SVKM's NMIMS
Mukesh Patel School of Technology Management & Engineering
Electrical Engineering (2016 – 2017)

Program: MBA Tech. (All Branches)				**Semester : III**	
Course : Engineering Mathematics - III				**Code :** MBEE03001	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	0	2	4	Scaled to 70 Marks	Scaled to 30 Marks

Objectives:

1. To provide an understanding of matrices to solve Engineering problems.
2. Impart knowledge of Laplace transforms and Fourier series.

Outcomes:

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

1. Solve problems using Matrices, Laplace transforms and Fourier series.
2. Apply Matrices, Laplace transforms, Fourier series to Engineering problems.
3. Analyses the concept of Matrices, Laplace transforms and Fourier series.

Detailed Syllabus:

Unit	**Description**	**Duration**
1.	**Matrices:** Linear dependence and independence of rows and columns of a matrix over real field, System of linear homogeneous and non-homogeneous equations, Characteristic equation, Eigen values and Eigen vectors of a square matrix, Cayley-Hamilton Theorem, Similar Matrices, Diagonalization of a Matrix, Functions of a Square Matrix, Quadratic Forms.	**12**
2.	**Laplace transform:** Definition, Laplace transform of $1, e^{at}, \sin at, \cos at, \sinh at, \cosh at, t^n$, First shifting theorem, Change of scale property, $L\{t^n f(t)\}, L\left\{\frac{f(t)}{t}\right\}, L\left\{\int_0^t f(u)du\right\}, L\{f^n(t)\}$, Evaluation of Inverse Laplace using partial fraction, Convolution Theorem, Laplace transforms of Periodic functions, Unit step functions, Second shifting theorem , Dirac delta functions and their Laplace Transform. **Application**: Solve initial and boundary value problems involving ordinary differential equations.	**20**
3.	**Fourier Series:** Orthogonality and Orthonormality**,** Periodic function, Trigonometric Series, Dirichlet's conditions, Euler's formulae	**13**

	(Derivation of Fourier coefficients a_0, a_n, b_n is not expected), Fourier series for the interval $[\alpha, \alpha+2\pi]$ and $[\alpha, \alpha+2c]$, Function having points of discontinuity, Even and Odd functions, Half range sine and cosine expansions, Parseval's identities.	
	Total Hours	**45**
	Note: Proofs of theorems are not expected	

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Eastern Ltd, 10th, 2010.
2. G.V. Kumbhojkar, "Applied Mathematics-III (Computer, EXTC)", C. Jamnadas & Co., 2nd, 2008-09.
3. H. K. Dass, "Advanced Engineering Mathematics", S.Chand, 17th, 2007.

Term Work:

1. Minimum ten tutorials to be taken.
2. Two class tests.

Program: MBA Tech. (Electrical)				**Semester : III**	
Course : Network Analysis and Synthesis				**Code :** MBEE03002	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	0	2	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Knowledge of Basic Electrical Engineering and Basic Electronics

Objectives:

1. To provide knowledge of basic fundamentals of Electrical & Electronics network analysis and synthesis.
2. To expose students to simulation tools for circuit analysis.
3. To analyze and synthesis two port networks.

Outcomes:

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

1. Apply knowledge of basic electrical engineering to analyze ac and dc circuits.
2. Apply knowledge of mathematics to evaluate the steady state and transient responses of electrical circuits.
3. Know different parameters of two-port networks.
4. Compute network parameters.
5. Synthesize L-C, R-C, R-L and RLC circuits.

Detailed Syllabus:

Unit	Description	Duration
1.	**Mesh & Node Analysis** Mesh & Node Analysis of circuits with independent & dependent AC and DC sources.	**05**
2.	**Network Theorems** Linearity, Superposition, Current & Voltage Source Transformation, Thevenin's & Norton's Theorem for dependent AC and DC sources, Maximum power transfer theorem. Miller's theorem, Tellegen's theorem.	**09**
3.	**Circuit Analysis** Introduction to Graph Theory. Tree, link currents, branch voltages, cut set & tie set. Mesh & Node Analysis, Duality.	**04**

4.	**Transient Analysis of Circuits using Classical Technique** First & second Order Differential equations for Evaluation & analysis of Transient and Steady state responses, initial conditions.	**05**
5.	**Transient and steady state response of circuits using Laplace Transform** Circuit analysis using Laplace Transform. Transfer function, Concept of poles and zeros. Frequency response of a system.	**04**
6.	**Network functions and Two - port Networks** Concept of two- port network. Driving point & Transfer Functions, Open Circuit impedance (Z) parameters, Short Circuit admittance (Y) parameters, Transmission (ABCD) parameters. Inverse Transmission (A'B'C'D') parameters. Hybrid (h) parameters. Inter Relationships of different parameters. Interconnections of two – port networks. T & Pi representation. Terminated two - port networks.	**09**
7.	**Network Synthesis** Positive real functions, Properties of Positive real functions, Testing Positive real functions,. Driving Point functions, Testing driving point functions. Properties of Hurwitz polynomials, Residue computations, Even & odd functions, Sturm's theorem. Driving Point Synthesis with L-C, R-C, R-L and RLC circuits.	**09**
	Total Hours	**45**

Text Books:

1. William. H. Hayt, Jack E. Kemmerly & Steven M. Durbin, 'Engineering Circuit Analysis', McGraw Hill International, 6th edition, 2002.
2. M. E. Van Valkenburg, 'Network Analysis', Prentice Hall of India, 3rd edition, 2006.

Reference Books:

1. A. Sudhakar & S. P. Shyammohan, 'Circuits and Networks', Tata McGraw Hill, thirteenth reprint, 2000.
2. Artice M. Davis, 'Linear Circuit Analysis', Thomson Asia Pte. Ltd., Singapore, first edition, 2001
3. Raymond A. DeCarlo & Pen-Min Lin, 'Linear Circuit Analysis', Oxford

University Press, second edition, 2001.
4. Ravish Singh 'Electrical Networks' Tata Mc Graw hill publication, 2009.

Term Work:

1. Minimum two assignments.
2. Minimum ten tutorials covering the whole of syllabus, duly recorded and graded.

Program: MBA Tech. (Electrical)				**Semester : III**	
Course : Energy Resources and Generation				**Code :** MBEE03003	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Knowledge of Basic Electrical Engineering, Basic Electronics and Engineering Physics

Objectives:

1. To provide knowledge of different power generation schemes.
2. To understand the importance of non conventional sources of energy and its impact on environment.
3. To introduce case studies for renewable and non renewable energy sources.

Outcomes:

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

1. Discuss significance of various energy generation schemes.
2. Compare the performance of different energy generation schemes.
3. Identify potential application for various energy generation schemes.

Detailed Syllabus:

Unit	Description	Duration
1.	**Thermal and Hydro Power plant:** Selection of site, working of various parts: Economizer, air preheater, condenser, cooling tower, coal handling system, ash handling system, Classification of hydro power plant according to available head, nature of load, functions of different components and their working.	**08**
2.	**Nuclear and Diesel Power plant:** Methods of producing nuclear reactions, functions of different components of nuclear plant, functions of different components of diesel plant	**06**
3.	**Solar Energy and its measurement:** Solar constants, solar radiation at earth's surface, solar radiation geometry, solar radiation measurement, estimation of average solar radiation, solar radiation on tilted surface, principle of solar energy conversion in to heat, flat plate collectors, energy balance	**08**

	equation and collector efficiency	
4.	**Fuel cells:** Chemistry applied to fuel cells, principle and operation, classification and types of fuel cells, performance characteristics of fuel cells.	**04**
5.	**Wind Energy:** Basic principle of wind energy conversion, wind data and energy estimation, selection of site, basic components of wind energy conversion system (WECS), classification of WEC systems, generating system, energy storage, application of wind energy.	**08**
6.	**Ocean and tidal energy:** Ocean energy resources, ocean energy routes, ocean thermal energy conversion, progressive wave, wave data collection, Basic principle of tidal power, components of tidal power plants, operation methods of utilization of tidal energy, estimation of power and energy in simple single basin tidal system	**06**
7	**Biomass:** Biomass production and use, Biomass heat and power Comparison between different sources, Environmental impact of each sources.	**05**
	Total Hours	**45**

Text Books:

1. S.B.Pandya, 'Conventional Energy Technology', Tata McGrawHill, 2005.
2. G.D.Rai, Non Conventional Energy Resources'', Khanna Publishers, 2001.

Reference Books:

1. Chetan Singh Solanki , Solar Photo Voltaics , PHI Learning Pvt Ltd., New Delhi,2009
2. Hashem Nehrir and Caisheng Wang, Modeling and control of fuel cells: Distributed Generation Applications, IEEE Press, 2009
3. J.F. Manwell, J.G. McGowan and A. L. Rogers , Wind Energy Explained, theory design and applications, Wiley publication, 2nd edition, 2009
4. D. D. Hall and R. P. Grover, Biomass Regenerable Energy, John Wiley, New York, 1987.

Term Work:

1. Minimum two assignments.
2. Minimum ten tutorials covering the whole of syllabus, duly recorded and graded.

Program: MBA Tech. (Electrical)				**Semester : III**	
Course : Analog Integrated Circuits and Applications				**Code :** MBEE03004	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Electronics Circuit Design

Objectives:

1. To provide knowledge of the circuit building block of OpAmp , its dc and ac equivalent circuit and its applications.
2. To understand and provide knowledge of various Analog Integrated circuits such as IC 741, 555 timer, 723 voltage regulator.
3. To understand the different types of filters and design them for the given specifications.

Outcomes:

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

1. Know various configurations and specifications of ideal and practical Op-amp
2. Design operational amplifier circuits for different linear and non-linear applications.
3. Design oscillators, filters and regulators using operational amplifiers for various specifications.
4. Analyze the working of power controller, PLL, VCO IC s and their applications.

Detailed Syllabus:

Unit	**Description**	**Duration**
1	**Operational Amplifiers:** Ideal operational amplifier circuit analysis. Differential amplifier circuit configurations, DC and AC analysis, current mirror, circuit description - output stage and working of 741 – OP AMP. Frequency response, Noise, Experimental measurement of OPAMP parameters. OP AMP specifications.	**08**

2	**Negative Feedback Applications:** Inverting, Non-inverting amplifiers, Voltage follower, Summer, Subtractor, Differentiator, Integrator, Instrumentation amplifier, Voltage to current, Current to Voltage converter and its applications, Instrumentation amplifier.	**06**
3	**Nonlinear Applications:** Voltage comparators, Schmitt trigger, Precison rectifier, peak detector, sample and hold circuit, log and antilog amplifier.	**06**
4	**Wave Form Generators:** Design of Wien bridge oscillator and R C Phase shift oscillator using 741, Monostable, Astable and Bistable Multivibrators using IC 555 timer & IC 741, Voltage Controlled Oscillator IC 566, Phase locked loop (IC 565) and its applications.	**08**
5	**Active Filters:** Frequency response and design of first order LP, HP, BP , Second order filters , High Order filters, Band-Pass filters, Narrow Band-Pass filter , Wide Band-Pass filters, All Pass filter and audio applications.	**08**
6	**IC Voltage regulators:** Fixed voltage regulators, Adjustable voltage regulators, switching regulators, Linear voltage regulator IC 723, Design of low voltage regulator and high voltage regulator using 723.	**06**
7	**Power Controller ICs** Power amplifiers using power boosters, Monolithic power amplifier- LM380, power audio amplifier and its applications.	**03**
	Total Hours	**45**

Text Books:

1. R. A. Gayakwad, Op-Amps and Linear Integrated Circuits, Prentice Hall of India Pvt. Ltd, 4th edition, 2009.
2. Sergio Franco, Design with operational amplifiers and analog circuits, McGraw Hill, 3rd edition, 2002.

Reference Books:

Robert Coughlin and F. Driscoll, Operational amplifiers and linear integrated circuits by, Prentice Hall of India Pvt. Ltd, 6th edition, 2009.

Term Work:

1. Minimum two assignments.
2. Minimum ten lab experiments covering the whole syllabus, duly recorded and graded.

Program: MBA Tech. (Electrical)				**Semester : III**	
Course : Measurements and Instrumentation				**Code :** MBEE03005	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Basic Electronics & Engineering Physics

Objectives:

1. To understand operation of different types of measuring instruments.
2. To understand the application of CT, PT & Electrical transducers.
3. To impart hands on experience in measuring circuit parameters.

Outcomes:

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

1. Know construction & working principle of measuring instruments.
2. Compare performance of different measuring instruments in practical applications.
3. Evaluate circuit parameters using various bridges.
4. To understand working principles of transducers.
5. Select and analyse Instrument transformers for various applications.

Detailed Syllabus:

Unit	Description	Duration
1	**Measuring Instruments:** **Types of instruments:** **Errors in Ammeter and Voltmeters** **Ohmmeters** **Electrodynamometer:** construction, Principle of operation, torque equation, Scale shape, errors, merits & demerits	**05**
2	**Watt meters & Energy meters:** **Electrodynamometer Wattmeter:** construction, theory of operation, torque equation, errors & demerits, **Electronic energy meter.** **Analysis of three phase balanced load** Measurement of active & reactive power & energy in single phase & three phase circuits.	**05**

3	**Measurement of circuit parameters:** Resistance: Medium resistance (Wheatstone Bridge), Low Resistance (Kelvin Double Bridge), High Resistance (Meggar) **Capacitance, Inductance AC bridges :** Maxwell, Wein, Hay, De sauty, Anderson, Schearing	**08**
4	**Electrical Transducers** : Classification & Characteristics **Displacement:** Potentiometer, Inductive transducer: LVDT Capacitive transducer: Change in area, Change in distance, change in dielectric constant **Angular Velocity:** DC tachometer Generator, AC tachometer Generator, Digital Methods (Photoelectric Tachometer). **Temperature:** RTD, Thermocouple, Thermister **Pressure:** Piezo Electric Transducer **Torque:** Inductive troque transducer, Digital Methods	**09**
5	**Instrument Transformer (IT)** **Instrument Transformer:** Use of IT, Disadvantages of shunts, multipliers. Advantages of IT, Ratio of IT, Burden of an IT **CT & PT:** Theory & construction, Phasor diagram, Ratio & Phase angle error, causes of error, sizing, applications	**08**
6	**High Voltage Measurements and Testing:** Measurement of RMS and peak values of voltages, High Voltage DC testing of cables, surge testing, high voltage testing of porcelain insulators.	**05**
7	**Special Measuring Instruments :-** Maximum demand indicator, Trivector meter, Frequency meter, P.F. meter, Phase sequence indicator, Synchroscope, stroboscope.	**05**
	Total Hours	**45**

Text Books:

1. A.K.Sawhney, A course in Electrical, Electronics measurement and Instrumentation, Dhanpat Rai & sons 2011.

Reference Books:

1. Oliver Cage, Electronic Measurement & Instrumentation, TMH 4th reprint 2010.
2. H.S Kalsi, Electronic Instrumentation, TMH 3rd edition, 2nd reprint 2011.

3. David Bell, Electronic Instrumentation & Measurement, Oxford University Press 2nd Edition, 2009.
4. Golding, Electrical measurement and measuring Instruments, Wheeler Publishing, 2nd Edition, 2003.

Term Work:

1. Minimum two assignments.
2. Minimum ten lab experiments covering the whole syllabus, duly recorded and graded.

Program: MBA Tech. (Electrical)				**Semester : III**
Course : Numerical Techniques				**Code :** MBEE03006
Teaching Scheme				**Evaluation Scheme**
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
2	2	0	3	Scaled to 50 Marks

Pre-requisite: Nil

Objectives:

1. To impart knowledge of numerical techniques.
2. To make students aware of various techniques to solve Engineering problems.
3. To make students aware of various solving skills by these numerical techniques

Outcomes:

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

1. Know the different types of errors occurring in numerical calculations.
2. Apply different methods to find roots for non linear algebraic equations.
3. Solve sets of linear equations.
4. Apply Interpolation and curve fitting models.
5. Evaluate Numerical solution of ordinary differential equations.
6. Apply Numerical Differentiation and Integration.
7. Implement algorithms for numerical methods.

Detailed Syllabus:

Unit	Description	Duration
1.	**Errors in Numerical Computations:** Types of Errors, Analysis & Estimation of Errors, Taylor's Series for Approximation of Functions, General Error Formula, Error Propagation: Stability & Condition.	**05**
2.	**Roots of Equations:** Bisection Methods, Secant Method, Method of False Position, Newton- Raphson Method, Convergence Method, Choice of Iterative Method, Engineering Applications.	**05**
3.	**Systems of Linear Algebraic Equations:** Systems with Small Number of Equations : Graphical Method,	**05**

	Cramer's rule, Matrix Inversion Method, Substitution Methods, Gaussian Elimination Method, Gauss Jordan Elimination Method, Gauss Siedel Iterative Method	
4.	**Curve Fitting:** Finite Difference Operators, Forward, Backward, Divided & Central Differences, Newton's Interpolation Methods, Lagrange Interpolation, Least Square Approximation.	**06**
5.	**Solution to Ordinary differential equations:** Taylor series method, Picard's method of successive approximation Runge-Kutta methods, Euler's method, Euler's predicator-corrector method, Runge-Kutta method of second order and forth order Boundary value and eigen value problems.	**05**
6.	**Numerical differentiation & Integration:** Methods based on interpolation and finite differences, Trapezoidal Rule for Numerical Integration, Simpson's 1/3 Rule, Simpson's 3/8 Rule.	**04**
	Total Hours	**30**

Text Books:

1. Seven C. Chapra , Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill, 4th Edition, 2002.

Reference Books:

1. Robert J. Schilling, Sandra L. Harris, Applied Numerical Methods for Engineers (Using MATLAB and C), Thomson Asia Pte. Ltd, 1st edition, 2002.
2. S. S. Sastry, Introduction to methods of Numerical Analysis, PHI, 4th edition, 2006.
3. E. Balaguruswamy, Numerical Methods, Tata McGraw Hill Education, 1st edition, 1999.

Term Work:

1. Minimum two assignments.
2. Minimum 10 Laboratory Experiments covering the whole syllabus, duly recorded and graded.

Program: MBA Tech. (Electrical)				**Semester : IV**	
Course : Electrical Machines - I				**Code :** MBEE04001	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Basic Electrical Engineering.

Objectives:

1. To impart knowledge for the concepts of Transformers and its applications.
2. To expose the students to the construction details, principle of operation of various types of electrical machines and applications of electrical machines.
3. To get hands on experience in electrical machines.

Outcomes:

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

1. To explain Constructional details, principle of operation of Transformers.
2. To understand concept of rotating machines.
3. Select and Analyse different machines for industrial applications
4. To understand construction details, principle of operation, Performance, starters and speed control of DC Machines

Detailed Syllabus:

Unit	Description	Duration
1.	**Transformer** Transformer principle of operation and Construction Ideal Two-Winding Transformer, Transformer phasor diagram at various load conditions, Equivalent Circuit of a Transformer, The per Unit System & Rating of Transformers Open-Circuit And Short-Circuit Tests, Voltage Regulation of a Transformer, Transformer Losses and Efficiency, hysteresis and eddy current losses, Testing of Transformers, Autotransformers, Parallel Operation of Single Phase Transformers, on load and no load tap changer Three phase transformer connections, Vector groups. Multiwinding Transformers, Star to delta, Delta to star.	**15**
2.	**Electromechanical Energy Conversion Principles** Principle of Energy Conversion, Single and doubly Excited	**06**

	Magnetic System, Electromagnetic and Reluctance torques.	
3.	**Basic Concepts of Rotating Electrical Machines** Constructional Features of Rotating Electrical Machines (Direct current machine, Poly phase induction machines, Synchronous machines). Concepts of General Terms Pertaining to Rotating Machines. Generated EMF's, in (full pitched coil, short pitched coil, Ac machines, dc machines) and torque equations. E.M.F's Polygon, Distribution (Breadth) Factor, Pitch (Coil-Span) Factor, Elimination of Harmonics from Alternator, E.M.F Waveforms. Rotating Magnetic field, Choice of power of electrical machines and applications.	**12**
4.	**D.C. Machines** Introduction, EMF and Torque, Circuit model. Torque speed characteristics and speed control of DC Motors Permanent Magnet DC Machine: Construction and working principle. Brushless DC motor: contruction and working principle. Stepper motor: Construction, working principle and Types of stepper motor Application of DC machines.	**12**
	Total Hours	**45**

Text Books:

1. Bimbhra P.S., 'Electrical Machinery'', Khanna Publishers, 4th edition, 2003
2. Kothari D.P & Nagrath I.J., 'Electric Machines', Tata McGraw Hill Pvt. Ltd., 4th edition, 2010

Reference Books:

1. Stephen Umans, 'Fitzgerald & Kingsley's Electric Machinery', McGraw Hill Education, 7th edition, 2013

Term Work:

1. Minimum two assignments.
2. Minimum ten laboratory Experiments covering the whole syllabus, duly recorded and graded.

Program: MBA Tech. (Electrical)				**Semester : IV**	
Course : Electromagnetic Field Theory				**Code :** MBEE04002	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	0	2	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Knowledge of Basic Electrical Engineering and Maths.

Objectives:

1. To introduce concepts of electric and magnetic fields and propagation of uniform plane waves.
2. To impart knowledge on electrostatics, electrical potential, energy density and their applications.
3. Understand concepts of magneto statics, magnetic flux density, scalar and vector potential and its applications.
4. To understand relations between field due to time-varying situations.

Outcomes:

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

1. Apply vector calculus concepts to understand behaviour of static electric and magnetic field.
2. Describe and analyze electromagnetic wave in free space.
3. To implement electromagnetic concepts.

Detailed Syllabus:

Unit	**Description**	**Duration**
1.	**Introduction to Vector Algebra:** Vector Field, Rectangular, Cylindrical and Spherical Coordinate systems.	**03**
2.	**Coulomb's law and electric field intensity:** Coulomb's law, electric field intensity, calculation of electric field intensity for various charge distributions, streamlines and sketches of field.	**05**
3.	**Electric flux density and Gauss's law:** Electric flux density, Gauss's law, vector operator and divergence theorem.	**05**
4.	**Energy and potential:**	

	Energy expended in moving a point charge in an electric field, line integral, potential and potential difference, calculations of electric field of both point charge and system of charges, potential gradient, dipole, energy density.	**05**
5.	**Conductors, Dielectrics, capacitance:** Current and current density continuity of current, conductor properties, dielectric material and properties, capacitance, calculation of capacitance of various configurations method of images.	**05**
6.	**Poisson and Laplace's equations:** Poisson and Laplace's equation and its application, uniqueness theorem, product solution of Laplace's equation.	**04**
7.	**Steady magnetic field:** Biot – Savart law, Ampere's circuital law, curl of H, Stoke's theorem, magnetic flux and flux density, scalar and vector magnetic potentials.	**04**
8.	**Time varying fields and Maxwell's equations:** Faraday's law concept of displacement currents, Maxwell's equations in point form, Maxwell's equations in integral form, boundary conditions and significance of Maxwell's equations.	**04**
9.	**Uniform Plane waves:** Uniform plane waves in time domain in free space, sinusoidally time varying uniform plane waves in free space, wave equation, wave equation and solution for material uniform plane, Waves in dielectrics and conductors, reflection of uniform plane waves, polarization of waves.	**05**
10.	**Poynting vector and flow of power:** Poynting vector and flow of power: Poynting theorem, power flow for a plane wave, Poynting loss in a plane conductor. Introduction to FDM, FEM and MOM	**05**
	Total Hours	**45**

Text Books:

1. Hayt& Buck, Engineering Electromagnetics, Tata McGraw-Hill, 7th Edition, 2006.
2. Matthew Sadiku, Elements of Electromagnetism, Oxford University Press, 5th Edition, 2010.

Reference Books:

1. Edward C. Jordan, Keith G Balmann, Electromagnetic Waves and radiating systems, Prentice Hall of India, 2nd edition, 2005.
2. Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, Pearson Education, 6th edition, 2004.
3. Edminister J.A, Electromagnetics, Tata McGraw-Hill, 2nd edition, 2006.

Term Work:

1. Minimum two assignments.
2. Minimum ten tutorials assignments covering all the topics.

Program: MBA Tech. (Electrical)				**Semester : IV**	
Course : Digital Circuits and Systems				**Code :** MBEE04003	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Basic Electronics

Objectives:

1. To provide knowledge of digital logic & digital system as well as their applications in technical field.
2. To provide knowledge of basic building blocks and their working.
3. To provide knowledge of designing the digital logic circuit using basic building blocks and necessary techniques which is required in computer hardware design.

Outcomes:

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

1. Convert different number systems, Codes, and compare Logic Gates
2. Describe Boolean laws and theorem and use them to simplify Boolean functions to minimum form using k-map and Boolean algebra.
3. Design and implement different types of combinational logic circuits using logic gates and sequential logic circuits using Flip-Flops.
4. Design & implement different types of Counters, Registers, and programmable Logic Devices
5. Describe and compare different types of memories.
6. Outline the concept of VHDL used for digital designing.

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction To Digital Systems:** Comparison of Analog and Digital Systems, Number Systems: binary, octal, hexadecimal, BCD and others. Conversion from one system to another, Binary Arithmetic including 1's and Two Complement Arithmetic, Importance of Binary and Hexadecimal Numbers	**02**

2.	**Binary Codes:** Weighted, reflective, sequential, gray, error detecting codes, even parity, Hamming codes, alphanumeric, Morse, teletypewriter ASCII, EBCDIC codes, converting binary to gray and gray to binary and XS3.	**03**
3.	**Logic Gates and Boolean Algebra:** AND, OR, NOT, XOR, XNOR, operation NAND, NOR use of universal gates for performing different operations. Laws Boolean algebra, DeMorgan's theorems. Relating truth table to a Boolean expression. Multi level circuits.	**04**
4.	**Combinational Logic:** Canonical Logic Form, minterms, maxterm SOP and POS implementation. Implementing a logic function using universal gates.K-maps and their use in simplifying Boolean expressions, Variable entered maps for five and six variables functions, Quine Mc Clusky tabular techniques.	**08**
5.	**Design of Combinational Logic Circuits:** Design of Code converter circuits-Binary to Gray, BCD to 7 segments, priority encoder, Binary comparator, binary arithmetic circuits – adders, subtractors (half and full), BCD adder–subtractor, ALU, Parity generator. Multiplexers (ULM), De-multiplexers, Decoders, Encoders, Tree structures. Hazards in combinational circuits.	**10**
6.	**Sequential Logic Circuits:** Comparison of combinational and sequential circuits, flip-flops, SR, T, D, JK, master slave JK, converting one flip-flop to another, use of debounce switch. Synchronous and Asynchronous Counters, modulus of a counter, , up / down counter, Counter designing by drawing state transition diagram and state transition table using all kinds of Flip –Flops. Ring counter, Johnson counter, twisted ring counter, pseudo random number generator. Finite and Mixed state Machines- Mealy and Moore Design, Logic state diagram analysis.	**12**
7.	**Registers:** Serial input -serial output; serial input-parallel output; Parallel In -Parallel Out, Serial In -Serial Out, Bi Directional Shift Registers, Universal Shift Registers.	**02**

8.	**Memories:** RAM, ROM, basic bipolar cell, CMOS, dynamic RAM cell. Magnetic core NVRAM, bubble memory, CCD, PAL, PLA, FPGA.	**02**
9.	**Introduction to VHDL**	**02**
	Total Hours	**45**

Text Books:

1. Morris Mano, Digital Design, PHI, 4th edition, 2008.

Reference Books:

1. R.P Jain, Digital Electronics and Microprocessors, Tata McGraw-Hill, 25th reprint 2007.
2. Roth and John: Principles of Digital Systems Design, Ceneage Learning, Sixth Indian Reprint 2011.

Term Work:

1. Minimum two assignments.
2. Minimum ten laboratory Experiments covering the whole syllabus, duly recorded and graded.

Program: MBA Tech. (Electrical)				**Semester : IV**	
Course : Probability and Random Processes				**Code :** MBEE04004	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	0	2	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Nil

Objectives:

1. To develop the concepts and techniques associated with the understanding of probability and random processes
2. To be able to analyse the chances of occurrence of error in communication field.

Outcomes:

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

1. Know the concept of probability and random variables.
2. Analyze the different probability density functions and their applications.
3. Know the basics of random processes.
4. Evaluate different random processes and its applications in telecommunication.
5. Recognize the statistical theory used in application areas like communication, signal processing and control.

Detailed Syllabus:

Unit	Description	Duration
1.	**Review of Probability** Sample Space, Events, and Probability, Conditional Probability, Mutually exclusive events, Joint probability of related and independent events, Statistical independence.	**06**
2.	**Random Variables** Random Variables, Cumulative Distribution function, Probability Density Function, Relationship between probability and probability density function, Discrete and continuous distributions. Important Random Variables – Bernoulli, Binomial, Uniform, Gaussian Rayleigh Probability Density Function, Gaussian , Probability Density Function	**08**

3.	**Expectations of Random Variable** Mean, variance , Moments of random variables, Two dimensional Random Variables, Covariance and correlation of random variables, Chebyschev's Inequality and Central Limit Theorem	**07**
4.	**Random Processes: Basic Concepts** Statistics– first order, Second order, Wide-Sense Stationary Processes, Multiple Random Processes, Random Processes and Linear Systems, Power Spectral Density of Stationary Processes, Power Spectral Density of a Sum Processes, Cross Spectral Densities, Cross power spectrum and cross correlation functions, Concept of Entropy. Introduction to stochastic process.	**16**
5.	**Estimation of Parameters** Estimation of Random Parameters, Invariance of Estimators, Maximum Likelihood Estimators, Mean Square Error (MSE) Estimates	**08**
	Total Hours	**45**

Text Books:

1. Anthanasios Papoulis, S. Unnikrishna Pillai, Probability, Random Variables and Stochatic Processes, Tata McGraw-Hill 2002, 4th edition, 2008.
2. T. Veerarajan, Probability, Statistics and Random Processes, Tata McGraw-Hill 2003, 3rd edition, 2008.

Reference Books:

1. John G. Proakis, Masoud Salehi, Fundamentals of Communication Systems, First Edition, Pearson Education, 2006.
2. S. P. Eugene Xavier, Statistical Theory of Communication, 1st Edition, New Age International Publishers, 1999.

Term Work:

1. Minimum two assignments.
2. Minimum ten tutorials covering the whole syllabus, duly recorded and graded.

Program: MBA Tech. (Electrical)				**Semester : IV**	
Course : Power Electronics				**Code :** MBEE04005	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Basic Electrical Engineering, Basic Electronics

Objectives:

1. To study basic understanding of modern power semiconductor devices, their strengths, their switching and protection techniques.
2. To provide knowledge of the wide range of power electronic converter circuits for AC-DC, DC-DC and DC-AC power conversion.

Outcomes:

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

1. Describe the construction and characteristics of power devices.
2. Identify and design protection circuits for power devices.
3. Discuss and analyze the working of power converter circuits.
4. Explain different industrial applications of power switching devices.

Detailed Syllabus:

Unit	Description	Duration
1.	**Power Devices** Construction, Static and dynamic characteristics and ratings of SCR, GTO, IGBT, MOSFET, DIAC, TRIAC Methods of turning on of SCR - Design of Gate triggering circuit using UJT, Methods of turning off, Commutation circuits.	**08**
2	**Protection, Isolation circuits** Isolation circuits using optocoupler and transformer, Protection circuits- Snubbers, MOVs, dv/dt, & di/dt, heat sink design.	**05**
3	**Single-phase& three-phase AC/DC Converter** Circuit diagram, operation & waveforms for R and R-L loads of line frequency phase controlled rectifiers – single phase and three phase half controlled and fully controlled converters with continuous and constant current.	**08**

4	**Single-phase & Three-phase DC/ AC inverters** Circuit diagram, operation & waveforms for single phase inverters- McMurray-Bedford, series & parallel, basic circuit operation of PWM inverters, Circuit diagram, operation & waveforms for three phase voltage source bridge inverters for 120 degree & 180 degree conduction for balanced star resistive load.	**08**
5	**Switched & Resonant DC/ DC converters** On-off control of DC/ DC converters. Circuit diagram, Waveforms & operation (o/p voltage calculation) of step down chopper (Buck converter), Step up chopper (Boost converter), Jones chopper	**08**
6	**Application of Power Switching Devices** Principle of operation and working of following switching circuits- Automatic battery charger, Voltage regulator, Emergency light, Time delay relay circuit, Fan speed control	**08**
	Total Hours	**45**

Text Books:

1. M. Rashid, Power Electronics, Prentice Hall of India Publication, 2nd Edition, 2010.
2. M.D. Singh & K. B. Khanchandani, Power Electronics, Tata McGraw Hill, first edition, 2006.
3. P. C. Sen, Modern Power Electronics, Wheeler Publication, 3rd Edition, 2008

Reference Books:

1. Ned Mohan, Undeland, Robbins, Power Electronics, John Wiley Publication, 2nd Edition, 2003.
2. Landers, Power Electronics, McGraw Hill, 2nd Edition, 2009.
3. Dubey G.K, Electrical Drives, Narosa Press, 1st Edition, 2002.

Term Work:

1. Minimum two assignments.
2. Minimum ten tutorials covering the whole of syllabus, duly recorded and graded.
3. Two term tests.

Program: MBA Tech. (Electrical)				**Semester : IV**	
Course : Signals and Systems				**Code :** MBEE04006	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Knowledge of Engineering Mathematics.

Objectives:

1. To provide knowledge of analog domain signals and systems for time and frequency domain analysis.
2. To study various continuous and discrete time transforms

Outcomes:

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

1. Define and identify various types of signals and systems.
2. Apply mathematical operations to analyze signals and systems.
3. Employ different state space analysis to construct system model.
4. Apply various mathematical transforms for continuous time signal and systems.
5. Use various transforms to analyze discrete time signal and systems.

Detailed Syllabus:

Unit	**Description**	**Duration**
1	**Signals:** Signals, classification of signals, elementary signals - analog and discrete signals, Basic operation of signals, systems.	**04**
2	**Time domain representation for linear time invariant systems (analog & discrete):** Classification of systems, series and parallel connection of systems, causal, non-causal, memory less and with memory, stable invertible systems. Convolution and de-convolution. Impulse, step response for first and second order LTI systems.	**09**
3	**Fourier representation for continuous time and discrete time signals:** Representation of signals in terms of orthogonal functions, orthonormal signals, Fourier series, Fourier transform, their properties, Fourier transform representation of periodic signals.	**12**

	Introduction to discrete time Fourier series & discrete time Fourier transform.	
4	**Laplace transforms:** Introduction to bidirectional Laplace transforms and ROC, its properties, LT of elementary signals unilateral Laplace transform Inversion of Laplace transform, Using L.T. with or without initial conditions, Transfer function of system.	**08**
5	**Z - transform:** Introduction, Z transform of elementary signals, ROC, Properties of Z transform, Inversion of Z transform, system function, solution of difference equation, unilateral Z transform.	**12**
	Total Hours	**45**

Text Books:

1. Oppenheim & Willsky, Signal and Systems, Prentice Hall of India publication, 2nd edition, 2008.
2. Simon Haykin & Barry van veen, Signal and Systems, John Wiley publication. 2nd edition, 2008.

Reference Books:

1. I.J Nagrath, S.N Sharan, Signals and Systems, Tata Mcgraw Hill publication, 2nd Edition, 2010.
2. B. P. Lathi, Signal processing and linear systems, Oxford publication, 2004.
3. H. P. HSU, Signals and Systems, Schaum's Outlines, McGraw-Hill publication, 2nd Edition, 2008.

Term Work:

1. Minimum two assignments.
2. Minimum ten Laboratory Experiments covering the whole syllabus, duly recorded and graded.

Program: MBA. Tech. (Electrical)				**Semester : V**	
Course : Control Systems – I				**Code : MBEE05001**	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Knowledge of Signals and systems, Mathematics

Objectives:

1. To introduce the basic control system and control system modelling using various Techniques.
2. To introduce methods for analysing the time response, the frequency response and the stability of the system.
3. To introduce the state variable analysis method.

Outcomes:

After completion of the course, students would be able to :

1. Apply the concepts of open and close loop control system for modelling physical systems.
2. Analyze the system for stability criteria in time and frequency domain.
3. Understand the concepts of state variable analysis for appropriate designing of non – linear systems.

Detailed Syllabus:

Unit	Description	Duration
1	**Concept of Open loop and Closed loop Systems**: Examples and applications of open and closed loop systems. Classifications of control systems. Brief idea of multivariable control systems. Control system components.	03
2	**Mathematical Modeling of Physical Systems:** Representation of physical system by differential equations. Transfer Function, Block diagram reduction technique, Signal flow graph method.	06
3	**State Variable Analysis:** 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. Laplace Transform solution of	08

	state equation.	
4	**Time response analysis:** Time response Analysis of first order and second order systems. Characteristic Equations, response to step, ramp and parabolic inputs. Steady state error and error constants. Design specifications in time domain.Concept of Controllability and Observability.	**06**
5	**Stability of the System:** Absolute stability and relative stability, Routh Hurwitz's stability criterion and limitations.	**04**
6	**Root Locus:** Definition, Properties, and Sketching Rules, stability analysis from root locus. Effect of addition of poles and zeros, Sensitivity and root locus.	**05**
7	**Frequency response Analysis:** Nyquist plot, Polar Plot and Bode plot. Frequency Domain Specifications. Principal of Argument, Nyquist Stability criterion for minimum phase system. Gain Margin and Phase Margin concept in Nyquist plot and bode plot. Design specification in frequency domain and their co-relation with time.	**10**
8	**Compensators:** Lead, Lag and Lag-lead compensators in time & frequency domain.	**03**
	Total Hours	**45**

Text Books:

1. Norman Nise, "Control Systems Engineering", 4th Edition, 1995.
2. I.G. Nagrath& M. Gopal, "Control Systems Engineering", Wiley Eastern Ltd., 5th Edition, 2000.

Reference Books:

1. Richard C. Drof and Robert H. Bishop, "Modern Control System", Person Int., 12th Edition, 2010.
2. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 5th Edition, 2009
3. Benjamin C. Kuo, "Automatic Control Systems", John Wiley & Sons, 8th Edition, 2009.

Term Work:

1. Minimum two assignments.
2. Minimum ten practicals covering the whole syllabus, duly recorder and graded.
3. Minimum two term tests.

Program: MBA. Tech. (Electrical)				**Semester : V**	
Course : Electrical Machines - II				**Code : MBEE05002**	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Knowledge of Electrical Machines – 1

Objectives:

1. To understand the construction and operating characteristics of AC motors.
2. To evaluate performance parameters of AC motors.

Outcomes:

After completion of the course, students would be able to

1. Understand construction and operating principle of induction motor and synchronous machine.
2. Acquire knowledge on characteristics of induction motor and synchronous machine for different operating conditions.
3. Test and calculate performance parameters of induction motor and synchronous machine.
4. Analyse and select machine for specific application.

Detailed Syllabus:

Unit	Description	Duration
1	**Polyphase Induction Motors** Rotating magnetic field, Motor construction, Motor specifications, Types of motors, Principle of operation, Basic equations, Vector diagram, Equivalent circuit, Torque and power equations Torque/slip characteristics, Performance calculations, Circle diagram, High torque motors, Manual and Automatic starting methods, Speed control – conventional and v/f control, crawling and cogging, Unbalanced operation of 3-phaseinduction	**12**

	motors, Applications, Motor enclosures.	
2	**Single-Phase Induction Motor** Types, Double field revolving theory, Equivalent circuit, Determination of motor parameters, Methods of starting, Applications.	**6**
3	**Alternator** Principle of operation, Constructional features and types, emf equation, Distributed ac windings, Distribution and coil span factors, Effect of harmonics on emf and its elimination, Armature reaction in cylindrical and salient pole machines, Two reaction theory, Equivalent circuit of cylindrical and salient pole machines, Voltage equation, Output equations, Vector diagrams, Voltage regulation by synchronous impedance, MMF and Zero Power Factor (ZPF) method, Transient and sub-transient reactance, Short circuit ratio (SCR), Concept of reactive power control through excitation system, Condition for maximum power, Synchronizing power and torque, Synchronizing conditions and methods, Operational aspects of alternators on infinite bus.	**12**
4	**Synchronous Motor** Principle of reversibility, Voltage equation, Phasor diagram, Torque and power equations, Steady state operating characteristic, 'V' and inverted 'V' curves and 'O' curves, Circle diagram, Starting, hunting, damper windings and its effect, Synchronous condenser, Construction and Working principle of auto synchronous motor.	**10**
5	**Basic ac Commutator Motors** Introduction, 1-phase ac series motor, Universal and Repulsion motors.	**5**
	Total Hours	**45**
Reference Books: 1. M. G. Say, "Performance and Design of Alternating Current Machines", CBS Publishers, 3rd edition, 2002. 2. E. Fitzgerald, "Electric Machinery", Tata McGraw-Hill, 5th edition, 1993.		
Term Work:		

1. Minimum two assignments.
2. Minimum ten practicals covering the whole syllabus, duly recorder and graded.
3. Minimum two term tests.

Program: MBA. Tech. (Electrical)				**Semester : V**	
Course : Electrical Power – I				**Code: MBEE05003**	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	0	2	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Knowledge of Basic Electrical Engineering, Energy Resource and Generation

Objectives:

1. To understand the performance parameters of generating stations.
2. To develop understanding of the economical aspects in the power system.
3. To be able to design transmission and distribution system effectively.

Outcomes:

After completion of the course, students would be able to

1. **Understand the fundamental concepts of electrical power generation, transmission & distribution.**
2. **Understand the economical aspects of power system.**
3. **Apply the basic concepts of designing the transmission and distribution system.**
4. **Enhancing the ability to identify and solve basic power systems problems.**

Detailed Syllabus:

Unit	Description	Duration
1	**Economics of Power Generation** Load curve, load duration curve, maximum demand, connected	**5**

	load, demand factor, diversity factor, depreciation, methods of determining depreciation, tariff, desirable characteristics of tariff and types of tariff.	
2	**Power Factor Improvement** Power factor, disadvantages of low power factor, causes of low power factor, power factor improvement equipment, calculations of power factor correction, most economical power factor.	**4**
3	**Mechanical Design of Overhead Lines** Different types of towers, sag – tension calculations, sag template, effect of ice covering and wind, overhead line with different levels, methods for measuring and checking the sag during erection, stringing chart.	**4**
4	**Overhead Line Insulators** Types of insulators, materials of insulators, potential distribution over suspension insulator string, string efficiency, methods of improving string efficiency, longer cross arm, grading of insulators, guard ring, failure of insulators, preventive maintenance.	**4**
5	**Cables** Construction, classification, insulation resistance, capacitance, dielectric stress, most economical diameter of conductor, grading, methods of laying, causes of failures, calculations of insulation resistance and capacitance, manufacturing processes**,** Comparison of conductor efficiencies for various systems, choice of transmission voltage, economic size of conductor.	**10**
6	**Transmission Line Parameters** Transmission line parameters, skin effects and proximity effect, calculation of inductance and capacitance of a single-phase transmission line and three-phase single & double circuit transmission lines, concept of self-geometrical mean distance and mutual geometrical mean distance, transposition, effect of the earth on capacitance of line, stranded and bundled conductors, Ferranti effect.	**15**
7	**Distribution System** Primary and secondary distribution systems, concentrated and uniformly distributed loads on distributors fed at one and both	**4**

	ends, ring distribution, tapered or stepped distributor, voltage drop and power loss calculation.	
	Total Hours	**45**

Text Books:

1. A. Chakrabarti, M. L. Soni, P. V. Gupta, U. S. Bhatnagar, "A Textbook on Power System Engineering", DhanpatRai& Co, 2nd Edition, 2008.
2. S. Ray, "Electrical Power Systems: Concept, Theory and Practice, PHI Publication", 2nd Edition, 2004.
3. J. B. Gupta, "A Course in Electrical Power", DhanpatRai Publishers, 3rd Edition, 2013.

Reference Books:

1. William D. Stevenson & John J. Grainger, "Modern Power System Analysis", TMH publication, 1stEdition, 1994.
2. S. L. Uppal& S. Rao, "Electrical Power Systems", Khanna Publisher, 15thEdition, 2013.

Term Work:

1. Minimum two assignments.
2. Minimum ten tutorials covering the whole syllabus, duly recorder and graded.
3. Minimum two term tests.

Program: MBA. Tech. (Electrical)				**Semester : V**	
Course : Renewable Energy				**Code: MBEE05004**	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Knowledge of Basic Electrical Engineering, Energy Resource and Generation

Objectives:

1. To understand the various aspects of renewable energy sources.
2. To understand the use of non – conventional energy sources in electrical power generation.

Outcomes:

After completion of the course, students would be able to :

1. Apply the concepts of renewable energy sources for electricity generation 2. Apply the concepts of grid integration with renewable sources 3. Evaluate the options and estimate the energy generation through renewable sources.		
Detailed Syllabus:		
Unit	**Description**	**Duration**
1	**Energy Sources** Conventional, Non-conventional, Renewable and non-renewable sources, Statistics of resources and data on different sources in world and in India, Significance of renewable sources and their exploitation.	**5**
2	**Solar Thermal System** Solar radiation, Solar radiation collectors, Applications, Solar power plants, Types of solar thermal power plants and their integration with grids, Comparison with conventional thermal power plants.	**5**
3	**Solar Photovoltaic System** Characteristics, PV panels, Characteristics of motors connected to PV set, MPPT and its requirement, Grid connected systems, Basic Principles to Follow When Designing a Quality PV System, Basic Steps to Follow When Installing a PV System, Typical System Designs and Options Grid-Interactive Only (No Battery Backup),	**13**
4	**Grid Connected PV System** Grid-Interactive With Battery Backup, Mounting Options Roof mount, Shade Structure Building-Integrated PV Array, Estimating System Output, Factors Affecting Output, Estimating System Energy Output, System Installation, General Recommendations, Materials recommendations, Equipment recommendations and installation methods PV System, Design and Installation Preparation Phase, Design Phase, Installation Phase, Maintenance and Operation Phase, Various applications of Solar PV system.	**10**
5	**Wind Energy System** Working principles, Limitations, Effects of wind speed on grid conditions, Grid independent systems like wind-battery, Wind-	**8**

	solar-battery, Wind-diesel, Wind-hydro-biomass etc., Wind operated pumps, Controller for energy balance, Grid connected systems, Complete System Design, Indian policy.	
6	**Small Hydro System** System configuration, Working principle, Limitation, Effect of hydro potential, Grid connected system, Synchronous versus induction generator for standalone systems.	**4**
	Total Hours	**45**

Text Books:

1. G. D. Rai, "Non-conventional energy sources", Khanna Publishers, 1st Edition, 2004.
2. B. H. Khan, "Non-Conventional Energy Resources", Tata McGraw Hill, 2nd Edition, 2006.
3. Chetan Singh Solanki, "Solar Photo Voltaics: Fundamentals, Technologies and Applications", PHI learning, 2nd Edition, 2011.

Reference Books:

1. G. S. Sawhney, "Non-Conventional Energy Resources", PHI learning, 1st Edition, 2012.
2. Joshua Earnest, "Wind Power Technology", PHI learning, 1st Edition, 2012.

Term Work:

1. Minimum two assignments.
2. Minimum ten practicals covering the whole syllabus, duly recorder and graded.
3. Minimum two term tests.

Program:	**MBA. Tech. (Electrical)**	**Semester : V**
Course :	Microprocessor and Real Time Programming	**Code: MBEE05005**
Teaching Scheme		**Evaluation Scheme**

Lecture Hours per week	Practical Hours per week	Tutorial Hours per week	Credit	Internal Continuous Assessment (ICA) As per Institute Norms (100 Marks)
0	5	0	4	Scaled to 100 Marks

Pre-requisite: Knowledge of Digital Logic Design, Signal and System

Objectives:

1. To provide exposure in terms of real time programming using various microprocessors and microcontrollers
2. To select appropriate processor and controllers of electrical engineering application

Outcomes:

After completion of the course, students would be able to :

1. understand the generalized architecture of advanced microprocessors advanced microcontrollers
2. develop algorithm/program of the advanced microcontrollers for a particular t
3. interface advanced microcontrollers with external peripherals

Detailed Syllabus:

Description

The course will contain laboratory sessions where video lectures and hands on session will be demonstrated based on specific processors and their applications in Electrical Engineering Discipline. The theoretical aspects related to programming skills, instruction sets, understanding architecture, basics of interfacing is expected to be carried out during video lectures or during hands on sessions. Based on the application, a particular processor will be selected and using appropriate algorithm coding for the same will be carried out. Students will be given hands on practise on atleast 10 practical's including Real Time Programming through MATLAB/Simulink. Following processors and controllers can be used for performing various application based experiments:

1. 8086 μP.
2. ARM Microcontroller.
3. Arduino Boards.

Evaluation:

Total 10 experiments to be carried out which will be duly evaluated and graded.
At the end of the semester, practical examination related to above experiments will be conducted.

Text Books:

1. R. S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085", Penram International Publications, 5th Edition, 2007.

2. K. J. Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Penram International Publications, 3rd Edition, 2006.

Reference Books:

1. Mazidi and Mazidi, "8051 Microcontroller and Embedded system", Pearson Publications, 2nd Edition, 2008.
2. John B. Peatman, "Design with PIC Microcontrollers", Pearson Education, 2nd Edition, 2010.
3. Rob Toulson and Tim Wilmshurst, "Fast and Effective Embedded system design-Applying the ARM", Elsevier, 2nd Edition, 2012.
4. Steve Furber, "ARM System-On-Chip Architecture", Pearson Publications, 2nd Edition, 2000.

Program: MBA. Tech. (Electrical)				**Semester : VI**	
Course : Control Systems – II				**Code : MBEE06001**	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Knowledge of Control Systems I, Engineering Mathematics

Objectives:

1. To understand the design process of cascade compensation to improve the steady state error and transient response by using Frequency Response method.
2. To gain knowledge of digital control system and its applications for gain design of the system.
3. To learn in brief about Optimal and Non Linear Control Systems.

Outcomes:

After completion of the course, students would be able to :

1. Understand and apply modern control theory in the field of engineering.
2. Able to analyze linear as well as non-linear control system.
3. Able to test stability and modification to be applied to improve the performance of control system.

Unit	**Detailed Syllabus:**	**Duration**
1	**Introduction:** Elementary ideas of compensating network, PID, Lag, Lead and Lag, lead.	**03**
2	**Design via root locus techniques:** Improving steady state error via cascade compensation, Improving transient response via cascade compensation,	**08**

	Improving steady state and transient response, Feedback compensation.	
3	**Design Via Frequency response** Design specification in frequency domain and their co-relation with time domain Design via Frequency response techniques: Transient response via gain adjustment, Lag compensation, Lead compensation, Lag-Lead Compensation via Bode	**10**
4	**Design by state space:** State variable feedback structure, pole placement design using state feedback, state feedback with integral control, critique of pole placement feedback control, observer based state feedback control.	**10**
5	**Digital Control Systems**: Modelling of digital computer, The z-Transform, Transfer function, Block diagram reduction, Stability, Steady-state error, transient response on z-plane, Gain Design on the z-Plane.	**10**
6	**Nonlinear systems and theory of basics of Optimal Control** Unique characteristics of Nonlinear systems, Lyapunov Stability, Lyapunov stability theorem, Optimal Control	**04**
	Total Hours	**45**

Text Books:

1. M. Gopal, "Control Systems- Principle and Design", TATA Mc-Graw Hill Eduction, 4th edition, 2012.
2. Norman S. Nise, "Control System Engineering", John Wiley & Sons Inc., 6th Edition, 2010.

Reference Books:

1. Jacqueline Wilkie, et al, "Control Engineering an Introductory course", Palgrave, 1st Edition, 2002.
2. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 5th Edition, 2009.
3. I.G Nagrath and M.Gopal, "Control Systems Engineering ", Wiley Eastern Limited, 5th Edition, 2000.
4. J.J D'Azzo et al "Linear Control System Analysis and Design with MATLAB", Marcel Dekker, 2003.

Term Work:

1. Minimum two assignments.
2. Minimum ten practical covering the whole syllabus, duly recorder and graded.
3. Minimum two term tests.

Program: MBA. Tech. (Electrical)				**Semester : VI**	
Course : Electrical Power – II				**Code : MBEE06002**	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	0	2	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Knowledge of Electric Power – 1 and Energy Resource and Generation

Objectives:

1. To understand and evaluate various performance parameters of transmission systems.
2. To analyze various faults in the transmission system along with selection of appropriate grounding system.

Outcomes:

After completion of the course, students would be able to :

1. Evaluate the performance parameters of transmission lines.
2. Understand and analyze the effects of various faults in the power system.
3. Select appropriate type of grounding system and reactive power compensation techniques.

Detailed Syllabus:

Unit	Description	Duration
1	**Performance of Transmission Lines** Classification of transmission lines, Performance of short, medium and long transmission lines, Generalized constants for transmission line, Use of bundled conductors and selection aspects of conductors.	6
2	**Representation of Power System Components** One line diagram, Impedance/ reactance diagram, Per unit system representation.	4
3	**Power Circle Diagram** Receiving and sending end power circle diagrams, Universal power circle diagram.	4
4	**Symmetrical Fault Analysis** Transient on a transmission line, Short circuit of an unloaded and loaded synchronous machine, Reactance's of a synchronous machine, Short circuit current computations, Current limiting reactors, Algorithm for short circuit studies.	6
5	**Symmetrical Components** Symmetrical transformation, Phase shift in star-delta transformers, Sequence impedances of power system components, Sequence networks of power system.	5
6	**Unsymmetrical Fault Analysis** Symmetrical component analysis of unsymmetrical faults	5
7	**Corona** Introduction, Phenomenon of corona formation, Calculation of potential gradient, Critical voltages, Corona loss formula, Factors affecting corona loss, Methods of reducing corona loss, Radio interference.	6

8	**Earthing** Introduction, Isolated neutral, Earthed neutral systems, Solid, resistance, Reactance, Arc suppression coil, Voltage transformer earthing and earthing transformer, Equipment earthing - plate earthing, pipe earthing, Substation earthing.	**6**
9	**Reactive Power and Voltage Control** Production and absorption of reactive power, Voltage control methods, Static VAR systems, Clarks and Parks Transformation.	**3**
	Total Hours	**45**

Text Books:

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill, 3rd Edition, 2009.
2. A. Chakrabarti, M. L. Soni, P. V. Gupta, U. S. Bhatnagar, "A Textbook on Power System Engineering", Dhanpat Rai & Co, 2nd Edition, 2008.
3. C. .L. Wadhwa, "Electrical Power Systems", New Age International (P) Ltd, 7th Edition, 2017.

Reference Books:

1. S. S. Vadheram, "Power System Stability and Control", Dhanpat Rai, 3rd Edition, 2003.
2. William D. Stevenson & John J. Grainger, "Modern Power System Analysis, TMH publication, 1st Edition, 1994.
3. Prabha Kundur, "Power System Stability and Control (EPRI Power System Engineering)", 1stEdition, 1994.

Term Work:

1. Minimum two assignments.
2. Minimum ten tutorials covering the whole syllabus, duly recorder and graded.
3. Minimum two term test.

Program:	**MBA. Tech. (Electrical)**	**Semester : VI**
Course :	Switchgear and Protection	**Code : MBEE06003**

Teaching Scheme				Evaluation Scheme	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 70 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 70 Marks	Scaled to 30 Marks

Pre-requisite: Knowledge of Electrical Power – 1, Electrical Machines - I

Objectives:

1. To impart the basic knowledge on power system protection concepts, substation equipment and protection schemes.

Outcomes:

After completion of the course, students would be able to :

1. Understand the principle of protective schemes and various faults in the Power System Scenario.
2. Examine protection of power system with various protection relays.
3. Study the various types of the circuit breakers, the arc quenching phenomena and the protection against over voltages.

Detailed Syllabus:

Unit	Description	Duration
1	**Introduction** Need of Protective system, Nature and cause of faults, Type of faults, effects of faults, fault statistics, evolution of protective relays, zones of protection, essential qualities of protection, classification of protective schemes.	**7**
2	**Relay Protection Schemes** Constructional features, various types, principle of operation, application and their limitations, over current, directional (current and power), differential, distance, frequency and other types of relays.	**10**
3	**Numerical Protection** Introduction, block diagram of numerical relay, numerical over-current protection, numerical transformer differential protection, numerical distance protection of transmission line.	**9**
4	**Equipment Protection Schemes** Generator and transformer protection systems, protection of busbars, protection of transmission lines including principles of	**9**

	pilot wire and carrier protection, CTs, CVTs & PTs and their application in protective schemes.	
5	**Switchgear** Fault clearing and interruption of current, theory of initiation of arc, methods of quenching arc, restriking and recovery voltage, rating of the circuit breakers, construction and principle of operation of various types of circuit breakers - indoor and outdoor types, MCB, MCCB, ELCB, air - break, SF6, vacuum and HVDC circuit breakers, selection of circuit breakers, elementary ideas of testing methods.	**10**
	Total Hours	**45**

Text Books:

1. B. Ravindranath & M. Chander, "Power System Protection and Switchgear", New Age International Publishers, 1st Edition, 2009.
2. B. Ram, "Power System Protection and Switchgear", Tata McGraw Hill, 1st Edition, 2010.

Reference Books:

1. Paithankar Y. O, "Fundamentals of Power System Protection", PHI Publication, 2nd Edition, 2010.
2. S.S.Rao, "Switchgear and Protection", Khanna Publishers,9th Edition, 2007.

Term Work:

1. Minimum two assignments.
2. Minimum ten practicals covering the whole syllabus, duly recorder and graded.
3. Minimum two term tests.

<table>
<tr><td colspan="4">Program: MBA. Tech. (Electrical)</td><td colspan="2">Semester : VI</td></tr>
<tr><td colspan="4">Course : Electric Drives and Tractions</td><td colspan="2">Code : MBEE06004</td></tr>
<tr><td colspan="4">Teaching Scheme</td><td colspan="2">Evaluation Scheme</td></tr>
<tr><td>Lecture Hours per week</td><td>Practical Hours per week</td><td>Tutorial Hours per week</td><td>Credit</td><td>Theory (3 Hrs, 70 Marks)</td><td>Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)</td></tr>
<tr><td>3</td><td>2</td><td>0</td><td>4</td><td>Scaled to 70 Marks</td><td>Scaled to 30 Marks</td></tr>
<tr><td colspan="6">Pre-requisite: Knowledge of Electrical Machines – 1, Power Electronics, Electrical Machines – II.</td></tr>
<tr><td colspan="6">Objectives:
1. To study the AC and special motor drives.
2. To understand the role of power electronics in drives applications.
3. To understand the energy requirements for traction applications.</td></tr>
<tr><td colspan="6">Outcomes:
After completion of the course, students would be able to :
1. Understand theoretical concepts of dynamics of electric drives
2. Analyze the performance of dc motor drives and induction motor drives for various operating conditions
3. Estimate energy consumption and decide rating of motor for traction application</td></tr>
<tr><td colspan="6">Detailed Syllabus:</td></tr>
<tr><td>Unit</td><td colspan="4">Description</td><td>Duration</td></tr>
<tr><td>1</td><td colspan="4">Fundamental of Electric Drives
Basic concepts, Characteristics and operating modes of drive motors, Starting, braking and speed control of motors, Four quadrant drives, Nature and classification of load torque and associated controls used in process industries, Selection of motors</td><td>6</td></tr>
</table>

	and rating.	
2	**Induction Motor Drives** Operation with unbalanced source voltages and unbalanced rotor impedances, Effect of time harmonics on the motor performance, Braking, Stator voltage control of induction motor, Variable voltage variable frequency (VVVF) operation, Voltage source inverter (VSI) fed induction motor drive, Static rotor resistance control, Slip power recovery systems, closed loop control of ac drives, Introduction to field oriented control of ac motors, Comparison of ac and dc drive, Their selection for particular application.	**8**
3	**Synchronous Motor Drives** Variable frequency control, Self Control, Voltage source inverter fed synchronous motor drive, Vector control.	**5**
4	**Permanent Magnet Brushless DC Motor Drives** Half wave converter based drives, split supply converter topology, merits and demerits of PMBDC motor, design considerations of PMBDC motor, C – Dump Toplogy, principle of operation, motoring and regeneration operation, analysis, variable dc link converter topology, variable dc link converter topology with buck – boost topology.	**8**
5	**Switched Reluctance Motor Drives** Introduction to SRM, inductance profile of SRM, block diagram of general purpose SRM, drive with speed/position sensor, asymmetric bridge converter, (n+1) switches and diode configurations, C – Dump Toplogy.	**6**
6	**Electric Traction** General features of electrical traction, Mechanics of train movement, Nature of traction load, Speed-time curves, Calculations of traction drive rating and energy consumption, Train resistance, Adhesive weight and coefficient of adhesion, Tractive effort for acceleration and propulsion, Power and energy output from driving axles, Methods of speed control and braking of motors for traction load, Electric drive systems for	**12**

	electric traction.	
	Total Hours	**45**

Text Books:

1. G. K. Dubey, "Fundamental of Electrical Drives", Narosa Publication, 2nd Edition, 2016.
2. B. K. Bose, "Power Electronics & Variable Frequency drive", IEEE press,2nd Edition, 2007.
3. G. C. Garg, "Utilization of Electrical Power and Electrical Traction", Khanna Publication, 1st Edition, 2004.

Reference Books:

1. R. Krishnan, "Electric Motor Drives: Modelling, Analysis and Control", Prentice Hall, 1st Edition, 2002.
2. S. K. Pillai, "First Course on Electrical Drives", Wiley Eastern Limited, 2nd Edition, 1989.
3. V.Subramanyam,"ElectricDrives–conceptsandapplications",TataMcGrawHill, 1st Edition, 2001.

Term Work:

1. Minimum two assignments.
2. Minimum ten practicals covering the whole syllabus, duly recorder and graded.
3. Minimum two term tests.

Program: MBA. Tech. (Electrical)				**Semester : VI**	
Course : Digital Signal Processing				**Code : MBEE06005**	
Teaching Scheme				**Evaluation Scheme**	
Lecture Hours per week	**Practical Hours per week**	**Tutorial Hours per week**	**Credit**	**Theory (3 Hrs, 60 Marks)**	**Internal Continuous Assessment (ICA) As per Institute Norms (50 Marks)**
3	2	0	4	Scaled to 60 Marks	Scaled to 40 Marks

Pre-requisite: Knowledge of Signals and systems

Objectives:

1. To introduce different types of linear systems.
2. To study various discrete transforms and their properties.
3. To gain knowledge of specific DSP Processors used in Electrical Engineering

Applications.

Outcomes:

After completion of the course, students would be able to :

1. Analyze Finite Impulse Response and Infinite Impulse Response filters.
2. Apply various transforms for DT signals.
3. Analyze and design Finite Impulse Response and Infinite Impulse response filters.
4. Discuss the elements of DSP processor.

Detailed Syllabus:

Unit	Description	Duration
1	**Analysis of LTI systems:** Frequency response of LTI systems, pole zero plots, phase distortion and delay, all pass systems, minimum, maximum mixed phase systems, review of low pass, high pass, band pass filters, digital resonator, comb filters, notch filters & digital sinusoidal oscillators	09
2	**Transforms for Discrete Time Signals:** Discrete Fourier transform: DFT and its properties, multiplication of two DFTs- the circular convolution, additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method, Fast Fourier transform.	09
3	**Design of FIR filters:** Linear phase filters, causal generalized linear phase system, symmetric, anti-symmetric filters. Types of windows, comparison, windowing method of FIR design, frequency sampling method, FIR differentiators.	05
4	**Design of IIR filters:** Impulse invariance, Bilinear transformation, Butterworth, Introduction to Chebyshev filters. Frequency transformation low pass to high pass, band pass, band reject filters.	05
5	**Structures for discrete time systems:** FIR structures (direct form, cascade form, frequency sampling and lattice); structures for linear phase filters, Structures for IIR systems, direct form-I, Direct form-II, Transposed structures, Basic structure of phase shifters, All-pass filters. Analysis of cascaded and parallel IIR structures and FIR structures.	07
6	**DSP Application in Electrical Engineering** DSP processor v/s General purpose processor, Introduction to	10

	TMS320C2000 series digital signal processors, peripherals, basic instruction sets for programming DSP, Configuring ADC for close loop applications, Configuring PWM port for inverter control, Understanding GPIO, Applications of DSP in Renewable Energy Sources, Variable Frequency Drive.	
	Total Hours	**45**

Text Books:

1. John Proakis, "Digital signal processing", Prentice Hall of India Publication, 4th edition, 2010.
2. Monson H. Hays, "Schaums Outline of Digital Signal Processing", McGraw-Hill, 2nd edition, 2011.

Reference Books:

1. Alan V. Oppenheim & Ronald W. Scheffer, "Discrete time signal processing", Prentice Hall of India Publication, 3rd edition, 2009.
2. F.W. Smith, Scientist & Engineers, "Guide to Digital Signal Processing (e-book) (California Technical Publishing)". Web-site : www.DSPguide.com
3. Maurice Bellanger, "Digital Processing of signals", John Wiley Publication, 3rd edition, 2000.
4. Hamid Toliyat, "DSP Based Electromechanical Based Motion Control", CRC Press, 1st Edition, 2003.

Term Work:

1. Minimum two assignments.
2. Minimum ten experiments based on Syllabus.
3. Minimum two term tests.