B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER - IV

ENGINEERING MATHEMATICS –IV (Core Subject)

Subject Code	15MAT41	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80

Credits - 04

Course Objectives:

Module-1	**Teaching Hours**
	10
Revised Bloom's Taxonomy Level	

Module-2	
	10
Revised Bloom's Taxonomy Level	

Module-3	
	10
Revised Bloom's Taxonomy Level	

15MAT41 ENGINEERING MATHEMATICS – IV (Core Subject) CHOICE BASED CREDIT SYSTEM (CBCS)	
Module-4	**Teaching Hours**
	10
Revised Bloom's Taxonomy Level	
Module-5	
	10
Revised Bloom's Taxonomy Level	
Course outcomes:	
Graduate Attributes (As per NBA)	
Question paper pattern:	
Text/Reference Books:	

1	Title	Authors	Publisher	Edition Year
2				
3				
4				
5				

B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER - III

POWER GENERATION AND ECONOMICS (Core Subject)

Subject Code	15EE42	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80

Credits - 04

Course objectives:

- Explain the arrangement and operation of hydroelectric, steam, diesel, gas turbine and nuclear power plants and working of major equipment in the plants.
- Classification of substation and explain the operation of different substation equipment.
- Explain the importance of grounding and different grounding methods used in practice.
- Explain the economics of power generation and importance of power factor.

Module-1	**Teaching Hours**
Hydroelectric Power Plants: Hydrology, Run off and stream flow, Hydrograph, Flow duration curve, Mass curve, Reservoir capacity, Dam storage. Hydrological cycle, Merits and demerits of hydroelectric power plants, Selection of site. General arrangement of hydel plant, Elements of the plant, Classification of the plants based on water flow regulation, Water head and type of load the plant has to supply. Water turbines – Pelton wheel, Francis, Kaplan and propeller turbines. Characteristic of water turbines Governing of turbines, Selection of water turbines. Underground, Small hydro and pumped storage plants. Choice of size and number of units, Plant layout and auxiliaries. ■	**10**
Revised Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding.	
Module-2	
Steam Power Plants: Introduction, Efficiency of steam plants, Merits and demerits of plants, Selection of site. Working of steam plant, Power plant equipment and layout, Steam turbines, Fuels and fuel handling, Fuel combustion and combustion equipment, Coal burners, Fluidized bed combustion, Combustion control, Ash handling, Dust collection, Draught systems, Feed water, Steam power plant controls, Plant auxiliaries. **Diesel Power Plant:** Introduction, Merits and demerits, Selection site, Elements of diesel power plant, Applications. **Gas Turbine Power Plant**: Introduction, Merits and demerits, Selection site, Fuels for gas turbines, Elements of simple gas turbine power plant, Methods of improving thermal efficiency of a simple steam power plant, Closed cycle gas turbine power plants. Comparison of gas power plant with steam and diesel power plants. ■	**10**
Revised Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding.	
Module-3	
Nuclear Power Plants: Introduction, Economics of nuclear plants, Merits and demerits, selection of site, Nuclear reaction, Nuclear fission process, Nuclear chain reaction, Nuclear energy, Nuclear fuels, Nuclear plant and layout, Nuclear reactor and its control, Classification of reactors, Power reactors in use, Effects of nuclear plants, Disposal of nuclear waste and effluent, Shielding.■	**10**
Revised Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding.	

15EE42 POWER GENERATION AND ECONOMICS (Core Subject) (continued)
CHOICE BASED CREDIT SYSTEM (CBCS)

Module-4	**Teaching Hours**
Substations: Introduction to Substation equipment; Transformers, High Voltage Fuses, High Voltage Circuit Breakers and Protective Relaying, High Voltage Disconnect Switches, Lightning Arresters, High Voltage Insulators and Conductors, Voltage Regulators, Storage Batteries, Reactors, Capacitors, Measuring Instruments and power line carrier communication equipment. Classification of substations – indoor and outdoor, Selection of site for substation, Busbar arrangement schemes and single line diagrams of substations. Interconnection of power stations. Introduction to gas insulated substation, Advantages and economics of Gas insulated substation. **Grounding:** Introduction, Difference between grounded and ungrounded system. System grounding – ungrounded, Solid grounding, Resistance grounding, Reactance grounding and resonant grounding. Earthing transformer. Neutral grounding and neutral grounding transformer. ■	**10**
Revised Bloom's Taxonomy Level: L_1 – Remembering, L_2 – Understanding.	
Module-5	
Economics: Introduction, Effect of variable load on power system, classification of costs, Cost analysis. Interest and Depreciation, Methods of determination of depreciation, Economics of Power generation, different terms considered for power plants and their significance, load sharing. Choice of size and number of generating plants. Tariffs, objective, factors affecting the tariff, types. Types of consumers and their tariff. Power factor, Disadvantages and causes of low power factor, Methods of improving power factor, Economics of power factor improvement and comparison of methods of improving the power factor. Choice of equipment. ■	**10**
Revised Bloom's Taxonomy Level: L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	

Course outcomes:

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

- Describe the working of hydroelectric, steam, nuclear power plants and state functions of major equipment of the power plants
- Classify various substations and explain the importance of grounding.
- Understand the economic aspects of power system operation and its effects.
- Explain the importance of power factor improvement.

Graduate Attributes (As per NBA)

Engineering Knowledge
Problem analysis
Engineers and Society
Environment and Sustainability

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

15EE42 POWER GENERATION AND ECONOMICS (Core Subject) (continued) CHOICE BASED CREDIT SYSTEM (CBCS)				
Text/Reference Books				
1	A Course in Power Systems	J.B. Gupta	Katson	2008
2	Generation of Electrical Energy	B.R.Gupta	S. Chand	2015
3	Electrical power Generation, Transmission and Distribution	S.N. Singh	PHI	2nd Edition, 2009
4	Power Plant Engineering	P.K. Nag	Mc Graw Hill	4th Edition, 2014
5	Electrical Power Distribution Systems	V. Kamaraju	Mc Graw Hill	1st Edition, 2009
6	Electrical Distribution Engineering	Anthony J. Pansini	CRC Press	3rd Edition, 2006
7	Electrical Distribution Systems	Dale R Patrick Et al	CRC Press	2nd Edition, 2009
8	A Text Book on Power System Engineering	A.Chakrabarti, et al	Dhanpath Rai	2nd Edition, 2010

B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER - IV

TRANSMISSION AND DISTRIBUTION (Core Subject)

Subject Code	15EE43	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80

Credits - 04

Course Objectives:

- To understand the concepts of various methods of generation of power.
- To understand the importance of HVAC, EHVAC, UHVAC and HVDC transmission.
- To design insulators for a given voltage level.
- To calculate the parameters of the transmission line for different configurations and assess the performance of the line.
- To study underground cables for power transmission and evaluate different types of distribution systems

Module-1	**Teaching Hours**
Introduction to power system: Structure of electric power system: Generation, Transmission and distribution. Advantages of high voltage transmission: HVAC, EHVAC, UHVAC and HVDC. Interconnection. Feeders, Distributors and service mains. **Overhead transmission lines:** A brief introduction to types of supporting structures and line conductors-Conventional conductors; Aluminium Conductor steel reinforced (ACSR), All –aluminium alloy conductor (AAAC) and All –aluminium conductor (AAC). High temperature conductors; Thermal resistant aluminium alloy (ATI),Super thermal resistant aluminium alloy (ZTAI), Gap type thermal resistant aluminium alloy conductor steel reinforced (GTACSR), Gap type super thermal resistant aluminium alloy conductor steel reinforced (GZTACSR). Bundle conductor and its advantages. Importance of sag, Sag calculation – supports at same and different levels, Effect of wind and ice. Line vibration and vibration dampers. Overhead line protection against lightening; ground wires. **Overhead line Insulators:** A brief introduction to types of insulators, Material used-porcelain, toughened glass and polymer (composite). Potential distribution over a string of suspension insulators. String efficiency, Methods of increasing string efficiency. Arcing horns. ■	**10**
Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.
Module-2	
Line parameters: Introduction to line parameters- Resistance, Inductance and capacitance. Calculation of inductance of single phase and three phase lines with equilateral spacing, Unsymmetrical spacing, Double circuit and transposed lines. Inductance of composite – conductors, Geometric mean radius (GMR) and geometric mean distance (GMD). Calculation of capacitance of single phase and three phase lines with equilateral spacing, Unsymmetrical spacing, Double circuit and transposed lines. Capacitance of composite – conductor, Geometric mean radius (GMR) and geometric mean distance (GMD). Advantages of single circuit and double circuit lines. ■	**10**
Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying.

15EE43 TRANSMISSION AND DISTRIBUTION (Core Subject) (continued)
CHOICE BASED CREDIT SYSTEM (CBCS)

Module-3		**Teaching Hours**
Performance of transmission lines: Classification of lines – Short, Medium and Long lines. Current and voltage relations, Line regulation and Ferranti effect in short length lines, Medium length lines considering Nominal T and nominal π circuits, and long lines considering hyperbolic form equations. Equivalent circuit of a long line. ABCD constants in all cases.		**10**
Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	
Module-4		
Corona: Phenomena, Disruptive and visual critical voltages, Corona loss. Advantages and disadvantages of corona. Methods of reducing corona. **Underground cable:** Types of cables, Constructional features, Insulation resistance, Thermal rating, Charging current, Grading of cables – capacitance and inter-sheath. Dielectric loss. Comparison between ac and dc cables. Limitations of cables. Specification of power cables. ■		**10**
Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	
Module-5		
Distribution: Primary AC distribution systems – Radial feeders, parallel feeders, loop feeders and interconnected network system. Secondary AC distribution systems – Three phase 4 wire system and single phase 2 wire distribution, AC distributors with concentrated and uniform loads. Effect of disconnection of neutral in a 3 phase four wire system. **Reliability and Quality of Distribution system:** Introduction, Definition of reliability, failure, Probability concepts, Limitation of distribution systems, Power quality, Reliability aids. ■		**10**
Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	

Course Outcomes:

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

- Explain the concepts of various methods of generation of power.
- Explain the importance of HVAC, EHVAC, UHVAC and HVDC transmission.
- Design and analyze overhead transmission system for a given voltage level.
- Calculate the parameters of the transmission line for different configurations and assess the performance of line.
- Explain the use of underground cables and evaluate different types of distribution systems.

Graduate Attributes (As per NBA)

Engineering Knowledge
Problem Analysis
Design / development of solutions
Engineers and society
Ethics

15EE43 TRANSMISSION AND DISTRIBUTION (Core Subject) (continued)
CHOICE BASED CREDIT SYSTEM (CBCS)

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Text/Reference Books:

1	A Course in Electrical Power	Soni Gupta and Bhatnagar	Dhanpat Rai	
2	Power System Analysis and Design	J. Duncan Glover at el	Cengage Learning	4th Edition 2008
3	Principles of Power System	V.K. Mehta Rohit Mehta	S. Chand Publishers	1st Edition 2013
3	Electrical power Generation, Transmission and Distribution	S.N. Singh	PHI	2nd Edition,2009
4	Electrical Power	S.L.Uppal	Khanna Publication	
5	Electrical power systems	C. L. Wadhwa	New Age International	5th Edition, 2009
6	Electrical power systems	Ashfaq Hussain	CBS Publication	
7.	Electric Power Distribution	A.S. Pabla	Mc Graw-Hill	6th Edition,2011
7	For High temperature conductors refer www.jpowers.co.jp/english/product/pdf/gap_c1.pdf and Power System Analysis and Design, J. Duncan Glover at el			

B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER - IV

ELECTRIC MOTORS (Core Subject)

Subject Code	15EE44	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80

Credits - 04

Course Objectives:

- To study the constructional features of Motors and select a suitable drive for specific application.
- To study the constructional features of Three Phase and Single phase induction Motors.
- To study different test to be conducted for the assessment of the performance characteristics of motors.
- To study the speed control of motor by a different methods.
- Explain the construction and operation of Synchronous motor and special motors.

Module-1	**Teaching Hours**
DC Motors: Classification, Back emf, Torque equation, and significance of back emf, Characteristics of shunt, Series & Compound motors. Speed control of shunt, Series and Compound motors. Application of motors. DC motor starters – 3 point and 4 point. **Losses and efficiency-** Losses in DC motors, Power flow diagram, Efficiency, Condition for maximum efficiency. ■	**10**
Revised Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding, L_3 – Applying.	
Module-2	
Testing of dc motors: Direct & indirect methods of testing of DC motors-Brake test, Swinburne's test, Retardation test, Hopkinson's test, Field's test, Merits and demerits of tests. **Three phase Induction motors:** Review of concept and generation of rotating magnetic field, Principle of operation, construction, classification and types; squirrel-cage, slip-ring (No question shall be set from the review portion). Slip, Torque equation, Torque-slip characteristic covering motoring, Generating and braking regions of operation. Maximum torque, Significance of slip. ■	**10**
Revised Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	
Module-3	
Performance of three-phase Induction Motor: Phasor diagram of induction motor on no-load and on load, Equivalent circuit, Losses, Efficiency, No-load and blocked rotor tests. Performance of the motor from the circle diagram and equivalent circuit. Cogging and crawling. High torque rotors-double cage and deep rotor bars. Equivalent circuit and performance Evaluation of double cage induction motor. Induction motor working as induction generator; Standalone operation and grid connected operation**.** ■	**10**
Revised Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	

15EE44 ELECTRIC MOTORS (Core Subject) (continued)
CHOICE BASED CREDIT SYSTEM (CBCS)

Module-4		**Teaching Hours**
Starting and speed Control of Three-phase Induction Motors: Need for starter. Direct on line, Star-Delta and autotransformer starting. Rotor resistance starting. Speed control by voltage, Frequency and rotor resistance methods **Single-phase Induction Motor:** Double revolving field theory and principle of operation. Construction and operation of split-phase, Capacitor start, Capacitor run, and shaded pole motors. Comparison of single phase motors and applications. ■		**10**
Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	
Module-5		
Synchronous motor: Principle of operation, Phasor diagrams, Torque and torque angle, Blondel diagram, Effect of change in load, Effect of change in excitation, V and inverted V curves. Synchronous condenser, Hunting and damping. Methods of starting synchronous motors. **Other motors:** Construction and operation of Universal motor, AC servomotor, Linear induction motor and stepper motor. ■		**10**
Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	

Course Outcomes:

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

- Explain the constructional features of Motors and select a suitable drive for specific application.
- Analyze and assess the performance characteristics of DC motors by conducting suitable tests and control the speed by suitable method.
- Explain the constructional features of Three Phase and Single phase induction Motors and assess their performance.
- Control the speed of induction motor by a suitable method.
- Explain the operation of Synchronous motor and special motors.

Graduate Attributes (As per NBA)

Engineering Knowledge
Problem Analysis
Conduct investigations of complex Problems

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

15EE44 ELECTRIC MOTORS (Core Subject) (continued) CHOICE BASED CREDIT SYSTEM (CBCS)				
Text/Reference Books:				
1	Electric Machines	D. P. Kothari, I. J. Nagrath	Mc Graw Hill	4th edition, 2011
2	Principles of Electric Machines and power Electronics	P.C.Sen	Wiley	2nd Edition, 2013
3	Electric Machines	R.K. Srivastava	Cengage Learning	2nd Edition,2013
4	Electrical Machines, Drives and Power systems	Theodore Wildi	Pearson	6th Edition, 2014
5	Electrical Machines	M.V. Deshpande	PHI Learning	2013
6	Electric Machinery and Transformers	Bhag S Guru at el	Oxford University Press	3rd Edition, 2012
7	Electric Machinery and Transformers	Irving Kosow	Pearson	2rd Edition, 2012
8	Theory of Alternating Current Machines	Alexander Langsdorf	Mc Graw Hill	2nd Edition, 2001

B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER - IV

ELECTROMAGNETIC FIELD THEORY (Core Subject)

Subject Code	15EE45	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80

Credits - 04

Course Objectives:

- To study different coordinate systems for understanding the concept of gradient, divergence and curl of a vector.
- To study the application of Coulomb's Law and Gauss Law for electric fields produced by different charge configurations.
- To evaluate the energy and potential due to a system of charges.
- To study the behavior of electric field across a boundary between a conductor and dielectric and between two different dielectrics.
- To study the magnetic fields and magnetic materials.
- To study the time varying fields and propagation of waves in different media.

Module-1	**Teaching Hours**
Vector Analysis: Scalars and Vectors**,** Vector algebra, Cartesian co-ordinate system, Vector components and unit vectors. Scalar field and Vector field. Dot product and Cross product, Gradient of a scalar field. Divergence and Curl of a vector field. Co – ordinate systems: cylindrical and spherical, Relation between different coordinate systems. Expression for gradient, Divergence and curl in rectangular, Cylindrical and spherical co-ordinate systems. Problems. **Electrostatics:** Coulomb's law, Electric field intensity and its evaluation for (i) point charge (ii) line charge (iii) surface charge (iv) volume charge distributions. Electric flux density, Gauss law and its applications. Maxwell's first equation (Electrostatics). Divergence theorem. Problems. ■	**10**
Revised Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding, L_3 – Applying.	
Module-2	
Energy and Potential: Energy expended in moving a point charge in an electric field. The line integral. Definition of potential difference and potential. The potential field of a point charge and of a system of charges. Potential gradient. The dipole. Energy density in the electrostatic field. Problems. **Conductor and Dielectrics:** Current and current density. Continuity of current. Metallic conductors, Conductor's properties and boundary conditions. Perfect dielectric materials, capacitance calculations. Parallel plate capacitor with two dielectrics with dielectric interface parallel to the conducting plates. Capacitance of two wire line. Problems. ■	**10**
Revised Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding, L_3 – Applying.	
Module-3	
Poisson's and Laplace equations: Derivations and problems, Uniqueness theorem. **Steady magnetic fields:** Biot - Savart's law, Ampere's circuital law. The Curl. Stokes theorem. Magnetic flux and flux density. Scalar and vector magnetic potentials. Problems. ■	**10**
Revised Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding, L_3 – Applying.	

15EE45 ELECTROMAGNETIC FIELD THEORY (Core Subject) (continued)

CHOICE BASED CREDIT SYSTEM (CBCS)		
Module-4		**Teaching Hours**
Magnetic forces: Force on a moving charge and differential current element. Force between differential current elements. Force and torque on a closed circuit. Problems. **Magnetic materials and magnetism:** Nature of magnetic materials, Magnetisation and permeability. Magnetic boundary conditions. Magnetic circuit, Inductance and mutual inductance. Problems. ■		**10**
Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying.	
Module-5		
Time varying fields and Maxwell's equations: Faraday's law, Displacement current. Maxwell's equations in point form and integral form. Problems. **Uniform plane wave:** Wave propagation in free space and in dielectrics. Pointing vector and power considerations. Propagation in good conductors, skin effect. Problems. ■		**10**
Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	

Course Outcomes:

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

- Use different coordinate systems to explain the concept of gradient, divergence and curl of a vector.
- Use Coulomb's Law and Gauss Law for the evaluation of electric fields produced by different charge configurations.
- Calculate the energy and potential due to a system of charges.
- Explain the behavior of electric field across a boundary between a conductor and dielectric and between two different dielectrics.
- Explain the behavior of magnetic fields and magnetic materials.
- Assess time varying fields and propagation of waves in different media.

Graduate Attributes (As per NBA)

Engineering Knowledge
Problem Analysis
Conduct investigations of complex Problems

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

15EE45ELECTROMAGNETIC FIELD THEORY (Core Subject) (continued) CHOICE BASED CREDIT SYSTEM (CBCS)				
Text/Reference Books:				
1	Engineering Electromagnetics	William H Hayt et al	Mc Graw Hill	8th Edition, 2014
2	Principles of Electromagnetics	Matthew N. O. Sadiku	Oxford University Press	6th Edition, 2015
3	Fundamentals of Engineering Electromagnetics	David K. Cheng	Pearson	2014
4	Electromagnetism - Theory (Volume -1) -Applications (Volume-2)	Ashutosh Pramanik	PHI Learning	2014
5	Electromagnetic Field Theory Fundamentals	Bhag Guru et al	Cambridge University press	2005
6	Electromagnetic Field Theory	Rohit Khurana	Vikas Publishing	1st Edition,2014
7	Electromagnetics	J. A. Edminister	Mc Graw Hill	3rd Edition, 2010
8	Electromagnetic Field Theory and Transmission Lines	Gottapu Sasibhushana Rao	Wiley	1st Edition, 2013

B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER - IV

OPERATIONAL AMPLIFIERS AND LINEAR ICs (Foundation Course)

Subject Code	15EE46	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80

Credits - 04

Course Objectives:

- To understand the basics of Linear ICs such as Op-amp, Regulator, Timer & PLL.
- To learn the designing of various circuits using linear ICs.
- To use these linear ICs for specific applications.
- To understand the concept and various types of converters.
- To use these ICs, in Hardware projects.

Module-1	**Teaching Hours**
Operational amplifiers: Introduction, Block diagram representation of a typical Op-amp, Schematic symbol, Characteristics of an Op-amp, Ideal op-amp, Equivalent circuit, Ideal voltage transfer curve, Open loop configuration, Differential amplifier, Inverting & non – inverting amplifier, Op-amp with negative feedback ; voltage series feedback amplifier- gain, Input resistance, Output resistance, Voltage shunt feedback amplifier- gain, Input resistance, Output resistance. **General Linear Applications:** D.C. & A.C amplifiers, Peaking amplifier, Summing, Scaling & averaging amplifier, Inverting and non-inverting configuration, Differential configuration, Instrumentation amplifier. ■	**10**
Revised Bloom's Taxonomy Level: L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	
Module-2	
Active Filters: First & Second order high pass & low pass Butterworth filters, Higher order filters Band pass filters, Band reject filters & all pass filters. **DC Voltage Regulators:** Voltage regulator basics, Voltage follower regulator, Adjustable output regulator, LM317 & LM337 Integrated circuit regulators. ■	**10**
Revised Bloom's Taxonomy Level: L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	
Module-3	
Signal generators: Triangular / rectangular wave generator, Phase shift oscillator, Wien bridge oscillator, Oscillator amplitude stabilization, Signal generator output controls. **Comparators & Converters:** Basic comparator, Zero crossing detector, Inverting & non-inverting Schmitt trigger circuit, Voltage to current converter with grounded load, Current to voltage converter and basics of voltage to frequency and frequency to voltage converters. ■	**10**
Revised Bloom's Taxonomy Level: L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	
Module-4	
Signal processing circuits: Precision half wave & full wave rectifiers limiting circuits, Clamping circuits, Peak detectors, Sample & hold circuits. **A/D & D/A Converters:** Basics, R–2R D/A Converter, Integrated circuit 8-bit D/A, successive approximation ADC, Linear ramp ADC, Dual slope ADC, Digital ramp ADC. ■	
Revised Bloom's Taxonomy Level: L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	

15EE46 OPERATIONAL AMPLIFIERS AND LINEAR ICs (Foundation Course) (continued)
CHOICE BASED CREDIT SYSTEM (CBCS)

Module-5		**Teaching Hours**
Phase Locked Loop (PLL): Basic PLL, Components, Performance factors, Applications of PLL IC 565. **Timer:** Internal architecture of 555 timer, Mono stable, Astable multivibrators and applications. ■		**10**
Revised Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.	

Course Outcomes:
At the end of the course the student will be able to:
- Explain the basics of linear ICs.
- Design circuits using linear ICs.
- Demonstrate the application of Linear ICs.
- Use ICs in the electronic projects.

Graduate Attributes (As per NBA)
Engineering Knowledge
Design / development of solutions
Conduct investigations of complex Problems

Question paper pattern:
- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Text/Reference Books:

1	Op-Amps and Linear Integrated Circuits	Ramakant A Gayakwad	Pearson	4th Edition 2015
2	Operational Amplifiers and Linear ICs	David A. Bell	Oxford University Press	3rd Edition 2011
3	Linear Integrated Circuits; Analysis, Design and Applications	B. Somanthan Nair	Wiley India	2013
4	Linear Integrated Circuits	S. Salivahanan, et al	Mc Graw Hill	2nd Edition,2014
5	Operational Amplifiers and Linear Integrated Circuits	K. Lal Kishore	Pearson	1st Edition, 2012
6	Linear Integrated Circuits	Muhammad H Rashid	Cengage Learning	1st Edition,2014
7	Op-Amps and Linear Integrated Circuits, Concept and Application	James M Fiore	Cengage	2009

B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER - IV

ELECTRICAL MACHINES LABORATORY -2

Subject Code	15EEL47	IA Marks	20
Number of Practical Hours/Week	03	Exam Hours	03
Total Number of Practical Hours	42	Exam Marks	80

Credits - 02

Course Objectives:

- To perform tests on dc machines to determine their characteristics.
- To control the speed of dc motor
- To conduct test for pre-determination of the performance characteristics of dc machines
- To conduct load test on single phase and three phase induction motor.
- To conduct test on induction motor to determine the performance characteristics
- To conduct test on synchronous motor to draw the performance curves.

Sl. No	Experiments
1	Load test on dc shunt motor to draw speed – torque and horse power – efficiency characteristics
2	Field Test on dc series machines.
3	Speed control of dc shunt motor by armature and field control.
4	Swinburne's Test on dc motor.
5	Retardation test on dc shunt motor.
6	Regenerative test on dc shunt machines.
7	Load test on three phase induction motor.
8	No load and Blocked rotor test on three phase induction motor to draw (i) equivalent circuit and (ii) circle diagram. Determination of performance parameters at different load conditions from (i) and (ii).
9	Load test on induction generator.
10	Load test on single phase induction motor to draw output versus torque, current, power and efficiency characteristics.
11	Conduct suitable tests to draw the equivalent circuit of single phase induction motor and determine performance parameters.
12	Conduct an experiment to draw V and Λ curves of synchronous motor at no load and load conditions.

Revised Bloom's Taxonomy Level	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating

15EEL47 ELECTRICAL MACHINES LABORATORY -2 (continued)
CHOICE BASED CREDIT SYSTEM (CBCS)

Course Outcomes:

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

- Test dc machines to determine their characteristics.
- Control the speed of dc motor
- Pre-determine the performance characteristics of dc machines by conducting suitable tests.
- Perform load test on single phase and three phase induction motor to assess its performance.
- Conduct test on induction motor to pre-determine the performance characteristics
- Conduct test on synchronous motor to draw the performance curves.

Graduate Attributes (As per NBA)

Engineering Knowledge
Individual and Team work
Communication

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.■

B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER - IV

OP- AMP AND LINEAR ICS LABORATORY

Subject Code	15EEL48	IA Marks	20
Number of Practical Hours/Week	03	Exam Hours	03
Total Number of Practical Hours	42	Exam Marks	80

Credits - 02

Course Objectives:

- To conduct different experiments using OP-Amps
- To conduct experiments using Linear IC's

a). Study of pin details, specifications, application features of IC741 (LM741) and IC555 (Timer) through corresponding datasheets (Datasheets are instruction manuals for electronic components. They explain exactly what a component does and how to use it.).
b). Comparison of output performance quantity of an Operational Amplifier obtained by rigging up the circuit with the ideal value of
(i) A Non – Inverting Amplifier ($V_{out} = AV_{in}$) (ii) An Inverting Amplifier ($V_{out} = -AV_{in}$) (iii) A Difference Amplifier ($V_{out} = -A(V_p - V_n)$) (iv) A Difference Amplifier with floating inputs ($V_{out} = AV_{in}$) (v) A Non – Inverting Amplifier with negative feedback (ii) An Inverting Amplifier with negative feedback (vi) A Differential Amplifier with a negative feedback (vii) A Differential Amplifier with negative feedback and equalised amplifications.
(viii) A Voltage follower (ix) A differential – in differential –out amplifier (x) An instrumentation amplifier
c). Plot of input and output transfer characteristics to analyse and conclude that op-amps are rarely used in open-loop.
d). Testing of op – amp.

To be covered in 03 Laboratory classes.

Sl. No	Experiments
1	Design and verify a precision full wave rectifier. Determine the performance parameters.
2	Design and realize to analyse the frequency response of an op – amp amplifier under inverting and non - inverting configuration for a given gain.
3	Design and verify the output waveform of an op – amp RC phase shift oscillator for a desired frequency.
4	Design and realize Schmitt trigger circuit using an op – amp for desired upper trip point (UTP) and lower trip point (LTP).
5	Verify the operation of an op – amp as (a) voltage comparator circuit and (b) zero crossing detector.
6	Design and verify the operssation of op – amp as an (a) adder (b) subtractor (c) integrator and (d) differentiator.
7	Design and realize an op – amp based first order Butterworth (a) low pass (b) high pass and (c) band pass filters for a given cut off frequency/frequencies to verify the frequency response characteristic.
8	Design and realize an op – amp based function generator to generate sine, square and triangular waves of desired frequency.
9	Design and realization of R – 2R ladder DAC.
10	Realization of Two bit Flash ADC.
11	Design and verify an IC 555 timer based pulse generator for the specified pulse.
12	Designing of Fixed voltage power supply (voltage regulator) using IC regulators 78 series and 79 series.

Revised Bloom's Taxonomy Level	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating

15EEL48 OP- AMP AND LINEAR ICS LABORATORY (continued)
CHOICE BASED CREDIT SYSTEM (CBCS)

Course Outcomes:

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

- To conduct experiment to determine the characteristic parameters of OP-Amp
- To design test the OP-Amp as Amplifier, adder, subtractor, differentiator and integrator
- To design test the OP-Amp as oscillators and filters
- Design and study of Linear IC's as multivibrator power supplies.

Graduate Attributes (As per NBA)

Engineering Knowledge
Individual and Team work
Communication

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

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