to:

1. Get familiarized with representation of real world signals in digital format and understand transform-domain (Fourier and z-transforms) representation of the signals;
2. Learn the relationship between transforms such as ZT, DTFT, DFT, and calculate those for various signals;
3. Learn designing and applications of different types of filters and their real-time implementation.
4. Understand simulation of various signal processing operations and systems using programming languages such as MATLAB;

### **Course Outcomes**

After completion of this course students are expected to be able to:

1. Understand analysis of signals & systems in time domain and transform domain.
2. Learn basic signal processing operations such as DTFT, DFT, FFT, etc. required in various practical electrical, electronic systems such as speech processing, image processing etc.
3. Design various electrical filters suitable for each real world application.
4. Implement various signal processing systems in high level programming languages such as MATLAB.

### **List of Experiments:**

Term work consists of any five programs/simulations of the following in MATLAB.

1. Plotting magnitude and phase response of system (DTFT).
2. Calculation of DFT.
3. Calculation of IDFT.
4. Linear convolution using DFT / IDFT method.
5. Circulation convolution.
6. Circular convolution using DFT / IDFT.
7. Linear convolution using Circular convolution.
8. Implementation of IIR analog LPF, HPF using Butterworth approximation.
9. Implementation of IIR analog LPF, HPF using Chebyshev approximation.
10. Implementation of IIR analog LPF, HPF using inverse Chebyshev approximation.
11. Implementation of FIR filters using any window function such as Rectangular, Bartlett, Blackman, Hamming, Hanning, etc.

<b>SEMESTE – V</b>	<b>CLASS: T.Y.B.Tech. Electrical</b>		
<b>CODE: BTE306</b>	<b>COURSE: Power Electronics</b>		
Period per week (each of 60 minutes)	Lecture	03	
	Laboratory	--	
	Tutorial	--	
		Hours	Marks
Scheme of Evaluation	In Semester	01	20*2
	End Semester*	03	100
	Total	---	100

\* 60% Weightage for end semester

**Course Objectives:**

1. Explain controlled converters
2. Analyze current and voltage inverters and demonstrate the operation and control of inverter circuits
3. Discuss DC to DC converters
4. Discuss need and application of AC filters

**Course Outcomes**

At the end of the course the student will be able to:

1. Understand the behavior of semiconductor devices operated as power switches.
2. Analyze and design rectifier circuit.
3. Analyze DC/DC converter circuits.
4. Analyze DC/AC inverter circuit.

**Course Contents:**

Module	Details	Hrs
<b>1.</b>	<b>Silicon Controlled Rectifiers:</b> Principle of operation of SCR, Static & Dynamic characteristics, Gate characteristics, pulse firing	
<b>2.</b>	<b>Other Switching Devices:</b> Principle of operation, characteristics, rating and applications of Triac, MOSFET, IGBT and power diodes, GTO. Comparison of devices on the basis of turn on, turn off time.	
<b>3.</b>	<b>Rectifiers:</b> Introduction to Half wave uncontrolled and controlled rectifiers with different load Full wave controlled rectifiers with different load (single phase and three phase) Power factor improvements in rectifiers. Effect of load and source inductances	
<b>4.</b>	<b>AC Filters:</b> AC filter for grid connected converter, AC inductor design and need of LCL filter, LCL filter design	

<b>5.</b>	<b>Inverters:</b> (i) Principle of operation, Performance parameters, Single phase bridge Inverters with R-L, R-L-E and pure L load. 3 phase bridge Inverters: 180 degree conduction mode. (ii) Voltage control of single phase and three phase inverters using PWM techniques, Connection of three phase inverter to grid, concept of active and reactive power flow between inverter and grid (iii) Current source inverters (iv) Space vector modulation	
<b>6.</b>	<b>Choppers:</b> Switching mode regulators – Buck, Boost, Buck-Boost and Cuk regulators, Bi-directional Chopper	
<b>7.</b>	<b>AC Voltage Controllers:</b> Principle of Phase Control, Single Phase bidirectional control with R-L load, Three phase full wave controllers, AC voltage controllers with PWM control, Applications	

**Term Work:-**

Term Work shall consist of minimum eight practicals covering the entire syllabus and two computer programs or simulations.

**Text Books:**

1. Muhammad H. Rashid, “Power Electronics, Circuits Devices and Applications”, Third Edition, Prentice-Hall of India, 2006
2. Ned Mohan et. al, “Power Electronics: Converters, Applications and Design”, 3rd Ed., John Wiley Pub.
3. Alok Jain, “Power Electronics & its Applications,” Penram International Publishing (India) Pvt. Ltd.

**Reference Book:**

1. Cyril W. Landers, “Power Electronics”, McGraw Hill, 1993
2. M. D. Singh, K. B. Khanchandani, “Power Electronics” Tata McGraw Hill, 2003
3. P.C.Sen, “Power Electronics”, Tata McGraw-Hill Education, 2001  
Related Websites
4. A.V.d. Bossche and V. C. Valchev, “Inductor and Transformer for power electronics”. Boca Raton : Taylor and Francis, 2005
5. W.G. Hurley and W.H. Wolfle, “Transformer and Inductor for power Electronics : theory, design and applications” , 1<sup>st</sup> edition. Somerset ,NJ, USA : John Wiley and sons 2013.

Sr. No.	Examination	Module
1	T1	1 , 2, 3
2	T2	4, 5(i)
3	END SEMESTER	1 to 7

<b>SEMESTER-V</b>	<b>CLASS: T.Y. B.Tech. (Electrical)</b>		
<b>CODE:BTE354</b>	<b>COURSE: Power Electronics Lab</b>		
Period per week (each of 60 minutes)	Lecture	-	
	Laboratory	02 per batch	
	Tutorial	---	
Scheme of Evaluation		Hours	Marks
	In Semester	-	--
	End Semester	-	-
	Practical	02	25
	Laboratory Work(Journal)		
	TOTAL		25

Distribution of marks for in semester evaluation will as under, Attendance - 20 %, practical Performed during semester and graded assignment submission/ – 40 %, /Practical Examination/mini project – 40 %

### **Course Objective**

1. To simulate various converter circuits.
2. To familiarize the students by introducing MATLAB simulation and help them to simulate and analyze different Converters .

### **Course Outcomes**

A student who successfully fulfills the course requirements will be able to

1. Simulate uncontrolled and controlled rectifiers on software
2. Observe and analyze various converter waveforms for different loads.
3. Apply knowledge of dual converter in DC motor applications.
4. Execute three phase bridge rectifier connections and analyze waveforms
5. Identify difference in ideal and practical power electronics circuits

### **List of Experiments:**

1. Half wave diode converter
2. Half wave S.C.R. converter
3. Single phase Full wave fully controlled S.C.R. converter with resistive load.
4. Single phase Full wave fully controlled S.C.R. converter with RL load.
5. 3 phase full wave fully controlled S.C.R. converter with resistive load
6. Separately excited DC motor speed control using Dual Converter
7. Single phase Inverter
8. 2 Matlab simulations of uncontrolled & controlled converters

**Third Year B.Tech. Sem. VI**  
**Electrical Engineering**  
**Credit System And Course Content**  
**Year 2017-18**

<b>SEMESTER - VI</b>	<b>CLASS: T.Y.B.Tech. Electrical</b>		
<b>CODE : BTE326</b>	<b>COURSE: Power System Operation and Control</b>		
Period per week (each of 60 minutes)	Lecture	03	
	Laboratory	---	
	Tutorial	02 per batch	
Scheme of Evaluation		Hours	Marks
	In Semester	01	20*2
	End Semester*	03	100
	Practical	---	---
	Laboratory Work (Journal)	---	25
	Total	---	125

\* 60% Weightage for end semester

**Course Objectives:**

1. To review the effect of different equipment constraints on operation of power system.
2. Discuss the effect of change in load on the frequency and also to study the effect of change in frequency on the active power.
3. Discuss the effect of reactive power on the voltage.
4. Understand the methods to control the reactive power and the active power of the system.

**Course Outcomes**

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

1. Describe the effects equality constraints and inequality constraints on the operation of the power system.
2. Demonstrate the methods of controlling frequency of the system.
3. List different methods of compensating a system to maintain voltage of the system and Compare different methods to control power flowing through the tie line.
4. Select the generators for optimal load scheduling.
5. Illustrate the deregulated structure of the power system.

**Course Contents:**

Module	Details	Hrs
	<b>Pre-requisite:</b> Performance of lines, load flow, Stability of power system.	
1.	<b>Equipment and Stability Constraints in System Operation:</b> Generator constraints, generator capability curves, transmission line constraints, thermal and dielectric limitations of a transmission line, effect of loading on voltages, power transmission capability versus distance, stability problems in power systems, large disturbance angle stability, voltage instability.	
2.	<b>Voltage and Reactive Power Flow Control:</b> Production and absorption of reactive power, means of voltage control in power systems, generator excitation systems and reactive power characteristics of power system components	

3.	Introduction to reactive power characteristics of special devices such as HVDC converters, static var compensators etc.	
4.	<b>Power Flow Control:</b> Series compensation of lines, thyristor controlled series compensator, phase shifting transformers, ac-dc-ac conversion, dc link vs TCSC controlled ac link.	
5.	<b>Frequency Control in a Power System:</b> (i) Relationship between generator rotor speeds and "system frequency" during transients, (ii) Calculation of system frequency, frequency control, speed governor, automatic generation control (AGC).	
6.	<b>Real Power Scheduling:</b> Constraints on system operation, real power scheduling, merit order dispatch, economic dispatch, some issues in economic dispatch optimal power flow.	
7.	<b>Structure of a Deregulated Industry:</b> Power system structure, the reasons for restructuring, structure of a deregulated industry. Different entities in a deregulated industry, Indian scenario.	

**Term Work:-**

Term Work shall consist of minimum six tutorials covering the entire syllabus and two computer programs or simulations.

**Text Books:**

1. Kothari. D. P, Nagrath. I. J., "Modern Power System Analysis", TMH Publication, Third Edition, 2008.
2. www.cdeep.iitb.ac.in/nptel/Electrical Engineering/Power System Operation and Control
3. Chakrabarti .A, Halder. S, "Power System Analysis- Operation and Control", PHI, Second Edition 2008
4. Prabha Kundur, "Power System Stability and Control", TMH Publication, 2008.

**Reference Books:**

1. Hingorani N.G., "Understanding of Facts", Wiley Publications, 2013.
2. Allen. J. Wood., Bruce. F. Wollenberg, "Power Generation operation and Control", Wiley India, 2<sup>nd</sup> Ed., 2007.

Sr. No.	Examination	Module
1	T1	1 , 2(i)
2	T2	2(ii), 3, 4
3	END SEMESTER	1 to 7

<b>SEMESTER - VI</b>	<b>CLASS: T.Y.B.Tech. Electrical</b>		
<b>CODE : BTE 327</b>	<b>COURSE: Control System- II</b>		
Period per week (each of 60 minutes)	Lecture	03	
	Laboratory	--	
	Tutorial	--	
Scheme of Evaluation		Hours	Marks
	In Semester	01	20*2
	End Semester*	03	100
	Total	---	100

\* 60% Weightage for end semester

**Course Objectives:**

Student should learn to;

1. Sketch, understand and analyze Polar plot, Nyquist plot and Bode plot for LTI system.  
 Appreciate the stability concepts Gain margin and Phase Margin in analyzing LTI system in frequency domain. Distinguish between frequency domain and time domain specifications and learn to find relation among them. Design the compensator like Leg, Lead and Lag-Lead to satisfy the given requirements through the Bode Plots.
2. Represent the simple system into state space model and define various forms of state model. The meaning of State trajectory and relationship between state model and transfer function in case of a linear system. The concept of Similarity transformation and its invariance properties.
3. Find the solution of state model and understand the concept of Eigen values, Eigen vectors, state transition matrix, Generalized Eigen Vector and Modal Matrix. The technique to transfer any state model to canonical form using Modal Matrix. The concept of Controllability and Observability and techniques to determine the for LTI model.
4. The methods for design of controller i.e. pole placement technique to meet the specific requirements as well as design the observer while appreciating the importance of observer.

**Course Outcomes:**

After completion of the course student will be able to;

1. Sketch the Polar plot, Nyquist plot and Bode of a given system and analyse them in frequency domain by finding frequency domain specifications and stability margins and find the compensator for a given specifications by designing them using Bode Plot as tool and verify the design through simulations.
2. Represent the simple physical system into state model and will be able to explain invariance of stability properties under similarity transformation. Provide solution of given state space model through different methods and simulate the state trajectories in Matlab. Transform simple linear state model into canonical i.e. diagonalized state model.

3. Find the controllability and observability of LTI state model. Design the various controllers for the LTI state model as per the given required specifications through pole placement technique and verify the design through simulation in Matlab.
4. Design the Observer for the system whose state variable is not accessible and verify the design through simulations in MATLAB.

**Course Contents:**

Module	Details	Hrs
	<b>Pre-requisite</b> : Electrical Network, Control System- I	
1	<b>Frequency response Analysis:</b> Nyquist plot, Polar Plot and Bode plot. Frequency Domain Specifications. Principle of Argument, Nyquist Stability criterion for minimum phase system. Gain Margin and Phase Margin concept in Nyquist plot and bode plot.	
2	Design specification in frequency domain and their co-relation with time domain Design via Frequency response techniques: Transient and steady state compensation by gain, lag, lead and lag-lead compensator through Bode Plot.	
3	<b>State Variable Analysis:</b> Concept of state, state variables and state model. Concept of state space, state trajectory and Vector matrix representation of state model. Physical, phase and canonical state space representation. Transfer function from state model.	
4	Similarity transformation. Invariance properties of Similarity transformation. Controllability canonical form, Observability Canonical form, Diagonal Canonical Form and Jordan Canonical Form.	
5	Solution of state equation. State Transition Matrix (STM): Significance and Properties. Evaluation of STM. Characteristics equation, Eigen Values, Eigen Vectors, Generalized Eigen Vector and Modal Matrix. Diagonalization of a square Matrix. Stability in State Space.	
6	Controllability and Observability concept. Gilbert and Kalman test for controllability and Observability. Invariant theorems on controllability and observability.	
7.	Controller Design (Pole Placement technique) in state space. Observer: Concept and requirement analysis. Observer Design.	

**Term Work:**

Term work shall consist of minimum 8 Simulations / Practical's /demonstrations based on topics such as-

1. State variable representation of physical systems
2. Representation of physical systems using Z transforms
3. Frequency response analysis
4. Design of controllers

**Text Books:**

1. Norman Nise, "Control Systems Engineering", Wiley students Edition, 4<sup>th</sup> Edition, year
2. Jacqueline Wilkie, et al, "Control Engineering an Introductory course", Palgrave, 1<sup>st</sup> Edition, 2002
3. K.Ogata, "Modern Control Engineering", Prentice Hall, 4<sup>th</sup> Edition

4. I.G Nagrath and M.Gopal, “Control Systems Engineering “, Wiley Eastern Limited, 5<sup>th</sup> Edition,

**Reference Books:**

1. J.J D’Azzo et al “Linear Control System Analysis and Design with MATLAB”, Marcel Dekker, 2003.
2. G.F Franklin, “Feedback Control of Dynamic Systems”, Pearson higher Education, 2002.

<b>Sr. No.</b>	<b>Examination</b>	<b>Module</b>
1	T1	1 , 2, 3(i)
2	T2	3(ii), 4, 5(i)
3	END SEMESTER	1 to 7

<b>SEMESTER-VI</b>	<b>CLASS: T.Y. B.Tech. (Electrical)</b>		
<b>CODE:BTE376</b>	<b>COURSE: Control system II Lab</b>		
Period per week (each of 60 minutes)	Lecture	-	
	Laboratory	02 per batch	
	Tutorial	---	
Scheme of Evaluation		Hours	Marks
	In Semester	-	
	End Semester*	-	-
	Practical	02	25
	Laboratory Work(Journal)		
	TOTAL		25

**Course Objectives:**

Student should learn to;

1. Use MATLAB to simulate the transfer function in frequency domain and extract the specifications as well as stability information from simulations by observing Polar Plot, Bode Plot or Nyquist Plot.
2. Design the lag, lead and lag-lead compensator using bode plot through MATLAB simulations for required specifications.
3. Simulate solution of state space equation in MATLAB.
4. Design state feedback controller and observer for state space represented LTI system .

**Course Outcomes:**

After completion of the course student will be able to;

1. Confidently simulate the transfer function in frequency domain and derive specification from it to analyse the system.
2. Design the compensator like lag, lead and lag-lead as per the given required specifications.
3. Simulate solution of LTI state space system and derive various specifications from it.
4. Design state feedback controller and observer once given a LTI system in state space along with required specifications.

**List of Experiments:**

1. Simulate the various first order, second order and higher order open loop system for frequency domain and observe the performance of the systems in frequency domain context.
2. Simulate the typical second order system for various combinations of damping ratio and natural frequency of oscillations through frequency domain and observe frequency domain specifications. Note down the various observations and verify them with hand calculations.
3. Simulate to observe Polar plot, Bode plot and Nyquist plot for various transfer functions and note down the observations and verify them through calculations. Also note down Gain Margin and Phase Margin observations in Bode and Nyquist plot.
4. Design the Lag, Lead and Lag-Lead compensator for meeting the required specifications through Bode Plot and verify them through time domain simulations.

5. Simulate various orders linear state space model for solution of state equation for different nature of input. Observe and note the nature of state trajectory, write your comments and conclusion based on eigen values of the state model.
6. Choose various state models for understanding the concept of Controllability and Observability and note down your observations.
  - a. Observe the nature of Eigen values and Eigen Vector of the system.
7. Design the controller using complete state feedback to meet the required specifications and verify them using simulations.
8. Design the observer for estimating the full states of the system and simulate the same.
9. Design the controller using full state feedback from the observer and simulate the same.

<b>SEMESTER-VI</b>	<b>CLASS: T.Y. B.Tech. (Electrical)</b>		
<b>CODE: BTE328</b>	<b>COURSE: Communication Engineering</b>		
Period per week (each of 60 minutes)	Lecture	03	
	Laboratory	--	
	Tutorial	---	
Scheme of Evaluation		Hours	Marks
	In Semester	01	20*2
	End Semester*	03	100
	TOTAL		100

\*60% Weightage for end semester

**Course Objectives:**

1. Discuss concepts of analog and digital modulation /demodulation.
2. Explain the importance of information theory.
3. Demonstrate with case study error detection/ correction code.
4. Overview of computer networking.
5. Understand different cryptography techniques.

**Course Outcomes:**

1. Incorporate different communication technologies.
2. Use different channel coding methods
3. Demonstrate network and transport layer system, network security applications.
4. Appreciate importance of wireless sensors
5. Apply cryptography methods.

**Course Contents:**

Module	Details	Hrs.
<b>1</b>	<b>Basics of communication –</b> Introduction, Components of communication systems, Data representation, Bandwidth, Bit rate, Baud rate, Transmission of digital signals.	
<b>2</b>	<b>Analog and Digital Communication</b> Analog modulation – AM, FM, PM Digital modulation – ASK, FSK, PSK, QAM, PCM, DM Information theory – Information, Entropy, Rate of information, Channel capacity, Shannon theorem, Huffman coding Channel Coding – Linear block code, Cyclic code, Convolution code.	

<b>3</b>	<p><b>Utilization of Media Bandwidth</b>  Guided and unguided media – Twisted pair cable, Coaxial cable, Fiber optic, Radio waves, Microwaves, Infrared waves, Light waves,  Multiplexing – FDM, TDM  Spreading – DSSS, FHSS,  Introduction to networking.</p>	
<b>4</b>	<p><b>Small Area Networks</b>  Concept of LAN communication,  Wired &amp; wireless LAN technologies – Ethernet, Serial communication standard (RS485), IEEE 802.11 (Wi-Fi) standard,  Concept of PAN communication,  Wired &amp; wireless PAN technologies – Serial communication standards (USB, RS232), ZigBee, Bluetooth, Infrared.</p>	
<b>5</b>	<p><b>Large Area Networks :</b>  Concept of MAN communication,  Wired &amp; wireless MAN technologies – Telephone Networks, Dial-up, DSL, Cable TV, PLCC, IEEE 802.16 (Wi-MAX) standard,  Concept of WAN communication,  Wired &amp; wireless WAN technologies – SONET/SDH, Cellular networks, Satellite networks.</p>	
<b>6</b>	<p>Wireless sensor networks, Data dissemination, Data gathering, sensor management, localization, conventional encryption, cipher-block, location of encryption devices, key distribution, public key cryptography. RSA algorithms, Diffie-Hellman algorithms, message authentication, secure hash function, HMAC, digital signature, key management, Secret key cryptography, DES, IDEA, AES. .  Network security applications, Authentication applications, email security, PGP, SMIME IP Security, authentication on header, encapsulating security payload, combining security associations, key management, web security requirements, SSL, TSL, SET</p>	
<b>7</b>	<p><b>Applications</b>  Communication aspect of smart grid, Home Automation Networks (HANs), Automatic Metering Infrastructure (AMI), Line protection, Substation automation, Remote monitoring.</p>	

**Books**

1. Behrouz A. Forouzan, “Data Communications and Networking”, 4<sup>th</sup> Edition, 2007,
2. Simon Haykin, “Communication Systems”, 5<sup>th</sup> Edition, Wiley publication.
3. Theodore S. Rappaport, “Wireless Communications: Principles & Practice”, 2<sup>nd</sup> Edition, 2002, Prentice Hall publication
4. Ramjee Prasad and Luis Munoz, WLAN’s and WPAN’s towards 4G wireless, Artech House 2003
5. William Stallings, Cryptography and Network Security, 3<sup>rd</sup> Edition Pearson Education

6. R. P. Singh, S. D. Sapre, "Communication Systems: Analog & Digital", 3<sup>rd</sup> Edition McGraw-Hill publication.

<b>SR.NO.</b>	<b>EXAMINATION</b>	<b>MODUL</b>
1.	T1	1,2,3
2.	T2	3,4,5,
3.	ENDSEMESTER	1 to 7

<b>SEMESTER-VI</b>	<b>CLASS: T.Y. B.Tech. (Electrical)</b>		
<b>CODE:BTE377</b>	<b>COURSE: Communication Engineering Lab</b>		
Period per week (each of 60 minutes)	Lecture	-	
	Laboratory	2 hours/batch	
	Tutorial	---	
Scheme of Evaluation		Hours	Marks
	In Semester	-	--
	End Semester*	-	-
	Practical	02	25
	Laboratory Work(Journal)		
	TOTAL		25

### **Course Objective**

1. Simulation and demonstration of analog and digital modulation techniques
2. Simulation of source and channel coding.
3. Simulations of cryptography algorithms.

### **Course Outcomes**

1. Able to compare and simulate different modulation/demodulation methods
2. Able to write MATLAB codes
3. Incorporate different communication technologies with mini project.

### **List of Experiments:**

Part A: Study of analog and digital modulator/demodulators.

1. Amplitude modulation
2. Frequency Modulation
3. Amplitude shift keying
4. Frequency shift keying
5. Phase shift keying
6. Pulse code modulation
7. Delta modulation

Part B: Simulations

1. Huffman coding
2. Channel coding (Linear block code)
3. Channel coding (Cyclic code)
4. Cryptography algorithm.

Part C: Mini project.

<b>SEMESTER- VI</b>	<b>CLASS: T.Y.B.Tech. Electrical</b>		
<b>CODE: BTE329</b>	<b>COURSE: Switchgear and Protection</b>		
Period per week (each of 60 minutes)	Lecture	03	
	Laboratory	--	
	Tutorial	---	
Scheme of Evaluation		Hours	Marks
	In Semester	01	20*2
	End Semester*	03	100
	Total	---	100

\* 60% Weightage for end semester

**Course Objectives:**

1. Discuss the art and science of power system protection.
2. Demonstrate the relaying practices.
3. Introduce the fundamentals of overvoltage protection and protection scheme for transmission lines , transformer, generator and motor
4. Discuss the principle and operation of HV and LV circuit breakers.

**Course outcomes**

**At the completion of this course, students will be able to**

1. Appreciate knowledge in instrument transformers
2. Evaluate performance of unit protection and system protection with hands on practice
3. Demonstrate & design the relevant protection scheme for the elements of a power system.
4. Appreciate field of switchgear and Exposure to the modern protection practices

**Course Contents:**

Module	Contents	Hrs
	<b>Pre-requisite :</b> Fault Analysis	
1.	<b>Fundamentals of Protection:</b> Basic objective of system protection, Typical relay and relaying system, basic construction of electromagnetic, static and digital relays, Introduction to Numerical relay, Protective zones, Primary and backup protection, Desirable qualities. Relay Input Sources: Equivalent circuit and classification of CTs, CT saturation and DC offset current, Equivalent circuit of voltage transformer (VT), CCVT and its classification.	
2.	<b>Neutral Grounding:</b> Transient over voltages in ungrounded systems, Methods of neutral grounding	
3.	<b>Principle and characteristics of:</b> Over current Relays - Time setting, plug setting, Different characteristics like IDMT, very Inverse etc., Directional Relay, Distance Relay- Reactance, Impedance, MHO relay, Differential Relay.	

<b>4.</b>	<p><b>Power Apparatus Protection:</b>          Protection of Transmission lines &amp; feeders- over current protection and relay co-ordination, Distance relay application, Power swings and distance relaying, Pilot protection.          Protection of Transformer-The problems and hazard in transformer, Differential relay for 3 phase transformer winding protection, Magnetizing inrush, Restricted Earth fault protection, Buchholz relay.          Protection of Generator-The problems and hazard in generator, Differential protection for stator faults, Protection against loss of prime mover and loss of excitation, field suppression, out of step protection.          Motor Protection- The problems and hazards in Induction motor, Protection against single phasing, Thermal over load and short circuit protection using Type 2 co-ordination, Under voltage protection, Synchronous motor protection.          Bus Protection- Different bus arrangements with breakers, Ring bus arrangement, One and a half breaker arrangement and High impedance bus differential relay.</p>	
<b>5.</b>	<p><b>Principles of Circuit Braking:</b>          Initiation of arc, arc extinction, D.C and A.C. circuit breaking, arc voltage and current waveforms in an A.C. circuit., Definition of transient recovery voltage, rate of rise of TRV, expression for TRV for different values of arc resistance, current chopping, capacitance switching, Theories of arc extinction, arc control devices, Ratings and specifications of circuit breakers, making and breaking capacity.</p>	
<b>6.</b>	<p><b>Different types of LV and HV Switchgear:</b>          Air Circuit Breaker (ACB): construction and working, Miniature Circuit Breakers (MCB) and Moulded Case Circuit Breakers (MCCB), Earth leakage circuit breaker, Power contactors, HRC Fuse, Principle of arc quenching in- Air Blast Circuit Breaker (ABCB), Bulk Oil Circuit Breaker (BOCB), Minimum Oil Circuit Breaker (MOCB), Vacuum Circuit Breaker, SF6 Circuit Breaker.</p>	
<b>7.</b>	<p><b>Protection against over voltage surges:</b>          Lightening phenomenon, over voltages due to lightning, different types of lightning arresters, Insulation Co-ordination between different devices, BIL.</p>	

**Term Work:**

Term work shall consist of minimum eight practicals/ Simulations/ demonstrations/ computer Programs based on above syllabus.

**Text Books:**

1. Badri Ram and Vishwakarma D.N., "Power System Protection and Switchgear", TMH Publication, 1st Ed. 1994.
2. Ravindranath and Chander, "Switchgear and Protection", Wiley Eastern Ltd. 1<sup>st</sup> Ed. 1977.
3. Rao Sunil S., "Switchgear and Protection", Khanna Publication, 4<sup>th</sup> Ed., 1997.
4. Paithankar Y.G., "Transmission Network Protection", Marcel Dekker, Inc., 1998.
5. [www.cdeep.iitb.ac.in/nptel/Electrical\\_Engineering/Power\\_System\\_Protection](http://www.cdeep.iitb.ac.in/nptel/Electrical_Engineering/Power_System_Protection).

**Reference Books:**

1. Lewis Blackburn, "Protective relaying: Principles and Applications", Marcel Dekker, Inc., 1987.
2. Phadke A.G. and Thorp J.S, "Computer Relaying for Power Systems", John Wiley & sons, 1<sup>st</sup> Ed. 1990.

<b>Sr. No.</b>	<b>Examination</b>	<b>Module</b>
1	T1	1 , 2, 3
2	T2	4
3	End Semester	1 to 7

<b>SEMESTER-VI</b>	<b>CLASS: T.Y. B.Tech. (Electrical)</b>		
<b>CODE:BTE378</b>	<b>COURSE: Switchgear and protection Lab</b>		
Period per week (each of 60 minutes)	Lecture	--	
	Laboratory	02 per batch	
	Tutorial	---	
Scheme of Evaluation		Hours	Marks
	In Semester	-	--
	End Semester*	-	-
	Practical	02	25
	Laboratory Work(Journal)		
	TOTAL		25

### **Course Objectives:**

1. To demonstrate theoretical knowledge.
2. To conduct experiment based on overcurrent protection scheme.
3. To conduct experiment based on generator protection, earth fault protection.

### **Course outcomes**

#### **At the completion of this lab work, students will be able to**

1. Understand operating characteristics of electromagnetic relays, circuit breaker and other protective devices.
2. Understand various protection scheme used in power system equipments.
3. Analyze performance of electromagnetic, numerical and microprocessor based relay.
4. To develop an ability and skill to design the feasible protection systems needed for each main part of a power system

### **List of Experiments:**

1. IDMT characteristic of non-directional over voltage relay.
2. Study of Miniature Circuit Breaker HRC fuse, MCCB: components identification and Applications
3. Study of Power Contactor
4. Air Circuit Breaker: components identification and Applications.
5. Simulation of 2O/C+ 1E/F protection scheme.
6. Numerical Relay: Study and Application
7. Generator protection
8. Differential protection using static relay
9. Microprocessor based distance protection

<b>SEMESTER-VI</b>	<b>CLASS: T.Y. B.Tech. Electrical</b>		
<b>CODE: BTE330</b>	<b>COURSE: Environmental Engineering and Management System</b>		
Period per week (each of 60 minutes)	Lecture	01	
	Laboratory	---	
	Tutorial	02 per batch	
Scheme of Evaluation		Hours	Marks
	In Semester	01	10*2
	End Semester*	02	50
	Practical	---	---
	Laboratory Work (Journal)/Tutorial	---	50
	<b>TOTAL</b>	---	<b>100</b>

\* 60% Weightage for end semester

### Course Objective

1. To gain knowledge on the importance of environmental engineering and ecology.
2. To acquire knowledge about environmental pollution.
3. To acquire knowledge with respect to renewable energy and its positive impact on environment.
4. To be aware of the national and international concern for environment for protecting the environment.

### Course Outcome:

1. Apply knowledge of environmental engineering and ecology in the field of electrical engineering.
2. Analyze the problems associated with environmental pollution.
3. Establish relation between applications of renewable energy for conservation of environment.
4. Utilize the laws & acts for prevention of environmental pollution.

### Course Contents:

Module	Details	Hrs.
1.	Introduction to Environmental Engineering	
2.	Introduction to Ecology, Definition, Structure and function of an ecosystem-Ecological succession-primary and secondary succession. Ecological pyramid of number, pyramid of energy and pyramid of biomass.	
3.	Environmental pollution, Environmental segments – structure and composition of atmosphere. Pollution – Air, water, soil, thermal and radiation. Effects – acid rain, ozone layer depletion and green house effect.	

<b>4.</b>	Introduction to Renewable Energy. Solar, Wind, Geothermal, Ocean (Tidal), Biomass – Basics, Conservation of natural resources. Environmental and economic impact of each type of renewable energy.	
<b>5.</b>	Introduction to ISO 14001:2015 – Environmental management systems, Requirements with guidance for use.	
<b>6.</b>	National rating system – GRIHA (Green Rating for Integrated Habitat Assessment) and case studies of GRIHA registered/rated buildings. Site selection and site planning, Building operation and maintenance, Innovation points.	
<b>7.</b>	Environmental protection & Legislation. Important environmental protection acts in India – Air act-1981, water act-1974, wild life conservation and forest act. Functions of Central & State Pollution Control Boards (CPCB & SPCB). International effort – key initiatives of Rio declaration, Vienna convention, Ramsar convention, Kyoto protocol.	

**Term Work:** Lab Work shall consist of minimum two projects.

**Recommended Books:**

1. GRIHA Manual Volume 1 - Ministry of New and Renewable Energy, Government of India, New Delhi.
2. ISO 14001:2004(E) - Environmental management systems Requirements with guidance for use.
3. Jagdish Krishnawamy, R J Ranjit Daniels, “ Environmental Studies”, Wiley India Private Ltd. New Delhi.
4. An Indita Basak, Environmental Studies, Pearson.

Sr. No.	Examination	Module
1	T1	1, 2
2	T 2	3,4
3	END SEMESTER	1 to 7

<b>Sardar Patel College of Engineering</b>			
<b>Academic Year 2017 – 18</b>			
<b>Program:</b> B. Tech. Electrical Engineering		<b>Semester:</b> VI	
<b>Course:</b> Elective 1: Project Management (BTE 331)			
<b>Periods per Week</b>	<b>Lecture</b>	03	
	<b>Practical</b>	--	
	<b>Tutorial</b>	02 per batch	
		<b>Hours</b>	<b>Marks</b>
<b>Evaluation System</b>	<b>In semester tests</b>	1 each	20 x 2 (40)
	<b>End Semester exam</b>	3	100* (60)
	<b>Practical</b>	--	--
	<b>Tutorial work (Journal)</b>	--	25
	<b>Total</b>		

\* End semester exam paper will be of 100 marks. However the weight-age will be 60%.

**Rationale:**

The organizations today are looking for opportunities in the form of new products, new ventures, new markets, expansion of existing business, new collaborations, etc. To deal with these issues and to successfully execute their projects under the constraints of costs and time, organizations are required to follow good project management practices. With this, it is imperative that engineers working in manufacturing, process and service industry have to win the confidence of stakeholders, manage risks and resources and efficiently use project management principles for successful implementation of projects. Thus, even at the entry level of employment of engineering graduates, knowing Project Management principles have become desirable skills. Studying a course on Project Management will be helpful in increasing employability of engineering graduates.

**Prerequisite:**

Basics of Electrical Engineering, Basics of statistics and mathematics, general knowledge about working of organizations

**Course Objectives:**

In this course students are expected to:

1. Get familiarized with basics of project management, its organization and project management framework.
2. Learn five important project management process groups, namely: initiating, planning, executing, monitoring & control, and closing.
3. Learn ten important project management knowledge areas.
4. Understand the relationship between project management process groups and knowledge areas.
5. Understand the professional and social responsibility of project managers.

**Course Outcomes:**

After completion of this course students are expected to be able to:

1. Develop a detailed project management process chart for each of the project management processes.
2. Develop a project charter and project management plan using ten important project management knowledge areas.
3. Perform project management process group and knowledge area mapping.
4. Solve a case study using step-by-step process of managing projects and explain why each step is necessary.
5. Demonstrate ethical and professional application of project management.



	<p><b>Project Cost Management</b></p> <ul style="list-style-type: none"> <li>• Cost management process,</li> <li>• Earned value measurement, cost baseline, cost budget, performance measurement baseline,</li> <li>• Cost management plan, definitive estimate, budget estimate, reserve analysis, contingency reserve, management reserves, cost risk,</li> <li>• Variable / fixed costs, direct / indirect costs, life cycle costing, value analysis, control thresholds, cost of quality, Return of Interest (RoI), and discounted cash flow.</li> </ul> <p><b>Project Quality Management</b></p> <ul style="list-style-type: none"> <li>• Quality management process, quality metrics, quality management plan, process improvement plan, continuous improvement,</li> <li>• Seven basic quality improvement tools – control chart, Pareto diagram, Cause and effect diagram, flow chart, scatter diagram, histogram.</li> <li>• Benchmarking, process analysis, quality audits, design of experiments, statistical sampling, quality checklist, prevention over inspection, Just in Time (JIT),</li> <li>• Quality Standards (ISO 9000), standard deviation, Total Quality Management (TQM),</li> <li>• Responsibility of quality, impact of poor quality, cost-benefit analysis, cost of quality, 3 or 6 sigma, marginal analysis, population sample, normal distribution, mutually exclusive, probability, statistical independence,</li> <li>• Quality assurance tools and techniques – Affinity diagram, tree diagrams, process decision program charts, matrix diagrams, prioritization matrices, network diagrams.</li> </ul>	04
<b>4</b>	<p><b>Project Human Resource Management</b></p> <ul style="list-style-type: none"> <li>• Human resource management process, role of PM, PM team, sponsor, stakeholders, functional manager, portfolio manager, program manager, HR responsibilities of PM,</li> <li>• HR management plan, staffing management plan, recognition and reward systems, team building, powers of PM,</li> <li>• Conflict resolution techniques, sources of conflict, team performance assessments, project performance appraisals, personal assessment tools,</li> <li>• Responsibility Assignment Matrix (RAM), RACI Chart, organizational breakdown structure, resource breakdown structure, resource histogram, ground rules,</li> <li>• Motivation theory, Training, Halo effect, Management and Leadership styles, expectancy theory, preassignment, negotiation, virtual teams, stages of team formation and development, team types.</li> </ul> <p><b>Project Communication Management</b></p> <ul style="list-style-type: none"> <li>• Communication management process, communications management plan, performance reporting, types of reports,</li> <li>• Communication models, communication types, communication technology, channels, Communication method, control of communication, rules for meetings, communication blockers.</li> </ul>	
<b>5</b>	<p><b>Project Risk Management</b></p> <ul style="list-style-type: none"> <li>• Risk management process,</li> <li>• Risk management, threats, opportunities, risk register, risk management plan, risk response strategies,</li> <li>• Reserves, reserve analysis, probability and impact matrix, expected monetary value, contingency plans, fallback plans, watch list, workaround, risk owner, residual risks, secondary risks,</li> <li>• Risk types and categories, sensitivity analysis, common risk management errors, risk audits, risk reassessments, assumption analysis, SWOT analysis,</li> <li>• Variance and trend analysis, risk data quality assessment, risk urgency assessment,</li> </ul>	

	<ul style="list-style-type: none"> <li>• Risk appetite, triggers, tolerance, threshold, decision tree, risk averse, risk factors,</li> <li>• Closure of risks.</li> </ul> <p><b>Project Procurement Management</b></p> <ul style="list-style-type: none"> <li>• Procurement management process, Procurement management plan,</li> <li>• Types of agreements, contract types, managing different contract types, advantages and disadvantages of each contract type, contract change control system, termination, breach,</li> <li>• PM's role in procurement, procurement documents : RFP, IFB, RFQ, RFI,</li> <li>• Types of procurement, procurement performance review, claims administration, bidder conferences, source selection criteria, weighting criteria, screening system, incentives, procurement negotiations, financial closure, final contract performance reporting,</li> <li>• Conflict with procurement manager, procurement audit, formal acceptance, records management,</li> <li>• Qualified seller lists, centralized / decentralized contracting, contract interpretation, price, profit, cost, target price, sharing ratio, ceiling price,</li> <li>• Letter of Intent (LoI), lessons learned, procurement file, NDA.</li> </ul>	
<b>6</b>	<p><b>Project Stakeholder Management</b></p> <ul style="list-style-type: none"> <li>• Stakeholder management process,</li> <li>• Stakeholders, stakeholder analysis, stakeholder register, stakeholder expectations, stakeholder engagement,</li> <li>• Relationships with stakeholders, stakeholder management plan, stakeholder management plan Vs. communications management plan,</li> <li>• Power and interest grid, stakeholders engagement assessment matrix</li> </ul>	
<b>7</b>	<p><b>Professional and Social Responsibility</b></p> <ul style="list-style-type: none"> <li>• Ethical application of project management,</li> <li>• Project management traits in professional and social responsibility,</li> <li>• Code of Ethics and Professional conduct w. r. t. responsibility, respect, fairness, honesty.</li> </ul> <p><b>Project Management Case Study / Activity</b></p>	

**Books Recommended:**

1. *Gower Handbook of People in Project Management*, Dennis Lock and Lindsay Scott, Routledge Publishers, NY, USA, 2016.
2. *Project Management – Essentials You Always Wanted to Know*, Kalpesh Ashar, Vibrant Publishers, 2012.
3. *Projects: Planning, Analysis, Selection, Financing, Implementation and Review*, Prasanna Chandra, McGraw Hill India, 2014.
4. *A Guide to the Project Management Body of Knowledge (PMBOK Guide)*, 5<sup>th</sup> Ed., Project Management Institute, USA.
5. *Project Management: Processes, Methodologies and Economics*, 2<sup>nd</sup> Ed., Avraham Shtub, J. F. Bard, S, Globerson, PH Inc., USA.
6. *Project Management Handbook*, 2<sup>nd</sup> Ed., David Cleland, Wiley, 1988.

Sr. No.	Examination	Module
1	T1	1, 2
2	T 2	3,4
3	END SEMESTER	1 to 7

<b>SEMESTER-VI</b>	<b>CLASS: T.Y. B.Tech. (Electrical)</b>		
<b>CODE: BTE332</b>	<b>Elective Course: VLSI</b>		
Period per week (each of 60 minutes)	Lecture	03	
	Laboratory	---	
	Tutorial	02 per batch	
Scheme of Evaluation		Hours	Marks
	In Semester	01	20*2
	End Semester*	03	100
	Tutorial	---	---
	Laboratory Work(Journal)/Tutorial	---	25
	TOTAL		125

\*60% Weightage forendsemester

**Course Objectives:**

1. To introduce the fundamental principles of VLSI circuit design and layout techniques.
2. To highlight the circuit design issues in the context of VLSI technology.
3. To examine the basic building blocks of large-scale digital integrated circuits.

**Course Outcomes:**

After successfully completing the course students will be able to

1. Demonstrate a clear understanding of choice of technology and technology scaling.
2. Design MOS based circuits and draw layout.
3. Realize logic circuits with different design styles.
4. Demonstrate a clear understanding of system level design issues such as protection, timing and power dissipation.

**Course Contents:**

Module	Details	Hrs.
1	<p><b>Technology Trend:</b></p> <p><b>Technology Comparison:</b> Comparison of BJT, NMOS and CMOS technology.</p> <p><b>MOSFET Scaling:</b> Types of scaling, Level 1 and Level 2 MOSFET Models, MOSFET capacitances.</p>	
2	<p><b>MOSFET Inverters</b></p> <p><b>Circuit Analysis:</b> Static and dynamic analysis (Noise, propagation delay and power dissipation) of resistive load and CMOS inverter, comparison of all types of MOS inverters, design of CMOS inverters, CMOS Latch-up</p> <p><b>Logic Circuit Design:</b> Analysis and design of 2-I/P NAND and NOR using equivalent CMOS inverter.</p>	

<b>3</b>	<b>MOS Circuit Design Styles</b> <b>Design Styles:</b> Static CMOS, pass transistor logic, transmission gate, Pseudo NMOS. <b>Circuit Realization:</b> SR Latch, JK FF, D FF, 1 Bit Shift Register, MUX, decoder using above design styles.	
<b>4</b>	<b>Semiconductor Memories</b> <b>SRAM:</b> ROM Array, SRAM (operation, design strategy, leakage currents, read/write circuits), DRAM (Operation 3T, 1T, operation modes, leakage currents, refresh operation, Input-Output circuits), Flash (mechanism, NOR flash, NAND flash)	
<b>5</b>	<b>Data Path Design</b> <b>Adder:</b> Bit adder circuits, ripple carry adder, CLA adder <b>Multipliers and shifter:</b> Partial-product generation, partial-product accumulation, final addition, barrel shifter	
<b>6</b>	<b>VLSI Clocking</b> <b>Clocking:</b> CMOS clocking styles, Clock generation, stabilization and distribution. <b>Low Power CMOS Circuits:</b> Various components of power dissipation in CMOS, Limits on low power design, low power design through voltage scaling.	
<b>7</b>	<b>System Design</b> <b>IO pads and Power Distribution:</b> ESD protection, input circuits, output circuits, simultaneous switching noise, power distribution scheme <b>Interconnect:</b> Interconnect delay model, interconnect scaling and crosstalk	

**Tutorial:**

At least 10 tutorials/experiments based on syllabus

**Text books**

1. Sung-Mo Kang and Yusuf Leblebici, “*CMOS Digital Integrated Circuits Analysis and Design*”, Tata McGraw Hill, 3rd Edition.
2. Neil H. E. Weste, David Harris and Ayan Banerjee, “*CMOS VLSI Design: A Circuits and Systems Perspective*”, Pearson Education, 2nd Edition.

**References:**

1. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, “*Digital Integrated Circuits: A Design Perspective*”, Pearson Education, 2nd Edition.
2. Etienne Sicard and Sonia Delmas Bendhia, “*Basics of CMOS Cell Design*”, Tata McGraw Hill, First Edition.
3. Hill, First Edition.
4. Debaprasad Das, “*VLSI Design*”, Oxford, 1st Edition.
5. Kaushik Roy and Sharat C. Prasad, “*Low-Power CMOS VLSI Circuit Design*”, Wiley, Student Edition.
6. Student Edition.

SR.NO.	EXAMINATION	MODUL
1.	T1	1,2,3
2.	T2	4,5,6
3.	ENDSEMESTER	1TO7