

III Year – I SEMESTER

T P C  
3+1 0 3

### MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

#### Unit – I:

(\*The Learning objective of this Unit is to understand the concept and nature of Managerial Economics and its relationship with other disciplines, Concept of Demand and Demand forecasting)

#### Introduction to Managerial Economics and demand Analysis:

Definition of Managerial Economics and Scope-Managerial Economics and its relation with other subjects-Concepts of Demand-Types-Determents-Law of Demand its Exception-Elasticity of Demand-Types and Measurement-Demand forecasting and its Methods.

(\*\*The Learner is equipped with the knowledge of estimating the Demand for a product and the relationship between Price and Demand)

#### Unit – II:

(\*The Learning objective of this Unit is to understand the concept of Production function, Input Output relationship, different Cost Concepts and Concept of Cost-Volume-Profit Analysis)

#### Production and Cost Analyses:

Production function-Isoquants and Isocosts-Law of Variable proportions-Cobb-Douglas Production function-Economics of Sale-Cost Concepts-Opportunity Cost-Fixed vs Variable Costs-Explicit Costs vs Implicit Costs-Out of Pocket Costs vs Imputed Costs-Cost Volume Profit analysis-Determination of Break-Even Point (Simple Problem).

(\*\*One should understand the Cost Concepts for decision making and to estimate the least cost combination of inputs).

#### Unit – III:

(\*The Learning Objective of this Unit is to understand the Nature of Competition, Characteristics of Pricing in the different market structure and significance of various pricing methods)

#### Introduction to Markets, Theories of the Firm & Pricing Policies:

Market Structures: Perfect Competition, Monopoly and Monopolistic and Oligopoly – Features – Price, Output Determination – Managerial Theories of firm: Maris and Williamson's models – Methods of Pricing: Limit Pricing, Market Skimming Pricing, Internet Pricing: Flat Rate Pricing, Usage sensitive, Transaction based pricing, Priority Pricing.

(\*\* One has to understand the nature of different markets and Price Output determination under various market conditions)

#### **Unit – IV:**

(\***The Learning objective of this Unit is to know the different forms of Business organization and their Merits and Demerits both public & private Enterprises and the concepts of Business Cycles**)

##### **Types of Business Organization and Business Cycles:**

Features and Evaluation of Sole Trader – Partnership – Joint Stock Company – State/Public Enterprises and their forms – Business Cycles – Meaning and Features – Phases of Business Cycle.

(\*\*One should equipped with the knowledge of different Business Units)

#### **Unit – V:**

(\***The Learning objective of this Unit is to understand the different Accounting Systems preparation of Financial Statements and uses of different tools for performance evaluation**)

##### **Introduction to Accounting & Financing Analysis:**

Introduction to Double Entry Systems – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow cash flow statements (Simple Problems)

(\*\*The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis)

#### **Unit – VI:**

(\*The Learning objective of this Unit is to understand the concept of Capital, Capitalization, Capital Budgeting and to know the techniques used to evaluate Capital Budgeting proposals by using different methods)

**Capital and Capital Budgeting:** Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Need for Capital Budgeting-Techniques of Capital Budgeting-Traditional and Modern Methods.

(\*\*The Learner is able to evaluate various investment project proposals with the help of capital budgeting techniques for decision making)

Note: \*Learning Objective

\*\* Learning Assessment

#### **TEXT BOOKS**

1. Dr. N. Appa Rao, Dr. P. Vijay Kumar: ‘Managerial Economics and Financial Analysis’, Cengage Publications, New Delhi – 2011.

2. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2011.
3. Prof. J.V.Prabhakara Rao, Prof. P. Venkatarao. ‘Managerial Economics and Financial Analysis’, Ravindra Publication.

**REFERENCES:**

1. V. Maheswari : Managerial Economics, Sultan Chand.
2. Suma Damodaran : Managerial Economics, Oxford 2011.
3. Dr. B. Kuberudu and Dr. T. V. Ramana : Managerial Economics & Financial Analysis, Himalaya Publishing House 2011.
4. Vanitha Agarwal : Managerial Economics, Pearson Publications 2011.
5. Sanjay Dhameja : Financial Accounting for Managers, Pearson.
6. Maheswari : Financial Accounting, Vikas Publications.
7. S. A. Siddiqui & A. S. Siddiqui : Managerial Economics and Financial Analysis, New Age International Publishers, 2012.

**III Year – I SEMESTER**

<b>T</b>	<b>P</b>	<b>C</b>
<b>3+1</b>	<b>0</b>	<b>3</b>

**ELECTRICAL MEASUREMENTS****Preamble:**

This course introduces principle of operation of basic analog and digital measuring instruments for measurement of current, voltage, power, energy etc. Measurement of resistance, inductance and capacitance by using bridge circuits will be discussed in detail. It is expected that student will be thorough with various measuring techniques that are required for an electrical engineer.

**Learning Objectives:**

- To study the principle of operation and working of different types of instruments. Measurement of voltage and current.
- To study the working principle of operation of different types of instruments for measurement of power and energy.
- To understand the principle of operation and working of dc and ac potentiometers.
- To understand the principle of operation and working of various types of bridges for measurement of parameters –resistance, inductance, capacitance and frequency.
- To study the principle of operation and working of various types of magnetic measuring instruments.
- To study the applications of CRO for measurement of frequency, phase difference and hysteresis loop using Lissajous patterns.

**UNIT-I:****Measuring Instruments**

Classification – Deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type, dynamometer and electrostatic instruments – Expression for the deflecting torque and control torque – Errors and compensations– Extension of range using shunts and series resistance – CT and PT: Ratio and phase angle errors – Design considerations.

**UNIT –II:****Measurement of Power and Energy**

Single phase and three phase dynamometer wattmeter – LPF and UPF – Expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems – Type of P.F. Meters – Single phase and three phase dynamometer and moving iron type Single phase induction type energy meter – Driving and braking.

torques – errors and compensations –Testing by phantom loading using R.S.S. meter– Three phase energy meter – Tri vector meter – Maximum demand meters– Electrical resonance type frequency meter and Weston type synchroscope.

**UNIT – III:****Potentiometers**

Principle and operation of D.C. Crompton's potentiometer – Standardization – Measurement of unknown resistance – Current – Voltage – AC Potentiometers: polar and coordinate types –Standardization – Applications.

**UNIT – IV:****Measurements of Parameters**

Method of measuring low, medium and high resistance – Sensitivity of Wheat stone's bridge – Carey Foster's bridge– Kelvin's double bridge for measuring low resistance– Loss of charge method for measurement of high resistance – Megger– Measurement of earth resistance – Measurement of inductance – Quality Factor – Maxwell's bridge–Hay's bridge – Anderson's bridge–Measurement of capacitance and loss angle – Desautybridge – Schering Bridge–Wagner's earthing device–Wien's bridge.

**UNIT – V:****Magnetic Measurements**

Ballistic galvanometer – Equation of motion – Flux meter – Constructional details–Determination of B–H Loop methods of reversals six point method – AC testing – Iron loss of bar samples– Core loss measurements by bridges and potentiometers.

**UNIT – VI:****Digital Meters**

Digital Voltmeter–Successive approximation – Measurement of phase difference – Frequency – Hysteresis loop using lissajious patterns in CRO –

Ramp and integrating type–Digital frequency meter–Digital multimeter–Digital Tachometer.

**Learning Outcomes:**

- Able to choose right type of instrument for measurement of voltage and current for ac and dc.
- Able to choose right type of instrument for measurement of power and energy – able to calibrate energy meter by suitable method
- Able to calibrate ammeter and potentiometer.
- Able to select suitable bridge for measurement of electrical parameters
- Able to use the ballistic galvanometer and flux meter for magnetic measuring instruments
- Able to measure frequency and phase difference between signals using CRO. Able to use digital instruments in electrical measurements.

**Text Books:**

1. Electrical Measurements and measuring Instruments – by E.W. Golding and F.C.Widdis, fifth Edition, Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.
3. Electrical and Electronic Measurements and instrumentation by R.K.Rajput, S.Chand

**Reference Books:**

1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co. Publications.
2. Electrical Measurements – by Buckingham and Price, Prentice – Hall
3. Electrical Measurements by Forest K. Harris. John Wiley and Sons
4. Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U, New Age International (P) Limited, Publishers.
5. Electrical and Electronic Measurements –by G.K.Banerjee, PHI Learning Private Ltd., New Delhi–2012.

**III Year – I SEMESTER**

<b>T</b>	<b>P</b>	<b>C</b>
<b>3+1</b>	<b>0</b>	<b>3</b>

**POWER SYSTEMS–II****Preamble:**

This course is an extension of power systems–I course. It deals with basic theory of transmission lines modeling and their performance analysis. Transient in power system, improvement of power factor and voltage control are discussed in detail. It is important for the student to understand the mechanical design aspects of transmission lines, cables, insulators. These aspects are also covered in detail in this course.

**Learning Objectives:**

- To compute inductance and capacitance of transmission lines and to understand the concepts of GMD, GMR.
- To study short and medium length transmission lines, their models and performance computation.
- To study the performance and modeling of long transmission lines.
- To study the transient on transmission lines.
- To study the factors affecting the performance of transmission lines and power factor improvement methods.
- To discuss sag and tension computation of transmission lines as well as to study the over head insulators.

**UNIT–I:****Transmission Line Parameters**

Types of conductors – Calculation of resistance for solid conductors – Calculation of inductance for single phase and three phase– Single and double circuit lines– Concept of GMR and GMD–Symmetrical and asymmetrical conductor configuration with and without transposition– Numerical Problems–Calculation of capacitance for 2 wire and 3 wire systems – Effect of ground on capacitance – Capacitance calculations for symmetrical and asymmetrical single and three phase–Single and double circuit lines–Numerical Problems.

**UNIT–II:****Performance of Short and Medium Length Transmission Lines**

Classification of Transmission Lines – Short, medium, long line and their model representations –Nominal-T–Nominal-Pie and A, B, C, D Constants

for symmetrical and Asymmetrical Networks– Numerical Problems– Mathematical Solutions to estimate regulation and efficiency of all types of lines – Numerical Problems.

### **UNIT–III:**

#### **Performance of Long Transmission Lines**

Long Transmission Line–Rigorous Solution – Evaluation of A,B,C,D Constants–Interpretation of the Long Line Equations – Incident, Reflected and Refracted Waves –Surge Impedance and SIL of Long Lines–Wave Length and Velocity of Propagation of Waves – Representation of Long Lines – Equivalent-T and Equivalent Pie network models (Numerical Problems).

### **UNIT – IV:**

#### **Power System Transients**

Types of System Transients – Travelling or Propagation of Surges – Attenuation–Distortion – Reflection and Refraction Coefficients – Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – T-Junction– Lumped Reactive Junctions (Numerical Problems).

### **UNIT–V:**

#### **Various Factors Governing the Performance of Transmission line**

Skin and Proximity effects – Description and effect on Resistance of Solid Conductors –Ferranti effect – Charging Current – Effect on Regulation of the Transmission Line–Shunt Compensation –Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss – Radio Interference –Power factor improvement methods.

### **UNIT–VI:**

#### **Sag and Tension Calculations and Overhead Line Insulators**

Sag and Tension calculations with equal and unequal heights of towers– Effect of Wind and Ice on weight of Conductor–Numerical Problems – Stringing chart and sag template and its applications–Types of Insulators – String efficiency and Methods for improvement–Numerical Problems – Voltage distribution–Calculation of string efficiency–Capacitance grading and Static Shielding.

#### **Learning Outcomes:**

- Able to understand parameters of various types of transmission lines for using calculation and behavior during different operating conditions.



- Able to understand the insight into specific transmission lines short and medium type which would have application in medium and high voltage power transmission systems.
- Student will be able to understand the surge propagation, reflection and refraction in transmission lines. such output will be useful in protecting transmission line insulators and designing level of insulation coordination at various high voltages.
- Will be able to utilize it for understanding the surge behaviour of transmission line for protection of connects equipments,viz.power transformer and system connected shunt reactors.
- Will be able to understand various phenomenon related to charged line transmitting different level of power.
- Will be able to understand physical and geometrical parameters of transmission line for safe and efficient performance during operating condition of voltage and power.

**Text Books:**

1. Electrical power systems – by C.L. Wadhwa, New Age International (P) Limited, Publishers, 1998.
2. Modern Power System Analysis by I.J. Nagarith and D.P.Kothari, Tata Mc Graw Hill, 2<sup>nd</sup> Edition.
3. Electrical Power Systems by P.S.R. Murthy, B.S. Publications.

**Reference Books:**

1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4<sup>th</sup> edition
2. Power System Analysis and Design by B.R. Gupta, Wheeler Publishing.
3. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S. Bhatnagar A .Chakrabarthy, DhanpatRai& Co Pvt. Ltd.

**III Year – I SEMESTER****T P C**  
**3+1 0 3****ELECTRICAL MACHINES – III****Preamble:**

This course essentially covers ac machines. It covers topics related to principle of operation, constructional features and starting of single phase induction motors and three phase synchronous motors. In addition, it also covers voltage regulation and parallel operation of synchronous generators.

**Learning Objectives:**

- To study the application of “Double revolving field” theory for single – phase induction motor and appreciate the function and application of a.c series motor.
- To discuss e.m.f generation principle of synchronous generator and armature reaction effect.
- To study the effect of load at different power factors, methods of predetermination of regulation for non– salient and salient pole generators.
- To study the parallel operation and the concepts of transfer of real and reactive powers.
- To understand the operation and performance of synchronous motor.
- To study the power circle diagrams and methods of starting of synchronous motor.

**UNIT – I:****Single Phase Motors**

Single phase induction motors – Constructional features and the problem of starting–Double revolving field theory–AC Series motor–Compensation.

**UNIT-II:****Synchronous generator construction and operation**

Constructional features of non–salient and salient pole type – Armature windings –Distributed and concentrated windings – Distribution– Pitch and winding factors –E.M.F equation–Improvements of waveform and armature reaction– Numerical problems.

**UNIT – III:****Voltage regulation of synchronous generator**

Voltage regulation by synchronous impedance method– MMF method and Potier triangle method–Phasor diagrams– Two reaction analysis of salient pole machines and phasor diagram– Numerical problems.

**UNIT –IV:****Parallel operation of synchronous generators**

Parallel operation with infinite bus and other alternators – Synchronizing power – Load sharing –Transfer of real and reactive power– Numerical problems.

**UNIT–V:****Synchronous motor – operation**

Synchronous Motor principle and theory of operation– Phasor diagram – Starting torque–Variation of current and power factor with excitation – Synchronous condenser – Mathematical analysis for power developed– Numerical problems.

**UNIT – VI:****Synchronous motor performance and starting**

Excitation and power circles – Hunting and its suppression – Methods of starting – Synchronous induction motor.

**Learning outcomes:**

At the end of the course the student should be able to

- Analyze the performance of single phase induction and ac series motors.
- Explain the structure of synchronous machines and design the windings.
- Develop solutions for regulation of both non salient pole and salient pole synchronous generators.
- Explain the role of synchronous generators operation when connected to an infinite bus or when operating in parallel.
- Analyze the performance of synchronous motor for development of torque and power factor correction.
- Explain hunting phenomenon and methods of starting of synchronous motor.

**Text Books:**

1. Electrical Machines – by P.S. Bhimbra, Khanna Publishers.
2. The Performance and Design of AC Machines – by M.G.Say, ELBS and Ptiman & Sons.

**Reference Books:**

1. Electric Machinery – by A.E. Fitzgerald, C. Kingsley and S.Umans- by Mc Graw–Hill Companies, 5<sup>th</sup> edition, 1990.
2. Theory of Alternating Current Machinery by Langsdorf, Tata Mc Graw–Hill, 2<sup>nd</sup> edition.
3. Analysis of Electric Machinery and Drive systems – by Paul C. Krause, Oleg Wasynczuk and Scott D.Sudhoff, wiley publications, 2<sup>nd</sup> edition Publishers.

**III Year – I SEMESTER**

<b>T</b>	<b>P</b>	<b>C</b>
<b>3+1</b>	<b>0</b>	<b>3</b>

**POWER ELECTRONICS****Preamble:**

The usage of power electronics in day to day life has increased in recent years. It is important for student to understand the fundamental principles behind all these converters. This course covers characteristics of semi conductor devices, ac/dc, dc/dc, ac/ac and dc/ac converters. The importance of using pulse width modulated techniques to obtain high quality power supply (dc/ac converter) is also discussed in detail in this course.

**Learning Objectives:**

- To study the characteristics of various power semiconductor derive and analyze the operation of diode bridge rectifier.
- To design firing circuits for SCR. Analyze the operation of AC voltage controller and half-wave phase controlled rectifiers.
- To understand the operation of single phase full-wave converters and analyze harmonics in the input current.
- To study the operation of three phase full-wave converters and dual converter.
- To analyze the operation of single phase cyclo converters and high frequency dc-dc converters.
- To understand the working of inverters and application of PWM techniques for voltage control and harmonic mitigation.

**UNIT-I:****Power Semi Conductor Devices**

Thyristors–Silicon controlled rectifiers (SCR’s) –Characteristics of power MOSFET and power IGBT– Basic theory of operation of SCR–Static characteristics– Turn on and turn off methods–Dynamic characteristics of SCR– Snubber circuit design–Numerical problems–Diode bridge rectifier with R-load and capacitive filter–Output voltage and input current waveforms.

**UNIT-II:****Phase Controlled Converters – Single Phase**

Firing circuits for SCR– Line commutation principle– Single phase AC voltage controller with R and RL load–Half wave converters with R, RL and RLE loads– Derivation of average load voltage and current–Effect of freewheeling diode for RL load.

**UNIT-III:****Single Phase Bridge Converter and Harmonic Analysis Fully controlled converters**

Operation with R, RL and RLE loads–Derivation of average voltage and current – Effect of source Inductance.

**Semi Converters (Half Controlled):**

Operation with R, RL and RLE loads – Harmonic analysis for input current waveform in a system with a large load inductance –Calculation of input power factor.

**UNIT-IV:****Three Phase AC–DC Bridge Converters**

Full converter with R and RL loads–Semi converter (Half Controlled) with R and RL loads– Derivation of load voltage–Line commutated Inverter operation–Dual converters with non–circulating and circulating currents.

**UNIT – V:****AC–AC and DC–DC Converters**

Single phase Bridge type cyclo converter with R and RL load (Principle of operation) –High frequency DC–DC converters: Buck Converter operation–Time ratio control and current limit control strategies–Voltage and current waveforms–Derivation of output voltage–Boost converter operation–Voltage and current waveforms–Derivation of output voltage – Buck-Boost converter operation –Voltage and current waveforms.

**UNIT – VI:****DC–AC Inverters****Inverters**

Single phase inverters–Unipolar and bipolar switching–Three phase Inverters ( $120^\circ$  and  $180^\circ$  modes of operation) –PWM techniques– Sine triangular PWM technique– amplitude and frequency modulation Indices –Harmonic analysis.

**Learning Outcomes:**

Student should be able to

- Explain the characteristics of various power semiconductor derive and analyze the operation of diode bridge rectifier.
- Design firing circuits for SCR. Analyze the operation of AC voltage controller and half-wave phase controlled rectifiers.
- Explain the operation of single phase full-wave converters and analyze harmonics in the input current.
- Explain the operation of three phase full-wave converters and dual converter.
- Analyze the operation of single phase cyclo converters and high frequency dc-dc converters.
- Explain the working of inverters and application of PWM techniques for voltage control and harmonic mitigation.

**Text Books:**

1. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998
2. Power Electronics: converters, applications & design -by Nedmohan, Tore M. Undeland, Robbins by Wiley India Pvt. Ltd.
3. Power Converter Circuits -by William Shepherd, Li zhang, CRC Taylor & Francis Group.

**Reference Books:**

1. Elements of Power Electronics–Philip T.Krein.oxford.
2. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.
4. Power Electronics handbook by Muhammad H. Rashid, Elsevier.

III Year – I SEMESTER

T P C  
3+1 0 3

### LINEAR & Digital IC APPLICATIONS

#### Preamble:

All Electronic devices developed in circuit Concepts. Thus all analog circuits developed on circuit Concept basis. But the advancement of Technology in Fabrication Field gain prominence and all discrete components are fabricated using I.C Technology. On a Single chip millions of transistors are fabricated using Very Large Scale IC. In This context Operational Amplifiers which is an analog device plays an important role for Analog IC Design.

Operational Amplifiers performs Algebraic operations, Logarithmic Operations, Trigonometric Operations etc. Therefore these Operational Amplifiers design goes into System design instead of circuit design. So Linear IC applications plays vital role in the electronic field Starting from home appliances to Super computers.

#### Learning Objectives:

After completion of this course, the reader should be able to

- Draw a block diagram representing a typical op-amp with various definitions.
- Draw and explain the open-loop configuration and feedback configuration and can determine Voltage gain, the input resistance, the output resistance.
- Differentiate between Ideal and Non-Ideal Op-Amp, Determination of closed loop voltage gain, the input resistance, the output resistance for Non-Ideal Op-Amp Circuits.
- Perform various mathematical Operations, Trigonometric & Logarithmic Operations, and Instrumentation Amplifier with relevant Circuits.
- Design waveform generators (Astable, Monostable, Schmitt Trigger) using Single Op-Amp.
- Study of 555 timer & its applications using Astable and Monostable Operations.
- Can design various types of Active Filters such as LPF, HPF, BPF, BRF, NBPF, Notch Filter, ALL pass filters.
- Study the operation & applications of PLA.
- Explain the operation of A/D and D/A Converters.



**UNIT-I:****Introduction To Operational Amplifier**

Block diagram of Typical Op-Amp With Various Stages– BJT Differential Amplifier With  $R_E$  DC Analysis– AC Analysis –BJT differential amplifier with constant current source – Analysis Different input/output configurations dual input balanced output–Dual input unbalanced output–Signal input balanced output–Signal input unbalanced output–AC analysis with r-parameters –Current repeater circuits–Current mirror circuits–Analysis–Level translator – Cascade differential amplifier– FET differential amplifier.

**UNIT-II:****OP-AMP Parameter**

Input offset voltage – Input off-set current–Input bias current–Differential input resistance–Common mode rejection ratio–Slew ratio–PSRR–Large signal voltage gain–Output voltage swing transients response–definitions and explanations. Measurement of bias current–Measurement of offset currents–Measurement of offset voltage –Measurement of slew rate – Output offset voltage balancing circuits–Bias current compensations circuit–Dual power suppliers with shunt capacitance filter–Fix voltages Regulators 78XX–79XX series and as current sources– Dual power supply using 78XX and 79XX series.

**UNIT-III****Ideal Operational Amplifier Theory and Basic Circuits**

Ideal operational amplifier properties–Ideal assumptions–Basic circuits such as non inverting type comparator–Inverting type comparator–Voltage follower– Inverting amplifier–Non–inverting amplifier–Summing amplifier–Non–inverting summing amplifier–sub-tractor– Differentiator–Integrator–Scale changer–Instrumentation amplifier– V to I and I to V converters–Log and Anti–log amplifiers–Zero crossing detector–Schmitt-trigger peak detector– Half-wave and full-wave rectifiers– Precision diode– Non-ideal operational amplifier non–inverting amplifier– inverting amplifier– closed-loop gain–Input and output resistance equivalent circuits.

**UNIT-IV:**

**Wave form generator in angular waveform generator using op-amps and PLL** Design of Astable multivibrator –Monostable multivibrator using signal op-amp–Trigging waveform generator 555 timer:Introduction–Pindigram–Functional diagram for 8pin DIP–Design of Astable and monostable multi– Astable applicatio–Monostable applications– PLL: Introduction,basic blockdiagram– Functions of each block–566 VCO– 565 PLL block diagram –Function of each block–Applications of PLL–Frequency

multiplier role of each pin frequency translation– AM–FM and FSK demodulators.

## **UNIT–V:**

### **Active filters**

Introduction– Merits and demerits of active filters–Over passive filters– First order low pass Butter–Worth filter –Design and frequency response–Second order LPF design and frequency response – First order HPF design and frequency response– Second order HPF design and frequency response–Higher-order filters– BPF wide band–pass and narrow band–pass filter–Wide band reject filter–Notch filter–All-pass filter.

## **UNIT–VI:**

### **D to A and A to D Convertors**

Digital to Analog Convertors(D to A) – Introduction–Specifications–Basic DAC techniques– Weighted resistor DAC– R–2R ladder DAC–Inverted R–2R –Output expression for each type.

### **Analog to Digital Convertors**

Introduction–Specifications–Parallel comparator type–Counter type–Dual slope–Successive approximation type ADCs– Merits and demerits of each type, Comparison of different types.

### **Learning Outcomes:**

- After completion of this course student can able to differentiate “Analog Circuits & Digital Circuits”.
- The course content gives an insight in to the fundamentals so that one can design the “Linear Circuits” with their own innovative skills.
- Those who are taken this course can specialize in this subject in their Post Graduation. It is a challenging task for the individual to exhibit his logical skills & Analytical ability.
- They can design their own circuits which may be useful for current industry needs.

### **Text Books:**

1. OP–AMPS and liner integrator circuits by Ramakanth A Gayakwad (PHI).
2. Linear Integrated Circuits by D.Roy chowdary, New age international.

3. Op-amp and linear integrated circuits by sanjay sharma, S.K.Kataria & son's New Delhi.

**Reference Books:**

1. Micro Electronics– Mclliman Mc Graw Hill.
2. Analog Electronics– L.K.Maheswari, PHI.
3. Linear Integrated circuits by S.Salivahan, TMH.

**III Year – I SEMESTER**

T	P	C
0	3	2

**ELECTRICAL MACHINES – II LAB****Learning objectives:**

- To predetermine the efficiency and regulation of transformers and assess their performance.
- To predetermine the regulation of three-phase alternator by various methods, find  $X_d / X_q$  ratio of alternator and assess the performance of three-phase synchronous motor.
- To perform various tests on Induction motor for assessing its performance.

**The following experiments are required to be conducted as compulsory experiments:**

1. O.C. & S.C. Tests on Single phase Transformer
2. Sumpner's test on single phase transformers
3. Scott connection of transformers
4. No-load & Blocked rotor tests on three phase Induction motor
5. Regulation of a three –phase alternator by synchronous impedance & M.M.F. Methods.
6. V and Inverted V curves of a three—phase synchronous motor.
7. Equivalent Circuit of a single phase induction motor
8. Determination of  $X_d$  and  $X_q$  of a salient pole synchronous machine

**In addition to the above eight experiments, at least any two of the following experiments are required to be conducted from the following list:**

1. Parallel operation of Single phase Transformers
2. Separation of core losses of a single phase transformer
3. Brake test on three phase Induction Motor
4. Regulation of three-phase alternator by Potier triangle method.
5. Efficiency of a three-phase alternator

6. Heat run test on a bank of 3 Nos. of single phase Delta connected transformers.
7. Measurement of sequence impedance of a three-phase alternator.

**Learning outcomes:**

- Able to predetermine the efficiency and regulation of transformers and assess their performance.
- Able to predetermine the regulation of three-phase alternator by various methods, find  $X_d / X_q$  ratio of alternator and assess the performance of three-phase synchronous motor.
- Able to perform various tests on Induction motor for assessing its performance.

**III Year – I SEMESTER**

T	P	C
0	3	2

**CONTROL SYSTEMS LAB****Learning Objectives:**

- To impart hands on experience to understand the performance of basic control system components such as magnetic amplifiers, D.C. servo motors, A.C. Servo motors, stepper motor and potentiometer.
- To understand time and frequency responses of control system with and without controllers and compensators.

**Any 10 of the following experiments are to be conducted:**

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller – characteristics of stepper motor
4. Effect of feedback on DC servo motor
5. Effect of P, PD, PI, PID Controller on a second order systems
6. Lag and lead compensation – Magnitude and phase plot
7. DC position control system
8. Transfer function of DC motor
9. Temperature controller using PID
10. Characteristics of magnetic amplifiers
11. Characteristics of AC servo motor
12. Characteristics of DC servo motor
13. Potentiometer as an error detector

**Learning Outcomes**

- Able to analyze the performance and working Magnetic amplifier, D.C. servo motors, A.C. Servo motors and synchronous motors.
- Able to design P,PI,PD and PID controllers
- Able to design lag, lead and lag-lead compensators
- Able to control the temperature using PID controller
- Able to determine the transfer function of D.C.motor
- Able to control the position of D.C servo motor performance

**III Year – I SEMESTER**

<b>T</b>	<b>P</b>	<b>C</b>
<b>3+1</b>	<b>0</b>	<b>2</b>

**INTELLECTUAL PROPERTY RIGHTS AND PATENTS****UNIT I**

Introduction to Intellectual Property Law – Evolutionary past – Intellectual Property Law Basics - Types of Intellectual Property - Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration – Infringement - Regulatory – Over use or Misuse of Intellectual Property Rights - Compliance and Liability Issues.

**UNIT II**

Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of performers – Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law-Semiconductor Chip Protection Act.

**UNIT III**

Introduction to Patent Law – Rights and Limitations – Rights under Patent Law – Patent Requirements – Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation – International Patent Law – Double Patenting – Patent Searching – Patent Cooperation Treaty – New developments in Patent Law- Invention Developers and Promoters.

**UNIT IV**

Introduction to Trade Mark – Trade Mark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trade Mark – Likelihood of confusion – Trade Mark claims – Trade Marks Litigation – International Trade Mark Law.

**UNIT V**

Introduction to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement –

Trade Secret Law – Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law.

## **UNIT VI**

Introduction to Cyber Law – Information Technology Act - Cyber Crime and E-commerce – Data Security – Confidentiality – Privacy - International aspects of Computer and Online Crime.

### **REFERENCE BOOKS:**

1. Deborah E.Bouchoux: “Intellectual Property”. Cengage learning , New Delhi
2. Kompal Bansal & Parishit Bansal "Fundamentals of IPR for Engineers", BS Publications (Press)
3. Cyber Law. Texts & Cases, South-Western’s Special Topics Collections
4. Prabhuddha Ganguli: ‘ Intellectual Property Rights’ Tata Mc-Graw – Hill, New Delhi
5. Richard Stim: "Intellectual Property", Cengage Learning, New Delhi.
6. R. Radha Krishnan, S. Balasubramanian: "Intellectual Property Rights", Excel Books. New Delhi.
7. M. Ashok Kumar and Mohd. Iqbal Ali: “Intellectual Property Right” Serials Pub.



**III Year – II SEMESTER**

<b>T</b>	<b>P</b>	<b>C</b>
<b>3+1</b>	<b>0</b>	<b>3</b>

**SWITCHGEAR AND PROTECTION****Preamble:**

In order to supply power from generating end to receiving end several equipments are connected in to the system. In order to protect the equipments and components against various operating conditions and over voltages protective devices are required to be installed in the system. Topics specified in this subject deal with various types of protective equipments and their working principle including limitations etc.

**Learning objectives:**

- To provide the basic principles of arc interruption, circuit breaking principles, operation of various types of circuit breakers.
- To study the classification, operation, construction and application of different types of electromagnetic protective relays.
- To explain various types of faults in generators and transformers and different types of protective schemes.
- To impart knowledge of various protective schemes used for feeders and bus bars.
- To explain the principles and operations of different types of static relays.
- To study different types of over voltages in a power system and principles of different protective schemes for insulation co-ordination.

**UNIT-I:****Circuit Breakers**

Miniature Circuit Breaker(MCB)– Elementary principles of arc interruption– Restrike Voltage and Recovery voltages– Restrike phenomenon– Average and Max. RRRV– Current chopping and Resistance switching– Introduction to oil circuit breakers– Description and operation of Air Blast– Vacuum and SF6 circuit breakers– CB ratings and specifications– Auto reclosing.

**UNIT-II:****Electromagnetic Protection**

Principle of operation and construction of attracted armature– Balanced beam– induction disc and induction cup relays– Relays classification– Instantaneous– DMT and IDMT types– Applications of relays: Over current/under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison.

**UNIT-III:****Generator Protection**

Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth fault and inter turn fault protection– Numerical examples.

**Transformer Protection**

Protection of transformers: Percentage differential protection– Design of CT's ratio– Buchholz relay protection–Numerical examples.

**UNIT-IV:****Feeder and Bus bar Protection**

Protection of lines: Over current– Carrier current and three zone distance relay using impedance relays–Translay relay–Protection of bus bars– Differential protection.

**UNIT-V:****Static and Digital Relays**

Static relays: Static relay components– Static over current relay– Static distance relay– Micro processor based digital relays.

**UNIT-VI:****Protection against over voltage and grounding**

Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc–Oxide lightning arresters– Insulation coordination– BIL– impulse ratio– Standard impulse test wave– volt–time characteristics– Grounded and ungrounded neutral systems–Effects of ungrounded neutral on system performance– Methods of neutral grounding: Solid–resistance–Reactance–Arcing grounds and grounding Practices.

**Learning Outcomes:**

- To be able to understand the principles of arc interruption for application to high voltage circuit breakers of air, oil, vacuum, SF<sub>6</sub> gas type.
- Ability to understand the working principle and constructional features of different types of electromagnetic protective relays.
- Students acquire in depth knowledge of faults that is observed to occur in high power generator and transformers and protective schemes used for all protections.
- Improves the ability to understand various types of protective schemes used for feeders and bus bar protection.
- Generates understanding of different types of static relays with a view to application in the system.
- To be able to understand the different types of over voltages appearing in the system, including existing protective schemes required for insulation co-ordination.

**Text Books:**

1. Protection and SwitchGear by BhaveshBhalja, R.P. Maheshwari, NileshG. Chothani, Oxford University Press, 2013
2. Power system protection- Static Relays with microprocessor applications. by T.S. Madhava Rao, TMH
3. Electrical Power System Protection by C. CHRISTOPOULOS and A. Wright, Springer publications

**Reference Books:**

1. Power System Protection and Switchgear by Badari Ram, D.N Viswakarma, TMH Publications.
2. Fundamentals of Power System Protection by Paithankar and S.R. Bhide, PHI, 2003.
3. Art & Science of Protective Relaying – by C R Mason, Wiley Eastern Ltd.

\*\*\*

**III Year – II SEMESTER**

<b>T</b>	<b>P</b>	<b>C</b>
<b>3+1</b>	<b>0</b>	<b>3</b>

**MICROPROCESSORS AND MICROCONTROLLERS****Preamble:**

Microprocessor and microcontroller have become important building blocks in digital electronics design. It is important for student to understand the architecture of a microprocessor and its interfacing with various modules. 8086 microprocessor architecture, programming, and interfacing is dealt in detail in this course. Interfacing, assembly language programming and interfacing of 8051 microcontroller and its application in industry are also covered in this course.

**Learning objectives:**

- To understand the organization and architecture of Micro Processor
- To understand addressing modes to access memory
- To understand 8051 micro controller architecture
- To understand the programming principles for 8086 and 8051
- To understand the interfacing of MP with IO as well as other devices.
- To understand how to develop cyber physical systems

**UNIT-I:****Introduction to Microprocessor Architecture**

Introduction and evolution of Microprocessors– Architecture of 8086– Register Organization of 8086–Memory organization of 8086– General bus operation of 8086–Introduction to 80286–80386 and 80486 and Pentium.

**UNIT-II:****Minimum and Maximum Mode Operations**

Instruction set, Addressing modes– Minimum and Maximum mode operations of 8086–8086 Control signal interfacing–Read and write cycle timing diagrams.

**UNIT-III:****Assembly Language Programming**

Assembly Directives–Macro’s– Algorithms for Implementation of FOR Loop–WHILE–REPEAT and IF-THEN-ELSE Features–Addressing modes and Instruction set of 8051–Assembly language programming of 8051–Development systems and tools.

**UNIT-IV:****I/O Interface**

8255 PPI– Architecture of 8255–Modes of operation– Interfacing I/O devices to 8086 using 8255–Interfacing A to D converters– Interfacing D to A converters– Stepper motor interfacing– Static memory interfacing with 8086–DMA controller (8257)–Architecture–Interfacing 8257 DMA controller–Programmable Interrupt Controller (8259)–Command words and operating modes of 8259– Interfacing of 8259–Keyboard/display controller (8279)–Architecture–Modes of operation–Command words of 8279– Interfacing of 8279.

**UNIT-V:****Introduction to 8051 Micro Controller**

Overview of 8051 Micro Controller– Architecture– Register set–I/O ports and Memory Organization– Interrupts–Timers and Counters–Serial Communication.

**UNIT- VI:****Cyber physical systems and industrial applications of 8051**

Applications of Micro Controllers– Interfacing 8051 to LED’s–Push button–Relay’s and Latch Connections– Keyboard Interfacing– Interfacing Seven Segment Display–ADC and DAC Interfacing.

**Learning Outcomes:**

- To be able to understand the microprocessor capability in general and explore the evaluation of microprocessors.
- To be able to understand the addressing modes of microprocessors
- To be able to understand the micro controller capability

- To be able to program mp and mc
- To be able to interface mp and mc with other electronic devices
- To be able to develop cyber physical systems

**Text Books:**

1. Microprocessors and Interfacing, Douglas V Hall, Mc-Graw Hill, 2<sup>nd</sup> Edition.
2. Kenneth J Ayala, “The 8051 Micro Controller Architecture, Programming and Applications”, Thomson Publishers, 2nd Edition.
3. Ray and Burchandi, “Advanced Micro Processors and Interfacing”, Tata McGraw-Hill.

**Reference Books:**

1. R.S. Kaler, “ A Text book of Microprocessors and Micro Controllers”, I.K. International Publishing House Pvt. Ltd.
2. Ajay V. Deshmukh, “Microcontrollers – Theory and Applications”, Tata McGraw-Hill Companies –2005.
3. Ajit Pal, “Microcontrollers – Principles and Applications”, PHI Learning Pvt Ltd, 2011.

**III Year – II SEMESTER**

<b>T</b>	<b>P</b>	<b>C</b>
<b>3+1</b>	<b>0</b>	<b>3</b>

**UTILIZATION OF ELECTRICAL ENERGY****Preamble:**

This course primarily deals with utilization of electrical energy generated from various sources. It is important to understand the technical reasons behind selection of motors for electric drives based on the characteristics of loads. Electric heating, welding and illumination are some important loads in the industry in addition to motor/drives. Another major share of loads is taken by Electric Traction. Utilization of electrical energy in all the above loads is discussed in detail in this course. Demand side management concepts are also introduced as a part of this course.

**Learning objectives:**

- To understand the operating principles and characteristics of traction motors with respect to speed, temperature ,loading conditions.
- To acquaint with the different types of heating and welding techniques.
- To study the basic principles of illumination and its measurement.
- To understand different types of lightning system including design.
- To understand the basic principle of electric traction including speed–time curves of different traction services.
- To understand the method of calculation of various traction system for braking, acceleration and other related parameters, including demand side management of energy.

**UNIT – I:****Selection of Motors**

Choice of motor, type of electric drives, starting and running characteristics–Speed control–Temperature rise–Applications of electric drives–Types of industrial loads–continuous–Intermittent and variable loads–Load equalization.

**UNIT – II:****Electric Heating**

Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

**Electric Welding**

Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding

**UNIT – III:****Illumination fundamentals**

Introduction, terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Sources of light

**UNIT – IV:****Various Illumination Methods**

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–LED lighting.

**UNIT – V:****Electric Traction – I**

System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor–Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves.

**UNIT – VI:****Electric Traction – II**

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–Principles of energy efficient motors.

**Learning Outcomes:**

- Able to identify a suitable motor for electric drives and industrial applications
- Able to identify most appropriate heating or welding techniques for suitable applications.
- Able to understand various level of illuminosity produced by different illuminating sources.
- Able to estimate the illumination levels produced by various sources and recommend the most efficient illuminating sources and should be able to design different lighting systems by taking inputs and constraints in view.



- Able to determine the speed/time characteristics of different types of traction motors.
- Able to estimate energy consumption levels at various modes of operation.

**Text Books:**

1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab, DhanpatRai & 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.

**III Year – II SEMESTER**

T	P	C
3+1	0	3

**POWER SYSTEM ANALYSIS****Preamble:**

The course is designed to give students the required knowledge for the design and analysis of electrical power grids. Calculation of power flow in a power system network using various techniques, formation of  $Z_{bus}$  and its importance are covered in this course. It also deals with short circuit analysis and analysis of power system for steady state and transient stability.

**Learning Objectives:**

- To study the development of impedance diagram (p.u) and formation of  $Y_{bus}$
- To study the Gauss Seidel, Newton raphson, decoupled and fast decoupled load flow methods.
- To study the concept of the  $Z_{bus}$  building algorithm.
- To study short circuit calculation for symmetrical faults,
- To study the effect of unsymmetrical faults.
- To study the rotor angle stability analysis of power systems.

**UNIT –I:****Per Unit Representation & Topology**

Per Unit Quantities–Single line diagram– Impedance diagram of a power system – Graph theory definition – Formation of element node incidence and bus incidence matrices – Primitive network representation – Formation of  $Y$ –bus matrix by singular transformation and direct inspection methods.

**UNIT –II:****Power Flow Studies**

Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form) –Decoupled and Fast Decoupled methods (Algorithmic approach) – Problems on 3–bus system only.

**UNIT –III:****Z–Bus formulation**

Formation of Z–Bus: Partial network– Algorithm for the Modification of  $Z_{bus}$  Matrix for addition element for the following cases: Addition of element from a new bus to reference– Addition of element from a new bus to an old bus– Addition of element between an old bus to reference and Addition of element between two old busses (Derivations and Numerical Problems).– Modification of Z–Bus for the changes in network (Problems).

**UNIT – IV:****Symmetrical Fault Analysis**

3–Phase short circuit currents and reactances of synchronous machine–Short circuit MVA calculations.

**UNIT –V:****Symmetrical Components & Fault analysis**

Synthesis of unsymmetrical phasor from their symmetrical components– Symmetrical components of unsymmetrical phasor–Phase - shift of symmetrical components in Y– $\Delta$ –Power in terms of symmetrical components – Sequence networks – Positive, negative and zero sequence networks– Various types of faults LG– LL– LLG and LLL on unloaded alternator– unsymmetrical faults on power system.

**UNIT – VI:****Power System Stability Analysis**

Elementary concepts of Steady state– Dynamic and Transient Stabilities– Description of Steady State Stability Power Limit–Transfer Reactance– Synchronizing Power Coefficient –Power Angle Curve and Determination of Steady State Stability –Derivation of Swing Equation–Determination of Transient Stability by Equal Area Criterion–Application of Equal Area Criterion–Methods to improve steady state and transient stability.

- Able to draw an impedance diagram for a power system network.
- Able to form a  $Y_{bus}$  matrix for a power system network with or without mutual couplings.
- Able to find out the load flow solution of a power system network using different types of load flow methods.
- Able to formulate the  $Z_{bus}$  for a power system network.
- Able to find out the fault currents for all types faults with a view to provide data for the design of protective devices.

- Able to find out the sequence components of currents for any unbalanced power system network.
- Able to analyze the steady state, transient and dynamic stability concepts of a power system.

**Text Books:**

1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
2. Electrical Power Systems by P.S.R.Murthy, B.S.Publications
3. Modern Power system Analysis – by I.J.Nagrath&D.P.Kothari: Tata Mc Graw–Hill Publishing Company, 2nd edition.
4. Power System Analysis and Design by J.Duncan Glover, M.S.Sarma, T.J. Overbye – CengageLearning publications.

**Reference Books:**

1. Power System Analysis – by A.R.Bergen, Prentice Hall, Inc.
2. Power System Analysis by HadiSaadat – TMH Edition.
3. Power System Analysis by B.R.Gupta, Wheeler Publications.

**III Year – II SEMESTER**

T	P	C
3+1	0	3

**POWER SEMICONDUCTOR DRIVES****Preamble:**

This course is an extension of power electronics applications to electric drives. This course covers in detail the basic and advanced speed control techniques using power electronic converters that are used in industry. It is equally important to understand the four quadrant operation of electric drives and slip power recovery schemes in induction motors.

**Learning Objectives:**

- To learn the fundamentals of electric drive and different electric braking methods.
- To analyze the operation of three phase converter controlled dc motors and four quadrant operation of dc motors using dual converters.
- To discuss the converter control of dc motors in various quadrants.
- To understand the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.
- To learn the principles of static rotor resistance control and various slip power recovery schemes.
- To understand the speed control mechanism of synchronous motors

**UNIT-I:****Fundamentals of Electric Drives**

Electric drive – Fundamental torque equation – Load torque components – Nature and classification of load torques – Steady state stability – Load equalization– Four quadrant operation of drive (hoist control) – Braking methods: Dynamic – Plugging – Regenerative methods.

**UNIT-II:****Three phase converter controlled DC motors**

Revision of speed control techniques – Separately excited and series motors controlled by full converters – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics – Numerical problems – Four quadrant operation using dual converters.

**UNIT-III:****Control of DC motors by DC-DC converters (Type C & Type D)**

Single quadrant – Two quadrant and four quadrant chopper fed separately excited and series excited motors – Continuous current operation– Output voltage and current waveforms – Speed–torque expressions – Speed–torque characteristics –Four quadrant operations – Closed loop operation (Block diagrams only).

**UNIT-IV:****Induction motor control – Stator side**

Variable voltage characteristics–Control of Induction Motor by AC Voltage Controllers – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by voltage source inverter – PWM control – Closed loop operation of induction motor drives (Block Diagram Only).

**UNIT-V:****Control of Induction motor – Rotor side**

Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications.

**UNIT-VI:****Control of Synchronous Motors**

Separate control &self control of synchronous motors – Operation of self controlled synchronous motors by VSI– Closed Loop control operation of synchronous motor drives (Block Diagram Only) –Variable frequency control–Pulse width modulation.

**Learning Outcomes:**

Student should be able to

- Explain the fundamentals of electric drive and different electric braking methods.
- Analyze the operation of three phase converter controlled dc motors and four quadrant operation of dc motors using dual converters.
- Explain the converter control of dc motors in various quadrants.
- Explain the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.
- Explain the principles of static rotor resistance control and various slip power recovery schemes.

- Explain the speed control mechanism of synchronous motors

**Text Books:**

1. Fundamentals of Electric Drives – by G K Dubey Narosa Publications
2. Power Semiconductor Drives, by S.B. Dewan, G.R.Slemon, A.Straughen, Wiley-India Edition.

**Reference Books:**

1. Electric Motors and Drives Fundamentals, Types and Applications, by Austin Hughes and Bill Drury, Newnes.
2. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publications.
3. Power Electronic Circuits, Devices and applications by M.H. Rashid, PHI.
4. Power Electronics handbook by Muhammad H.Rashid, Elsevier.

\*\*\*

**III Year – II SEMESTER**

T	P	C
3+1	0	3

**MANAGEMENT SCIENCE****UNIT I**

**Introduction to Management:** Concept –nature and importance of Management – Functions of Management – Evaluation of Management thought- Theories of Motivation – Decision making process-Designing organization structure- Principles of organization - Types of organization structure.

**UNIT II**

**Operations Management:** Principles and Types of Management – Work study- Statistical Quality Control- Control charts (P-chart, R-chart, and Cchart).

Simple problems- Material Management: Need for Inventory control- EOQ, ABC analysis (simple problems) and Types of ABC analysis (HML, SDE, VED, and FSN analysis).

**UNIT III**

**Functional Management:** Concept of HRM, HRD and PMIR- Functions of HR Manager- Wage payment plans(Simple Problems) – Job Evaluation and Merit Rating - Marketing Management- Functions of Marketing – Marketing strategies based on product Life Cycle, Channels of distributions.

**UNIT IV**

**Project Management:** (PERT/CPM): Development of Network – Difference between PERT and CPM Identifying Critical Path- Probability- Project Crashing (Simple Problems).

**UNIT V**

**Strategic Management:** Vision, Mission, Goals, Strategy – Elements of Corporate Planning Process – Environmental Scanning – SWOT analysis-Steps in Strategy Formulation and Implementation, Generic Strategy alternatives.

**UNIT VI**

**Contemporary Management Practice:** Basic concepts of MIS, MRP, Justin- Time (JIT) system, Total Quality Management (TQM), Six sigma and Capability Maturity Model (CMM) Levies, Supply Chain Management,



Enterprise Resource Planning (ERP), Business Process outsourcing (BPO), Business process Re-engineering and Bench Marking, Balanced Score Card.

**Text Books**

1. Dr. P. Vijaya Kumar & Dr. N. Appa Rao, '*Management Science*' Cengage, Delhi, 2012.
2. Dr. A. R. Aryasri, '*Management Science*' TMH 2011.

**References**

1. Koontz & Wehrich: '*Essentials of management*' TMH 2011.
2. Seth & Rastogi: *Global Management Systems*, Cengage learning, Delhi, 2011.
3. Robbins: *Organizational Behaviour*, Pearson publications, 2011.
4. Kanishka Bedi: *Production & Operations Management*, Oxford Publications, 2011.
5. Philip Kotler & Armstrong: *Principles of Marketing*, Pearson publications.
6. Biswajit Patnaik: *Human Resource Management*, PHI, 2011.
7. Hitt and Vijaya Kumar: *Starategic Management*, Cengage learning.

**Objective:**

To familiarize with the process of management and to provide basic insights into select contemporary management practices.

**Codes/ Tables:**

Normal Distribution Function Tables need to be permitted into the examination Halls.

**III Year – II SEMESTER**

<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>3</b>	<b>2</b>

**POWER ELECTRONICS LAB****Learning objectives:**

- To study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
- To analyze the performance of single-phase and three-phase full-wave bridge converters, single-phase dual converter with both resistive and inductive loads.
- To understand the operation of AC voltage controller and cyclo converter with resistive and inductive loads.
- To understand the working of Buck converter, Boost converter, single-phase bridge inverter and PWM inverter.

**Any 10 of the Following Experiments are to be conducted**

1. Study of Characteristics of SCR, MOSFET & IGBT
2. Gate firing circuits for SCR's
3. Single -Phase Half controlled converter with R and RL load
4. Single -Phase fully controlled bridge converter with R and RL loads
5. Single -Phase AC Voltage Controller with R and RL Loads
6. Single -Phase Cyclo-converter with R and RL loads
7. Single -Phase Bridge Inverter with R and RL Loads
8. Single -Phase dual converter with RL loads
9. Three -Phase half controlled bridge converter with RL load.
10. Three- Phase full converter with RL-load.
11. DC-DC buck converter.
12. DC-DC boost converter.
13. Single -phase PWM inverter.
14. Single -phase diode bridge rectifier with R load and capacitance filter.
15. Forced commutation circuits(Class A, Class B, Class C, Class D and Class E)

**Learning outcomes:**

- Able to study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
- Able to analyze the performance of single-phase and three-phase full-wave bridge converters, single-phase dual converter with both resistive and inductive loads.
- Able to understand the operation of AC voltage controller and cyclo converter with resistive and inductive loads.
- Able to understand the working of Buck converter, Boost converter, single-phase bridge inverter and PWM inverter.

**III Year – II SEMESTER**

<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>3</b>	<b>2</b>

**ELECTRICAL MEASUREMENTS LAB****Learning Objectives:**

- To understand the correct function of electrical parameters and calibration of voltage, current, single phase and three phase power and energy, and measurement of electrical characteristics of resistance, inductance and capacitance of a circuits through appropriate methods.
- To understand measurement of illumination of electrical lamps.
- To understand testing of transformer oil.
- To measure the parameters of choke coil.

**Any 10 of the following experiments are to be conducted**

1. Calibration and Testing of single phase energy Meter.
2. Calibration of dynamometer wattmeter using phantom loading UPF
3. Crompton D.C. Potentiometer – Calibration of PMMC ammeter and PMMC voltmeter.
4. Kelvin's double Bridge – Measurement of resistance – Determination of Tolerance.
5. Capacitance Measurement using Schering bridge.
6. Inductance Measurement using Anderson bridge.
7. Measurement of 3 phase reactive power with single-phase wattmeter for balanced loading.
8. Measurement of complex power with Trivector meter and verification.
9. Optical bench – Determination of polar curve measurement of MHCP of electrical lamp.
10. Calibration of LPF wattmeter – by direct loading.
11. Measurement of 3 phase power with single watt meter and 2 No's of C.T.
12. C.T. testing using mutual Inductor – Measurement of % ratio error and phase angle of given C.T. by Null method.
13. P.T. testing by comparison – V.G. as Null detector – Measurement of % ratio error and phase angle of the given P.T.
14. Dielectric oil testing using H.T. testing Kit

15. LVDT and capacitance pickup – characteristics and Calibration
16. Resistance strain gauge – strain measurements and Calibration
17. Polar curve using Lux meter, Measurement of intensity of illumination of fluorescent lamp.
18. Transformer turns ratio measurement using AC. bridge.
19. A.C. Potentiometer – Polar form/Cartesian form – Calibration of AC Voltmeter, Parameters of Choke.
20. Measurement of Power by 3 Voltmeter and 3 Ammeter methods.
21. Parameters of choke coil.

**Learning Outcomes:**

- To be able to measure accurately the electrical parameters voltage, current, power, energy and electrical characteristics of resistance, inductance and capacitance.
- To be able to measure illumination of electrical lamps.
- To be able to test transformer oil for its effectiveness.
- To be able to measure the parameters of inductive coil.