SEMESTER IV

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
MA0U20C	PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS	BSC	3	1	0	4	2020

i) PRE REQUISITE: A basic course in one-variable and multi-variable calculus

ii) COURSE OVERVIEW:

This course introduces students to the modern theory of probability and statistics, covering important models of random variables and analysis of random processes using appropriate time and frequency domain tools. A brief course in numerical methods familiarises students with some basic numerical techniques for finding roots of equations, evaluating definite integrals solving systems of linear equations and solving ordinary differential equations which are especially useful when analytical solutions are hard to find.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Identify the different discrete random experiments and find the probabilities of their occurrence	Apply
CO 2	Identify the different continuous random experiments and find the probabilities of their occurrence	Apply
CO 3	Examine random processes using autocorrelation, power spectrum and Poisson process model as appropriate.	Apply
CO 4	Find roots of equations, definite integrals and interpolating polynomial on given numerical data using standard numerical techniques	Apply
CO 5	Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data and solving ordinary differential equations.	Apply

iv) SYLLABUS

Discrete random variables and their probability distributions, Binomial distribution, Poisson distribution, Discrete bivariate distributions, Expectation -multiple random variables.

Continuous random variables and their probability distributions-Uniform, exponential and normal distributions, Continuous bivariate distributions, Expectation-multiple random variables, i.i.d random variables and Central limit theorem.

Random processes and its classification, wide sense stationary (WSS) processes, power spectral density of WSS processes, Poisson process.

Roots of equations- Newton-Raphson, regula falsi methods. Interpolation-finite differences, Newton's forward and backward formula, Newton's divided difference method, Lagrange's method. Numerical integration.

Solution of linear systems-Gauss-Siedal and Jacobi iteration methods. Curve fitting-method of least squares, Solution of ordinary differential equations-Euler and Classical Runge-Kutta method of second and fourth order, Adams- Moulton predictor-correction method.

v) (a) TEXT BOOKS

1) Jay L. Devore, Probability and Statistics for Engineering and the Sciences,8th edition, Cengage, 2012.
2) Oliver C. Ibe, Fundamentals of Applied Probability and Random Processes, Elsevier, 2005.
3) Erwin Kreyszig, Advanced Engineering Mathematics, 10 th Edition, John Wiley & Sons, 2016.

(b) REFERENCES

1) Hossein Pishro-Nik, Introduction to Probability, Statistics and Random Processes, Kappa Research, 2014 (Also available online at www.probability course .com)
2) V. Sundarapandian, Probability, Statistics and Queueing theory, PHI Learning, 2009.
3) Gubner, Probability and Random Processes for Electrical and Computer Engineers, Cambridge University Press, 2006.
4) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Discrete random variables and probability distributions, expected value, mean and variance (discrete). Binomial distribution-mean, variance, Poisson distribution-mean, variance, Poisson approximation to binomial. Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expected values.	**12**
II	Continuous random variables and probability distributions, expected value, mean and variance (continuous). Uniform, exponential and normal distributions, mean and variance of these distributions. Continuous bivariate distributions, marginal distributions, Independent random variables, Expected values, Central limit theorem.	**12**
III	Random process -definition and classification, mean, autocorrelation WSS processes its autocorrelation function and properties. Power spectral density, Poisson process, inter-distribution of arrival time. combination of independent Poisson processes(merging) and subdivision (splitting) of Poisson processes.	**12**
IV	Errors in numerical computation-round-off, truncation and relative error, Solution of equations – Newton-Raphson method and Regula-Falsi method. Interpolation-finite differences (derivation of formulae for the above methods not required), Numerical integration - Trapezoidal rule and Simpson's 1/3rd rule with proof.	**12**
V	Solution of linear systems-Gauss-Siedal method, Jacobi iteration method. Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares. Solution of ODE-Euler and Classical Runge - Kutta methods of second and fourth order, Adams-Moulton predictor-corrector methods.	**12**
	Total hours	**60**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1U20D	DC MACHINES AND TRANSFORMERS	PCC	2	2	0	4	2020

i) PRE-REQUISITE: ES0U10D Basics of Electrical and Electronics Engineering, PH0U10A Engineering Physics A, MA0U10A Linear Algebra and Calculus.

ii) COURSE OVERVIEW:

This course provides an introduction to the basic concepts of DC Machines, transformers and their testing methods, emphasizing their inter-relations and applications to engineering. The course also intends to deliver the benefits of auto transformers and types of three phase connections. It introduces students to cognitive learning and develops problem solving skills.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Describe the construction principle of operation and types of DC Generators and Motors	Understand
CO 2	Solve problems based on the emf equation and power flow equations of DC Generators.	Apply
CO 3	Solve problems based on the power flow diagram, performance characteristics, speed control and testing of DC motors	Apply
CO 4	Explain the construction, principle of operation and types of transformers	Understand
CO 5	Develop the phasor diagram and equivalent circuit of a transformer, and to calculate its losses and efficiency	Apply
CO 6	Enumerate the advantages of auto transformers and identify the suitable three phase transformer connections for various applications	Apply

iv) SYLLABUS

Introduction to DC Machines-Construction, Types of windings, EMF, MMF, Electromagnetic Torque.

DC Generators-Principle-EMF equation-Armature reaction, compensating windings, interpoles–commutation-methods to improve commutation, Characteristics, Power Flow Diagram, Applications.

DC Motors – principle of operation – torque equation – losses and efficiency – power flow diagram – performance characteristics– methods of speed control – No load and load tests on DC motors - applications.

Transformers – principle of operation – types and construction –ideal transformer-equivalent circuit – phasor diagram, Transformer losses and efficiency-voltage regulation-Autotransformers - Three phase transformer connection.

v) (a) TEXT BOOKS

1) Bimbra P. S., *Electric Machines*, Khanna Publishers, 2nd Edition, 2017.
2) Fitzgerald A. E., Kingsley C. and Umans S., *Electric Machinery*, McGraw Hill, 6th Edition, 2003.
3) Theodore Wilde, *Electrical Machines, Drives and Power System*, Pearson Ed. Asia, 6th Edition, 2013.
4) Kothari D. P., Nagrath I. J., *Electric Machines*, Tata McGraw Hill, 5th Edition.

(b) REFERENCES

1) Gupta J. B., Theory and Performance of Electrical Machines, S K Kataria & Sons, 14th Edition, 2013.
2) Deshpande M. V., Electrical Machines, Prentice Hall India, New Delhi, Eastern Economy Edition, 2011.
3) Ashfaq Husain, Haroon Ashfaq, Electric Machines, Dhanpat Rai and Co., 3rd Edition.
4) Clayton A. E. and Hancock N. N., *The Performance and Design of Direct Current Machines*, CBS Publishers & Distributors, New Delhi, 3rd Edition, 2004.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Introduction to DC Machines**-Constructional details of dc machines - armature winding- single layer winding, double layer windings- lap and wave, equalizer rings, dummy coils, MMF of a winding, EMF developed, electromagnetic torque - numerical problems.	**12**
II	**DC Generators**–principle of operation, EMF equation, excitation, armature reaction–demagnetising and cross magnetising ampere turn, compensating windings, inter-poles, commutation, OCC, voltage build up and load characteristics, parallel operation. Power flow diagram– numerical problems.	**12**
III	**DC Motors**-Back EMF, generation of torque, torque equation, performance characteristics –numerical problems. Starting of dc motors- starters –3point and 4 point starters (principle only). Speed control of dc motors - field control, armature control. Braking of dc motors. Power flow diagram – losses and efficiency. Testing of dc motors - Swinburne's test, Hopkinson's test, and retardation test. DC motor applications – numerical problems.	**12**
IV	**Transformers**-Single phase transformers–constructional details, principle of operation, EMF equation, ideal transformer, dot convention, magnetising current, transformation ratio, phasor diagram, operation on no load and on load, equivalent circuit, percentage and per unit impedance, voltage regulation. Transformer losses and efficiency, condition for maximum efficiency, kVA rating. Testing of transformers– polarity test, open circuit test, short circuit test, Sumpner's test – separation of losses, all day efficiency. Parallel operation of single-phase transformers– numerical problems.	**12**

V	**Autotransformer** – Autotransformer – saving of copper –rating of autotransformers. **Three phase transformer** – construction- difference between power transformer and Distribution transformer –Different connections of 3-phase transformers. Y-Y, Δ-Δ, Y-Δ, Δ-Y, V-V. Vector groupings – Yy0, Dd0, Yd1, Yd11, Dy1, Dy11. Parallel operation of three phase transformers. Three winding transformer – stabilization by tertiary winding. Tap changing transformers- no load tap changing, on load tap changing, dry type transformers.	**12**
	Total hours	**60**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1U20E	ELECTROMAGNETIC THEORY	PCC	3	1	0	4	2020

i) PRE-REQUISITE: ES0U10D Basics of Electrical and Electronics Engineering, PH0U10A Engineering Physics A, MA0U20A Partial Differential Equations and Complex Analysis.

ii) COURSE OVERVIEW:

The purpose of the course is to familiarize the students with the fundamental concepts of electrostatics and magnetostatics. It enables the students to apply this knowledge in the determination of electric and magnetic fields and to summarize Maxwell's equations. It also introduces students to the concepts of time-varying fields and electromagnetic waves.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Apply vector analysis and co-ordinate systems to solve static electric and magnetic field problems.	Apply
CO 2	Apply Gauss's Law, Coulomb's law and Poisson's equation to evaluate fields and potentials for different charge distributions and capacitors.	Apply
CO 3	Apply Biot-Savart's law and Amperes Circuital law to determine magnetic fields due to various current distributions.	Apply
CO 4	Summarize Maxwell Equations for time varying fields by modifying Faraday's law and Amperes Circuital law.	Understand
CO 5	Analyse the characteristics of wave propagation in different media.	Analyze

iv) SYLLABUS

Introduction to Co-ordinate Systems; Del operations; Divergence Theorem; Stokes' Theorem.

Coulomb's Law; Electric field intensity; Flux Density; Gauss's law; Potential-Potential radient; Poisson's and Laplace's equations; Capacitance.

Biot-Savart's Law; Magnetic Field intensity; Magnetic Flux Density; Ampere's circuital law.

Conductors and dielectrics; Continuity equation; Boundary conditions; Maxwell's Equations.

Electromagnetic Wave Equations; Uniform Plane Waves; Poynting Theorem; Transmission Lines.

v) (a) TEXT BOOKS

1) Matthew N.O. Sadiku, *Principles of Electromagnetics*, Oxford university Press, 2015.
2) Bakshi A.V. and Bakshi U.A., *Electromagnetic Theory*, Technical Publications, 2017.

3) John Kraus and Daniel Fleisch, *Electromagnetics with Applications*, McGraw-Hill Education, 2017.

(b) REFERENCES

1) Hayt W. H. and J. A. Buck, *Engineering Electromagnetics*, McGraw-Hill Education, 2017.
2) Hayt W. H. and J. A. Buck, *Problems and Solutions in Electromagnetics*, McGraw-Hill Education, 2017.
3) Joseph A. Edminister, *Electromagnetics, Schaum's Outline Series*, McGraw-Hill Education, 2013.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Introduction to Co-ordinate Systems:** Introduction to vector calculus and different co-ordinate systems- Rectangular, Cylindrical and Spherical Co- ordinate Systems; Co-ordinate transformation. Gradient of a Scalar field, Divergence of a Vector field and Curl of a Vector field- their physical interpretation, Laplacian of a scalar. Divergence Theorem, Stokes' Theorem, simple applications.	**12**
II	**Electrostatics:** Coulomb's Law, Electric field intensity, Electric Field due to a line charge, surface charge and volume charge distribution; Electric Flux and Flux Density; Gauss's law and its application to determine the field due to an infinite line charge, infinite sheet charge. Electric Potential-Potential Gradient, Conservative property of electric field, Equipotential surfaces; Electric Dipole; numerical problems. Capacitance of a co-axial cable and two-wire transmission line; Poisson's and Laplace's equations.	**12**
III	**Magnetostatics:** Biot-Savart's Law, Magnetic Field intensity due to finite and infinite current carrying wires; Magnetic field intensity on the axis of circular loop and rectangular loop carrying current; Magnetic flux Density. Ampere's circuital Law and its application to find the magnetic field due to an infinite current carrying wire; force between current carrying conductors; numerical problems on magnetostatics.	**12**
IV	**Electric and magnetic fields in materials:** Boundary conditions for electric fields and magnetic fields. Conduction current and displacement current densities; Equation of continuity; Dielectric polarization; Electrostatic energy and energy density. Maxwell's Equations in Differential and Integral form for time-varying fields-from Modified form of Ampere's circuital law, Faraday's Laws and Gauss's Laws.	**12**

V	**Electromagnetic Waves:** Wave Equations from Maxwell's Equations; Wave equations in Phasor form. Uniform Plane Waves -Propagation of Uniform Plane waves in free space, loss-less and lossy dielectric medium, Uniform Plane waves in good conductor; properties in different medium-attenuation constant, phase constant, propagation constant, intrinsic impedance, phase velocity and group velocity; Skin effect and skin depth; numerical problems; Poynting Vector and Poynting Theorem; Basic concepts of Transmission Lines.	**12**
	Total hours	**60**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1U20F	DIGITAL ELECTRONICS	PCC	3	1	0	4	2020

i) PRE-REQUISITE: EE1U20C Analog Electronics

ii) COURSE OVERVIEW:

The Goal of this course is to expose the students to acquire the basic knowledge of digital logic levels and application of knowledge to understand the Digital Electronic Circuits. Students will be able to analyse, design and Implement Combinational and Sequential Circuits. This course also gives an introduction to students on designing Digital circuits using VHDL.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Classify various number systems, binary codes and formulate digital functions using Boolean algebra.	Apply
CO 2	Construct various Combinational logic circuits.	Apply
CO 3	Examine various Sequential logic circuits.	Apply
CO 4	Compare the operation of various analog to digital and digital to analog conversion circuits.	Understand
CO 5	Explain the basic concepts of Programmable Logic devices and VHDL.	Understand

iv) SYLLABUS

Introduction to various number representations –Decimal, Binary, Octal, Hexadecimal-number base conversions –Computer codes –Signed numbers- representation, addition and subtraction, Fixed point and floating-point representation. Error detection and correction-A/D and D/A converter

NAND gate and CMOS NOR gate, Comparison of CMOS and TTL performance of Logic gates, Universal gates, TTL and CMOS logic families.

Digital Logic Families- Characteristics, Comparison and performance of various logic families, Logic Gates-Boolean Algebra- De Morgan's Theorem- Karnaugh Map

Combinational Logic Design - Half Adder and Full Adder, Half Subtractor and Full Subtractor, Full Adder, Parity Generators, Encoder, decoder, Multiplexer, Demultiplexer.

Sequential Circuits- Flip Flops- D, S-R, J-K, T - Conversion, Shift Registers-SISO, SIPO, PISO, PIPO

Counters-Asynchronous and synchronous, Ring and Johnson counters- Mealy/Moore models- state diagram, state table

Analog to Digital Converters- Weighted Resistor and R-2R ladder, Digital to Analog Converters - Flash, Successive Approximation.

Programmable Logic Devices-ROM, PLA, PAL, FPGA-VHDL Coding – Combinational

v) (a) TEXT BOOKS

1) Thomas L. Floyd, *Digital Fundamentals*, Pearson Education, 10th Edition, 2011.
2) Roth C. H., Kimney L. L., *Fundamentals of Logic Design*, Cengage Learning, 7th Edition 2013
3) Mano M. M., *Logic and Computer Design Fundamentals*, Pearson Education, 4th Edition,2008.
4) Salivahanan S., Arivazhagan S., *Digital Electronics*, Vikas Publishers, 5th Edition 2018.
5) Roy Chaudari, Linear *Integrated Circuits*, New Age International Publications, 4th Edition 2017.

(b) REFERENCES

1) Ronald J. Tossi, Neal S. Widmer and Gregory L. Moss, *Digital Systems: Principles and Applications*, Pearson Education, 10th Edition,2011.
2) John F. Wakerly, *Digital Design: Principles and Practices*, Pearson, 4th edition ,2005.
3) Anand Kumar A., *Fundamentals of Digital Circuits*, Prentice Hall of India, 4th Edition, 2016.
4) Donald P. Leach, Albert Paul Malvino, Digital Principles and Applications, Tata Mc Graw Hill, 8th Edition, 2014.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Number Systems and Codes: Binary, Octal and hexadecimal conversions- ASCII code, Excess -3 code, Gray code, BCD, Error detection codes-Parity method. Signed numbers- representation, addition and subtraction, Fixed point and floating-point representation. Logic gates, Universal gates, TTL and CMOS logic families-Internal diagram of TTL NAND gate and CMOS NOR gate. Comparison of CMOS and TTL performance	**11**
II	Boolean Laws and theorems, Sum of Products method, Product of Sum method – K map representation and simplification (up to four variables) - Pairs, Quads, Octets, Don't care conditions. Combinational circuits: Adders -Full adder and half adder, Subtractors- half subtractor and full subtractor, 4 bit parallel binary adder/subtractor, Carry Look ahead adders.	**13**
III	Comparators, Parity generators and checkers, Encoders, Decoders, , BCD to seven segment decoder, Code converters, Multiplexers, Demultiplexers, Architecture of Arithmetic Logic Units (Block schematic only).	**11**

IV	Flip-Flops - SR, JK, D and T, JK Master Slave Flip-flop, Preset and clear inputs, Conversion of flip-flops. Registers -SISO, SIPO, PISO, PIPO. Up/Down Counters: Asynchronous Counters – Modulus of a counter – Mod-N counters, Ring counter, Johnson Counter. Synchronous counters - Design of Synchronous counters.	**13**
V	State Machines: State transition diagram, Moore and Mealy Machines Digital to Analog converter –Specifications, Weighted resistor type, R-2R Ladder type. Analog to Digital Converter – Specifications, Flash type, Successive approximation type. Programmable Logic Devices - PAL, PLA, FPGA (Introduction and basic concepts only). Introduction to Verilog, Implementation of AND, OR, half adder and full adder.	**12**
	Total hours	**60**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
ES0U20A	DESIGN AND ENGINEERING	ESC	2	0	0	2	2020

i) PRE-REQUISITE: Nil. Its generic to all engineering disciplines.

ii) COURSE OVERVIEW:

Goal of this course is to expose the students to the fundamental principles of design engineering. Students are expected to apply design thinking in learning, which is very important and relevant for today. The course also focuses on familiarizing the students with the aesthetics, ergonomics and sustainability factors in designs and practice professional ethics while designing.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Demonstrate the different stages involved in design engineering process	Understand
CO 2	Compose a problem statement with design objectives taking into account the customer requirements, design constraints and functionality.	Create
CO 3	Develop innovative solutions to the Design problem through brainstorming and ideation.	Apply
CO 4	Identify the concepts of Biomimicry, Aesthetics and Ergonomic factors in designs to add more value to it.	Apply
CO 5	Apply the Design communication tools to model an idea.	Apply
CO6	Incorporate different segments of knowledge in engineering in order to develop innovative, reliable, sustainable and economically viable designs.	Apply

iv) SYLLABUS

Introduction to engineering design. Generate a design through the Design Process stages.

Design Thinking Approach, Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning.

Ideation in Design Thinking - Brainstorming sessions. Design Engineering Concepts. Application of Biomimicry, Aesthetics and Ergonomics in Design. Design for X – Quality, Reliability and Sustainability

Design Communication, Data Representation, Communicating Designs Orally, Graphically and in Writing. Modelling, Prototyping and Proof of Concept.

Value Engineering, Concurrent and Reverse Engineering. Expediency, Economics and Environment in Design Engineering. Design Rights. Ethics in Design.

v) (a) TEXT BOOKS

1) Yousef Haik, Sangarappillai Sivaloganathan, Tamer M. Shahin, *Engineering Design Process*, Third Edition, Cengage Learning, (1 January 2017)

2) Linda C. Schmidt , George Dieter, *Engineering Design*, McGraw Hill Education; Fourth edition (1 July 2017)
3) Pavan Soni, *Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-Solving*, Penguin Random House India Private Limited, 2020.
4) Voland, G., *Engineering by Design*, Pearson India 2014, Second Edition, ISBN 9332535051

(b) OTHER REFERENCES

1) Clive L Dym, *Engineering Design: A Project Based Introduction*, Fourth Edition, John Wiley & Sons, New York 2009.
2) Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*, Harper Business; Revised, Updated ed. edition (5 March 2019).
3) **Don Norman , *The Design of Everyday Things*, Basic Books; 2nd edition (5 November 2013).**
4) Dominique Forest , *Art of Things: Product Design Since 1945*, Abbeville Press Inc.,U.S.; Special edition (16 October 2014).
5) **Javier Abarca, Al Bedard, et al, *Introductory Engineering Design – A Projects-Based Approach*, 3rd ed, Regents of the University of Colorado, 2000.**
6) Nigel Cross, Design Thinking: *Understanding How Designers Think and Work*, Berg Publishers 2011, First Edition, ISBN: 978-1847886361.
7) Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., *Engineering Design: A Systematic Approach*, Springer 2007, Third Edition, ISBN 978-1-84628-319-2.
8) George Dieter , *Engineering Design: A Materials and Processing Approach*, McGraw-Hill Education / Asia; 3rd edition (16 February 2000).

vi) COURSE PLAN

Module	Contents	No. of hours
I	Design Process: - Defining a Design Process-: Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.	3
	Practical Exercise: Need Identification. How to define a Problem Statement. Present an idea using the stages of Design Process.	3
II	Design Thinking Approach: -Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Empathize – User Persona, Day in the Life Technique, identify customer requirements using Morphological Chart and set design objectives. Define - Identifying and formulating a Problem Statement -Fish Bone Diagram	4
	Practical Exercise: User Persona Chart. Morphological Chart	2
III	Ideate - Brainstorming sessions, and ideation using Random word technique, SCAMPER. Design Engineering Concepts: Modular Design and Life Cycle Design Approaches. Application of Biomimicry, Aesthetics and Ergonomics in Design. Design for X – Quality, Reliability and Sustainability.	4

	Practical Exercise: Brainstorming, 6-3-5 technique, Random Word Technique	**2**
IV	Design Communication: - Data Representation, Communicating Designs Orally, Graphically and in Writing. Modelling, Prototyping and Proof of Concept. Awareness of Basic tools of Design like – Autodesk, CATIA, MATLAB	**3**
	Practical Exercise: Communicating Designs Graphically.	**4**
V	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. Expediency, Economics and Environment in Design Engineering: - Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design	**3**
	Practical Exercise: Case Studies	**2**
	Total hours	**30**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
NC0U20B	CONSTITUTION OF INDIA	MNC	2	0	0	---	2020

i) PREAMBLE:

The study of the Constitution of India enables the students to

1) Understand the fundamental rights & duties and directive principles
2) Understand the functions of Executive, Legislature and Judiciary of the Union and the States
3) Understand the relation between the Union and the States
4) Provides the student the knowledge and strength to face the society and people.

ii) PREREQUISITE: Nil

iii) COURSE OUTCOMES:

After the completion of the course, the student will be able to:

CO 1	Explain the historic background of the constitution of India and its features.	Understand
CO 2	Describe the fundamental rights, duties and directive principles of state policy.	Understand
CO 3	Discuss the machinery of executive, legislature and judiciary of the Union and the States.	Understand
CO4	Explain the relation between the Union and the States.	Understand
CO 5	Demonstrate national and patriotic spirit as responsible citizens of the country.	Apply

iv) SYLLABUS

Constitution of India: Definition, historical background, features, preamble, territory, citizenship. State, fundamental rights, directive Principles, fundamental duties. The machinery of the union government, machinery of the state governments. Statutory institutions, miscellaneous provisions, amendments to constitution.

v) (a) TEXT BOOKS

1) M. Laxmikanth, Indian Polity, McGraw Hill Education India, 6th Edition, 2019.
2) D. D. Basu, Introduction to the Constitution of India, Lexis Nexis, New Delhi, 24th Edition, 2019.
3) P. M. Bhakshi, The Constitution of India, Universal Law, 14th Edition, 2017.

(b) REFERENCES

1) Ministry of Law and Justice, The Constitution of India, Govt. of India, New Delhi, 2019.
2) J. N. Pandey, The Constitutional Law of India, Central Law agency, Allahabad, 51st Edition, 2019.
3) M. V.Pylee, India's Constitution, S. Chand and Company, New Delhi, 16th Edition, 2016.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Definition of constitution, historical back ground, salient features of the constitution. Preamble of the constitution, union and its territory. Meaning of citizenship, types, termination of citizenship.	**4**
II	Definition of state, fundamental rights, general nature, classification, right to equality,right to freedom, right against exploitation. Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences. Directive principles of state policy, classification of directives, fundamental duties.	**7**
III	The Union Executive, the President, the Vice President, the Council of Ministers, the Prime Minister, Attorney-General, functions. The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament. Union judiciary, the supreme court, jurisdiction, appeal by special leave.	**7**
IV	The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories. The State Legislature, composition, qualification and disqualification of membership, functions. The state judiciary, the high court, jurisdiction, writs jurisdiction.	**6**
V	Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission. Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals. Official language, elections, special provisions relating to certain classes, amendments to constitution.	**6**
	Total hours	**30**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1U28C	ELECTRICAL MACHINES LAB I	PCC	0	0	3	2	2020

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW:

Objective of the course is to impart practical knowledge to the students by exposing them to hands on experience of testing DC Machine and Transformers. The course also enables the students to analyse the performance of various machines and to validate the test results.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Draw the performance characteristics of DC Motors and DC Generators by performing load test.	Apply
CO 2	Sketch the open characteristics of a self-excited DC shunt Generator and check conditions of voltage build up by performing suitable experiment.	Apply
CO 3	Develop equivalent circuit and predetermine their regulation and efficiency by performing OC & SC tests on transformer.	Apply
CO 4	Determine the efficiency and regulation of the transformer by performing load test.	Apply
CO 5	Calculate the efficiency of a DC machine when working as motor and generator by conducting suitable test.	Apply
CO 6	Calculate the efficiency by performing Sumpner's test on two similar transformers.	Apply

iv) LIST OF EXPERIMENTS

- Familiarisation of meters, instruments and safety measures adopted in the laboratory
- Open Circuit Characteristics of a DC Shunt Generator
- Open Circuit Characteristics of a separately excited DC Generator
- Load Test on a DC Shunt Motor
- Load Test on a DC Series Motor
- Load Characteristics of a DC Shunt Generator
- Load Characteristics of a DC Compound Generator
- Swinburne's Test on a DC Shunt Machine
- OC and SC Tests on a Single-Phase Transformer
- Direct Load Test on a Single-Phase Transformer
- OC and SC Tests on a Three-Phase Transformer
- Direct Load Test on a Three-Phase Transformer
- Sumpner's Test on two identical Transformers
- Parallel Operation of two dissimilar Single-Phase Transformers
- Separation of Constant losses of a Single-Phase Transformer

v) REFERENCES

1) Bimbhra P. S., *Electrical Machinery*, Khanna Publishers, 2011.
2) Gupta J. B., *Theory and Performance of Electrical Machines*, S K Kataria & Sons, 2009.
3) Theraja B. L., *A Textbook of Electrical Technology: Volume II*, S. Chand & Company, 2008.
4) Fitzgerald A. E., C. Kingsley and S. Umans, *Electric Machinery*, McGraw Hill, 2020.

vi) COURSE PLAN

Experiment No.	List of exercises/experiments	No. of hours
I	a) Familiarisation of meters and instruments used in Electrical Machines Lab b) Study of safety measures to be taken while performing experiments in the lab	3
II	**Open Circuit Characteristics of a DC Shunt Generator** a) Determine the critical field resistance b) Obtain maximum voltage built up with given shunt field resistance c) Obtain critical speed for a given shunt field resistance. d) Predetermine the OCC at different speeds	3
III	**Open Circuit Characteristics of a separately excited DC Generator** a) Determine the critical field resistance b) Obtain critical speed for a given shunt field resistance. c) Predetermine the OCC at different speeds	3
IV	**Load Test on a DC Shunt Motor** Plot the Performance characteristics, Electrical characteristics and Mechanical characteristics.	3
V	**Load Test on a DC Series Motor** Plot the Performance characteristics, Electrical characteristics and Mechanical characteristics.	3
VI	**Load Characteristics of a DC Shunt Generator** Plot the load characteristics of the given DC Shunt generator.	3
VII	**Load Characteristics of a DC Compound Generator** a) Plot the load characteristics of the given DC Compound generator when cumulatively compounded. b) Plot the load characteristics of the given DC Compound generator when differentially compounded.	3
VIII	**Swinburne's Test on a DC Shunt Machine** a) Predetermine the efficiency of a D.C. shunt machine. When the machine operates as a motor and as a generator for various load conditions.	3

	b) Plot the efficiency curves of the given DC machine.	
IX	**OC and SC Tests on a Single-Phase Transformer** a) Predetermine the regulation and efficiency of the given single-phase transformer at different loads and power factors. b) Obtain the equivalent circuit of the given transformer.	**3**
X	**Direct Load Test on a Single-Phase Transformer** a) Determine the efficiency and regulation of the given transformer at unity power factor at different loads. b) Plot the efficiency vs output and regulation vs output characteristics.	**3**
XI	**OC and SC Tests on a Three-Phase Transformer** a) Predetermine the efficiency and regulation at different load conditions and power factors. b) Develop the per phase equivalent circuit.	**3**
XII	**Direct Load Test on a Three-Phase Transformer** a) Determine the efficiency and regulation of the given transformer b) Plot the efficiency vs output and regulation vs output characteristics.	**3**
XIII	**Sumpner's Test on two similar Transformers** a) Predetermine the efficiency and regulation at different loads and power factors. b) Develop the equivalent circuit.	**3**
XIV	**Parallel Operation of two dissimilar Single-Phase Transformers** Determine the load sharing of each transformer by their equivalent impedances.	**3**
XV	**Separation of Constant losses of a Single-Phase Transformer** Determine the components of constant losses of a single-phase transformer.	**3**
	Total Hours	**45**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1U28D	DIGITAL ELECTRONICS LAB	PCC	0	0	3	2	2020

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW:

The goal of this course is to impart practical experience to students by exposing them to various digital ICs, the building block of digital circuits. The course is designed to expose the students to perform analysis and design of various combinational and sequential logic circuits.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Formulate digital functions using Boolean Algebra and verify experimentally.	Apply
CO 2	Design and Implement combinational logic circuits.	Apply
CO 3	Design and Implement sequential logic circuits.	Apply
CO 4	Design and fabricate a digital circuit using the knowledge acquired from the laboratory.	Apply

iv) LIST OF EXPERIMENTS

- Familiarization of Logic circuit
- Realization of SOP and POS using gates
- Design and realization of various combinational circuits – 5 sessions
- Design and realization of various sequential circuits – 6 sessions
- Simulation using VHDL

v) REFERENCES

1) Thomas L. Floyd, *Digital Fundamentals*, Pearson Education, 10th Edition,2011
2) Mano M. M., Logic and Computer Design Fundamentals, Pearson Education, 4th Edition,2008.
3) Salivahanan S., Arivazhagan S., *Digital Electronics*, Vikas Publishers, 5th Edition 2018.
4) Roth C. H. and Kimney L. L., *Fundamentals of Logic Design*, Cengage Learning, 7th Edition 2013.

vi) COURSE PLAN

Experiment No.	List of exercises/experiments	No. of hours
I	Verification & Realisation of De Morgan's theorem.	3
II	Realisation of SOP & POS functions after K-map reduction.	3
III	Half adder & Full adder using gates.	3
IV	4-bit adder/subtractor & BCD adder using IC 7483.	3
V	Realisation of 2-bit comparator using gates and study of four-bit comparator IC 7485.	3
VI	BCD to decimal decoder and BCD to 7-segment decoder & display.	3
VII	Study of multiplexer IC and realization of combinational circuits using multiplexers.	3
VIII	Realization of RS, T, D & JK flip flops using gates.	3
IX	Study of flip flop ICs (7474 & 7476).	3
X	Realisation of ripple up and down counters and modulo-N counter using Flip Flops	3
XI	Study of counter ICs (7490, 7493).	3
XII	Design of synchronous up, down & modulo-N counters.	3
XIII	Realization of 4-bit serial IN serial OUT registers using flip flops.	3
XIV	Study of shift register IC 7495, ring counter and Johnsons counter.	3
XV	VHDL implementation of full adder, 4 bit magnitude comparator	3
	Total hours	**45**

B Tech (S4-MINOR)

Basket	Course Number	Course	L-T-P	Credit
I	EE0M20E	Electrical Machines	3-1-0	4
II	EE0M20F	Energy Systems	4-0-0	4
III	EE0M20G	Principles of Instrumentation	4-0-0	4
IV	EE0M20H	Electric Power Supply and Distribution Systems	4-0-0	4

B.Tech Minor offered by the Department of Science & Humanities

Course Number	Course	L-T-P	Credit
MA0M20B	Mathematical Optimization	3-1-0	4

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE0M20E	ELECTRICAL MACHINES	VAC	3	1	0	4	2020

i) PRE-REQUISITE: ES0U10D Basics of Electrical and Electronics Engineering, PH0U10A/B Engineering Physics A/B, MA0U10A Linear Algebra and Calculus.

ii) COURSE OVERVIEW:

This course provides an introduction to the basic concepts of DC Machines, transformers, synchronous and induction machines, emphasizing their applications to engineering. It introduces students to cognitive learning and develops problem solving skills.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the principle of operation and characteristics of DC generators and motors.	Understand
CO 2	Choose DC motors for various applications based on speed and torque requirements.	Apply
CO 3	Calculate the losses and efficiency of transformers from the given test data	Apply
CO 4	Illustrate the working of Induction motors and generators.	Apply
CO 5	Apply the operating principle of alternators to derive its emf equation and to illustrate the working of synchronous motors.	Apply

iv) SYLLABUS

DC Machines - principle of operation - EMF equation – types, General idea of armature reaction, losses and efficiency.

Characteristics of DC Generator and DC motor, Applications, Starting.

Transformers – construction - principle of operation - EMF equation – losses and efficiency - all day efficiency.

Three phase induction motors - Construction – types – principle of operation – torque-slip characteristics, Applications, Starting, Single phase induction motors.

Principle of operation of Induction Generators.

Alternators: Types – principle of operation and emf equation.

Principle of Operation of Synchronous Motors.

v) (a) TEXT BOOKS

1) Bimbra P. S., *Electric Machines*, Khanna Publishers, 2nd Edition, 2017.
2) Fitzgerald A. E., Kingsley C. and Umans S., *Electric Machinery*, McGraw Hill, 6th Edition, 2003.

3) Theodore Wilde, *Electrical Machines, Drives and Power System*, Pearson Ed. Asia, 6th Edition, 2013.
4) Kothari D. P., Nagrath I. J., *Electric Machines*, Tata McGraw Hill, 5th Edition.

(b) REFERENCES

1) Gupta J. B., Theory and *Performance of Electrical Machines*, S K Kataria & Sons, 14th Edition, 2013.
2) Deshpande M. V., *Electrical Machines*, Prentice Hall India, New Delhi, Eastern Economy Edition, 2011.
3) Ashfaq Husain, Haroon Ashfaq, *Electric Machines*, Dhanpat Rai and Co., 3rd Edition.
4) Clayton A. E. and Hancock N. N., *The Performance and Design of Direct Current Machines*, CBS Publishers & Distributors, New Delhi, 3rd Edition, 2004.
5) Theraja B. L. and A. K. Theraja, A TextBook of Electrical Technology, S. Chand & Company Ltd., 2008.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Introduction to Electrical Machines:** Broad Classification of Electrical Machines, Concepts of Electromagnetic and Permanent Poles, Construction and principle of operation of DC Motor and DC Generator, Emf equation, Classification.	12
II	**DC Generators:** Characteristics of DC Generator - OCC and load characteristics - simple numerical problems. Armature reaction– demagnetising and cross magnetising ampere turn, compensating windings, interpoles, commutation, OCC, voltage build up and load characteristics, parallel operation. Power flow diagram – numerical problems.	12
III	**Transformers:** Principle of operation – construction - emf equation – phasor diagram under lagging power factor load - losses and efficiency – OC and SC tests – equivalent circuit - efficiency calculations - maximum efficiency – all day efficiency – simple numerical problems.	12
IV	**Three phase induction motors:** Construction – types – principle of operation – power and torque equations – Numerical problems - No load and Blocked rotor tests – equivalent circuit - torque slip characteristics - Applications. Single phase induction motors - Principle of operation - split phase motors - capacitor start motors, Applications.	12
V	**Synchronous machines:** Alternators - Construction and principle of operation – Types - terminology of armature windings – concept of pitch and distribution factors (derivation not required) - emf equation - simple	12

	numerical problems – Basic Concepts of Parallel Operation & Synchronisation of Alternators. Principle of Operation of Synchronous Motors – Advantages, Disadvantages and Applications of Synchronous Motors – Comparison of Synchronous & Induction Machines.	
	Total hours	**60**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE0M20F	ENERGY SYSTEMS	VAC	4	0	0	4	2020

i) PRE-REQUISITE: EST 130 Basics of Electrical & Electronics Engineering, EET 253 Introduction to Power Engineering

ii) COURSE OVERVIEW:

The Goal of this course is to expose the students to acquire the basic knowledge of digital logic levels and application of knowledge to understand the Digital Electronic Circuits. Students will be able to analyse, design and Implement Combinational and Sequential Circuits. This course also gives an introduction to students on designing Digital circuits using VHDL.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Illustrate the Indian and global energy scenario and the different conventional and non-conventional energy generation schemes.	Understand
CO 2	Develop the design of Solar and Wind Energy systems based on the design requirements.	Apply
CO 3	Compare the principle of operation and performance characteristic of various energy storage schemes	Understand
CO 4	Identify major Global and Indian standards for Energy Management.	Understand
CO 5	Identify the use of different types of Energy Audit.	Apply
CO 6	Interpret various aspects of energy economics	Understand

iv) SYLLABUS

Energy Scenario, Energy Sector Reforms, Energy Conservation Act, Energy Efficient Systems

Renewable Energy Resources - Solar Thermal Energy, Solar Photovoltaic Energy, Wind Energy, Wave Energy, Tidal Energy, Ocean Thermal Energy, Biomass Energy, Small Hydro Power.

Energy Storage Systems - Compressed air storage, Flywheel Energy Storage, Battery Storage. Battery - Specification and types, Full Cell - Working

Energy Standards - International Energy Standards-ISO50001, Bureau of Energy Efficiency, star rating

Energy Management, Energy audit-types and procedures, governmental agencies related to energy conservation and management

Energy Economics, Energy demand forecasting, Economic Analysis of Energy Investments.

v) (a) TEXT BOOKS

1) A.G.Ter-Gazarian, "Energy Storage for Power Systems", 2nd Edition, The Institution of Engineering and Technology (IET) Publication, UK, (ISBN - 978-1- 84919-219-4), 2011.
2) Barney L. Capehart, Wayne C. Turner and William J. Kennedy, "Guide to Energy Management", Seventh Edition, The Fairmont Press Inc., 2012.
3) S. Pabla, "Electric Power Systems Planning", Mac Millan India Ltd., 1998

(b) REFERENCES

1) K.C. Kothari, D.P.Ranjan, Rakeshsingal "Renewable Energy Sources and Emerging Technology"- PHI; 2nd Revised edition (1 December 2011).
2) M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional", BS Publications/BSP Books (2017).
3) Albert Thumann, Scott Dunning, "EFFICIENT LIGHTING APPLICATIONS & CASE STUDIES"; The Fairmont Press, Inc. (16 April 2013).
4) "Energy Efficiency in Electrical Utilities"-Guide book for National Certificate Examination for Energy Managers and Energy Auditors: Bureau of Energy Efficiency.
5) Subhes C. Bhattacharyya, "Energy Economics-Concepts, Issues, Markets and Governance", Springer, 2011.

i) COURSE PLAN

Module	Contents	No. of hours
I	**Energy Scenario:** Indian Energy Scenario, World Energy Scenario, Indian Energy Sector Reforms, Energy and Environment, Energy Security, Energy conservation act **Energy Efficient Systems:** Reducing pollution and improving efficiency in buildings, Green Building Standards, Types of lamps and their efficiencies	**11**
II	**Renewable Energy Resources:** Solar Thermal System-Working Principle-Block diagram, Solar Photovoltaic System- Working Principle-Block diagram, Solar system efficiency calculation, Wind Energy Systems- Working Principle-Block diagram, wind power equation, Energy from Waves and tides- Working Principle-Block diagram, Ocean Thermal Energy System- Working Principle-Block diagram, Energy from Biomass, Small Hydro Power - Classification of Hydro projects, Types of Turbines, Design and Selection Considerations.	**13**
III	**Energy Storage:** Importance of Energy Storage- Means of Storing Energy- Principle of operation and performance comparison. Pumped hydroelectric Energy Storage, Compressed air storage, Flywheel Energy Storage, Battery Storage. **EV Battery Storage:** Plug in Hybrid Electric Vehicle (PHEV)-Grid to Vehicle (G2V) and Vehicle to Grid (V2G) enabling Technologies.	**13**

	Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles. **Battery:** Specification, Charging/Discharging rate, Primary and secondary cells-Dry cell, lead acid, lithium ion, Lithium air, Nickel Cadmium, Nickel Metal Hydride **Fuel Cell:** Working Principle, efficiency.	
IV	**Energy Standards** – International Energy Standards-ISO50001, Bureau of Energy Efficiency, star rating **Energy Management:** Significance and general principles of Energy Management, Energy audit-types and procedure, Energy audit report, Instruments for energy auditing. Government regulation and policy related to energy conservation and management-Energy demand forecasting: Introduction –Forecasting using simple indicators- trend analysis- end use method - MAED Model - LEAP Model.	**11**
V	**Energy Economics:** Traditional Types of Rates - Single-Part Rates - Two-Part Rates – Three Part Rates – Numerical problems. Economic Analysis of Energy Investments - Calculation of energy efficiency and payback period - Characteristics of Energy Projects - Identification of Costs and Benefits - Valuation of Costs and Benefits - Indicators of Cost-Benefit Comparison: Methods Without Time Value - Net Present Value Based Indicators - Role of Discount Rates - Internal Rate of Return – Numerical Problems.	**12**
	Total hours	**60**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE0M20G	PRINCIPLES OF INSTRUMENTATION	VAC	4	0	0	4	2020

i) PRE-REQUISITE: ES0U10D Basics of Electrical and Electronics Engineering

ii) COURSE OVERVIEW:

The goal of this course is to introduce the principle of operation and construction of basic instrumentation components, their selection and applications. Familiarization of modern basic digital systems are also included.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Describe the factors affecting performance of instrumentation system.	Understand
CO 2	Choose appropriate instrumentation system components for the measurement of different parameters.	Apply
CO 3	Describe the different amplifier circuits for instrumentation including selection of Op-amp for linear and Non-linear applications.	Understand
CO 4	Choose the various filters for instrumentation.	Apply
CO 5	Illustrate the principles of operation of linear & Non-linear signal processing systems.	Understand
CO 6	Explain the operating principles of basic building blocks of digital systems, recording and display units.	Understand

iv) SYLLABUS

Passive electronic components– Resistors- Capacitors- Inductors and transformers, Circuits with pn-diodes, Sensors– Sensor components Transducers - Definition and classification.

Circuits with bipolar transistors & field effect transistors, Operational amplifiers - Amplifier circuits with ideal operational amplifiers, Non-ideal operational amplifiers - Selection of operational amplifiers.

Nonlinear signal processing with OPAMP, Electronic switching circuits - Electronic switches - Properties and Components as electronic switches, Passive filters - First and second order RC-filters.

Modulation and Demodulation - Amplitude modulation and demodulation - Amplitude modulation methods - Demodulation methods. Digital-to-Analogue and Analogue-to-Digital conversion - Parallel converters - Binary signals and codes.

Measurement instruments - Stand-alone measurement instruments, Spectrum analyzers - Network analyzers - Impedance analyzers, Oscilloscopes- Principal of operation of general purpose CRO, DSO-Characteristics-Probes and Probing

techniques, Computer-based measurement instruments - Bus structures - Introduction to Virtual Instrumentation systems- Simulation softwares (description only).

v) (a) TEXT BOOKS

1) D. Patranabis, „Sensors and Transducers", Prentice Hall of India, 2003.
2) Helfrick& Cooper, Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall of India,5th Edition, 2000.
3) Sawhney A. K., *A course in Electrical and Electronic Measurements and instrumentation*, Dhanpat Rai & Co. (P), 10th Edition, 2015.
4) Kalsi H. S., Electronic Instrumentation, 3rd Edition, Tata McGraw Hill, New Delhi, 2012.
5) S Tumanski, Principles of electrical measurement, Taylor & Francis,2006.
6) Bell D. A., *Electronic Devices and Circuits*, Prentice Hall of India, 2007.

(b) REFERENCES

1) Bernard Oliver M., John Cage M., *Electronic Measurements and Instrumentation*, McGraw Hill, 2000.
2) E.O Doebelin and D.N Manik, Doebelin"s Measurements Systems, sixth edition, McGraw Hill Education (India) Pvt. Ltd., 2020.
3) P.Purkait, B.Biswas, S.Das and C. Koley, Electrical and Electronics Measurements and Instrumentation, McGraw Hill Education (India) Pvt. Ltd., 2013.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Passive electronic components–** Resistors- Capacitors- Inductors and transformers. **Circuits with pn-diodes** - Limiters - Peak detectors - Clamp circuits - DC voltages sources. **Sensors –** Sensor components - Resistive sensors - Inductive sensors - Capacitive sensors - Thermoelectric sensors - Piezoelectric sensors. **Transducers** - Definition and classification. LVDT, Electromagnetic and Ultrasonic flowmeters, Piezoelectric transducers-modes of operation-force transducer, Load cell, Strain gauge.	**12**
II	**Circuits with bipolar transistors & field effect transistors** - Voltage-to-current converter - voltage amplifier stage with base-current bias - voltage amplifier stage with a base-voltage. bias - emitter follower - source follower- differential amplifier. **Operational amplifiers** - Amplifier circuits with ideal operational amplifiers - Current-to voltage converters - Inverting voltage amplifiers - Non-inverting voltage amplifiers - Differential amplifiers - Instrumentation amplifiers. **Non-ideal operational amplifiers** - Selection of operational amplifiers (Specifications)- Input offset voltage - Finite voltage gain.	**12**

III	**Nonlinear signal processing with OPAMP** - Voltage comparators - Schmitt-trigger - Voltage limiters - Rectifiers - Nonlinear arithmetic operations - Logarithmic converters - Exponential converters – Multipliers and other arithmetic operators. **Electronic switching circuits -** Electronic switches - Properties and Components as electronic switches - Circuits with electronic switches - Time multiplexers - Sample-hold circuits - Transient errors. **Passive filters -** First and second order RC-filters - Low-pass first-order RC-filter – High pass first-order RC-filter - Bandpass filters - Notch filters.	**12**
IV	**Modulation and Demodulation** - Amplitude modulation and demodulation - Amplitude modulation methods - Demodulation methods. Systems based on synchronous detection - Phase-locked loop - Lock-in amplifiers - Chopper amplifiers. **Digital-to-Analogue and Analogue-to-Digital conversion** - Parallel converters - Binary signals and codes - Parallel DA-converters - Parallel AD-converters. Special converters - The serial DA-converter - The direct AD converter - Integrating AD-converters.	**12**
V	**Measurement instruments -** Stand-alone measurement instruments - Multimeters - Signal generators - Counters, frequency meters and time meters - Spectrum analyzers - Network analyzers - Impedance analyzers. **Oscilloscopes-** Principle of operation of general purpose CRO-basics of vertical and horizontal deflection system, sweep generator etc. DSO-Characteristics-Probes and Probing techniques. **Computer-based measurement instruments** - Bus structures - Introduction to Virtual Instrumentation systems- Simulation softwares (description only).	**12**
	Total hours	**60**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE0M20H	ELECTRIC POWER SUPPLY AND DISTRIBUTION SYSTEMS	VAC	4	0	0	4	2020

i) PRE-REQUISITE: ES0U10D Basics of Electrical and Electronics Engineering

ii) COURSE OVERVIEW:

Goal of this course is to expose the students to the fundamental concepts of Electric supply system, protective methods for the distribution system and Electrical safety.

iii) COURSE OUTCOMES

After the completion of the course the student will be able to:

CO 1	Explain about Electric supply system.	Understand
CO 2	Determine size of conductor required for various systems of power transmission.	Analyse
CO 3	Solve AC distribution calculations.	Apply
CO 4	Explain protective methods for the distribution system.	Understand
CO 5	Choose the appropriate safety method and carry out proper maintenance of electrical equipments.	Apply

iv) SYLLABUS

Electric supply system- Layout of Typical AC power supply scheme- Economics of power transmission

Transmission systems -Conductors- types of cables - Methods of power factor improvement- tariff schemes.

Lay out of HT and LT distribution system - constructional feature of distribution lines and their erection.

Purpose of protective gears -Power System earthing - tolerable limits of body current

Electrical safety programme structure - first aid-rescue techniques- Safety related case for electrical maintenance.

v) (a) TEXT BOOKS

1) Mehta V. K., Rohit Mehta, *Principles of Power Systems* Published by S. Chand Publisher, 2006.
2) Giridharan M. K., *Electrical Systems Design*, I K International Publishers, New Delhi, 2nd Edition, 2016.
3) Grainer J. J., Stevenson W. D., *Power system Analysis*, McGraw Hill, 1994.

(b) REFERENCES

1) Theodore R. Bosela, *Electrical Systems Design*, Prentice Hall; 1st Edition, 2002.
2) Rao S., *Electrical Safety Fire Safety Engineering and Safety Management,* Khanna Publications, 2nd Edition, 2012.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Electric supply system- Layout of Typical AC power supply scheme- Comparison of DC and AC Transmission- Advantage of high transmission voltage- Economics of power transmission- Economic choice of conductor size- Economic choice of transmission voltage- Power in single phase AC circuits – Complex Power- Power triangle - Power in balanced 3 phase ac circuits.	**11**
II	Conductors - types of conductors - copper, aluminium and ACSR conductors - Volume of conductor required for various systems of transmission- Cables -types of cables - insulation resistance - single core and 3 - core cables - current rating. Power factor considerations - Methods of power factor improvement. Tariffs - different types of LT and HT consumers - tariff schemes - uniform tariff and differential tariff.	**13**
III	Lay out of HT and LT distribution system, General awareness of IS Codes (IS 3043, IS 732, IS 2675, IS 5216-P12, IS 2309), constructional feature of distribution lines and their erection. LT feeders and service mains; Distribution system- classification of distribution system- radial and ring distributor - DC distribution- AC distribution - AC distribution calculations -over head versus underground system - determination of size of conductor.	**14**
IV	Purpose of protective gears - Fuses, function of fuse - Types of fuses, rewire-able, cartridge, HRC - Difference between switch, isolator and circuit breakers - Function of isolator- relays and circuit breaker- ELCB, MCB for distribution system (Descriptive). Power System earthing – objective-system earthing - equipment earthing - tolerable limits of body current – step and touch voltage (tolerable and actual values).	**11**
V	Electrical safety programme structure, development - first aid - rescue techniques - Safety related case for electrical maintenance - maintenance requirement for specific equipment and location- regulatory bodies -national electrical safety code - standard for electrical safety in work place - occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.	**11**
	Total hours	**60**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
MA0M20B	MATHEMATICAL OPTIMIZATION	VAC	3	1	0	4	2020

i) PRE RQUISITE: A basic course in the solution of system of equations, basic knowledge on calculus.

ii) COURSE OVERVIEW:

This course introduces basic theory and methods of optimization which have applications in all branches of engineering. Linear programming problems and various methods and algorithms for solving them are covered. Transportation and assignment problems and methods of solving them using the theory of linear optimization are also introduced in this course. Network analysis is introduced which has applications in planning, scheduling, controlling, monitoring and coordinating large or complex projects involving many activities. The course also includes a selection of techniques for non-linear optimization.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Solve linear programming problems using graphical or simplex method.	Apply
CO 2	Solve linear programming problems using duality theorems.	Apply
CO 3	Solve transportation and assignment problems using appropriate optimization techniques.	Apply
CO 4	Solve sequencing and scheduling problems and gain proficiency in the management of complex projects involving numerous activities using appropriate techniques.	Apply
CO 5	Solve non-linear optimization problems by identifying and classifying them using appropriate methods.	Apply

iv) SYLLABUS

Linear Programming Problem – Graphical solution, Simplex Method, Big-M method.

Two-phase method, Degeneracy and unbounded solutions of LPP, Duality in LPP, Dual Simplex Method.

Transportation Problem, Finding basic feasible solutions–MODI method. Assignment problem, Hungarian method for optimal solution, Solution of unbalanced problem. Travelling salesman problem.

Introduction, Problem of Sequencing, Scheduling Project Management-Critical path method (CPM), Project evaluation and review technique (PERT), Optimum scheduling by CPM, Linear programming model for CPM and PERT. Basics of nonlinear optimization.

Nonlinear programming problems- graphical illustration. unconstrained and unconstrained optimization problems- gradient search. The Karush –Kuhn Tucker conditions- Quadratic programming-modified simplex method-restricted entry rule, Separable programming.

v) (a) TEXT BOOKS

1) Frederick S Hillier, Gerald J. Lieberman, Introduction to Operations Research, 7th Edition, McGraw-Hill Higher Education, 1967.
2) Kanti Swarup, P. K. Gupta, Man Mohan, Operations Research, Sultan Chand Sons, New Delhi, 2008.

(b) REFERENCES

1) Singiresu S Rao, Engineering Optimization: Theory and Practice, New Age International Publishers, 1996
2) H A Taha, Operations research: An introduction, Macmillon Publishing company,1976.
3) B. S. Goel, S. K. Mittal, Operations research, Pragati Prakashan, 1980.
4) S.D Sharma, "Operation Research", Kedar Nath and RamNath - Meerut, 2008.
5) Phillips, Solberg Ravindran, Operations Research: Principles and Practice, 2nd Edition 2007.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Convex set and Linear Programming Problem – Mathematical Formulation of LPP-Basic feasible solutions, Graphical solution of LPP-Canonical form of LPP, Standard form of LPP, slack variables and Surplus variables, Artificial variables in LPP-Simplex Method Big-M method.	**12**
II	Two-phase method -Degeneracy and unbounded solutions of LPP Duality of LPP -Solution of LPP using principle of duality Dual Simplex Method.	**12**
III	Balanced transportation problem -unbalanced Transportation Problem-Finding basic feasible solutions – Northwest corner rule, least cost Method-Vogel's approximation method. MODI method Assignment problem, Formulation of assignment problem Hungarian method for optimal solution, Solution of unbalanced problem. Travelling salesman problem	**12**
IV	Introduction, Problem of Sequencing, the problem of n jobs and two machines -problem of m jobs and m machines. Scheduling Project Management-Critical path method (CPM). Project Evaluation and Review Technique (PERT), Optimum scheduling by CPM, Linear programming model for CPM and PERT. Steepest descent and conjugate gradient methods for optimization of quadratic functions.	**12**
V	Examples, Graphical illustration, One variable unconstrained Optimization-Multiple variable unconstraint optimization-- gradient search-The Karush –Kuhn Tucker condition for constraint optimization -Quadratic programming-modified simplex method- Separable programming.	**12**
	Total hours	**60**

B Tech (S4-HONOUR)

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1H20A	NETWORK ANALYSIS AND SYNTHESIS	VAC	3	1	0	4	2020

i) PRE-REQUISITE: EE1U20A Circuits and Networks

ii) COURSE OVERVIEW: This course is designed with the objective of expanding the student's knowledge in network analysis beyond the basic topics. It includes advanced topics in network analysis, basics of filter design and network synthesis concepts. This course would help students to explore more advanced concepts in the analysis of complex networks.

iii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO1	Apply the fundamental concepts of network topology in solving electric networks using incidence and circuit matrix.	Apply
CO2	Apply network topology concepts with theorems in the formulation and solution of electric network problems using loop and nodal analysis.	Apply
CO3	Apply two-port network analysis in the design and analysis of filter and attenuator networks.	Apply
CO4	Identify the properties and characteristics of network functions and verify the mathematical constraints for their physical realization.	Apply
CO5	Construct passive one-port network from its functions using Foster and Cauer methods	Apply

iv) SYLLABUS

Network topology – incidence matrix – circuit matrix – nodal analysis of networks.

Loop analysis of networks - fundamental cut sets – fundamental tie sets - relationships among incidence matrix - cut set matrix and tie set matrix – duality - formulation and solution of network equations using topological methods – Tellegen's theorem.

Two port networks – Image parameter description – Characteristic Impedance and Propagation constant - Filter terminology.

Network Functions – Pole-zero plot – Impulse Response – Hurwitz Polynomial – Positive Real functions.

Network Synthesis – Properties - Synthesis of LC, RC and RL networks by Foster I, II and Cauer I, II forms.

v) (a) TEXT BOOKS

1) Suresh Kumar K. S., *Electric Circuits Analysis*, Pearson Education India, 2013.
2) Franklin Kuo, *Network Analysis and Synthesis*, 2nd Edition, Wiley India, 1962.
3) Ravish R. Singh, *Network Analysis and Synthesis*, McGraw-Hill Education, 2013.
4) Van Valkenberg, *Network Analysis*, Prentice Hall India Learning Private Limited, 3rd Edition, 2011.

(b) REFERENCES

1) Suresh Kumar K. S., *Electric Circuits and Networks*, Pearson Education South Asia, 2009.
2) Joseph. A. Edminister and Mahmood Nahvi, *Electric Circuits*, Mc GrawHill, 7th Edition, 2017.
3) A. Chakrabarti, *Circuit Theory Analysis and Synthesis*, Dhanpat Rai & Co., 7th Revised Edition, 2018.
4) Choudhury Roy D., *Networks and Systems*, New Age International Pvt Ltd Publishers, 2nd Edition, 2013.
5) Dr. B.R. Gupta, *Network Analysis and Synthesis*, S. Chand & Company Ltd, 3rd Edition, 2013.
6) C. A. Desoer, E. S. Kuh, *Basic Circuit Theory*, McGraw-Hill, New York, 1969.
7) S. K. Bhattacharya, *Network Analysis and Synthesis*, Pearson Education India, 2015.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Network Topology** Linear Oriented Graphs -incidence matrix of a linear oriented graph – Kirchhoff's Laws in incidence matrix formulation –nodal analysis of networks (independent and dependent sources) – Circuit matrix of linear oriented graph – Kirchhoff's laws in fundamental circuit matrix formulation.	**12**
II	**Loop analysis of electric networks** (with independent and dependent sources) - Planar graphs –Mesh analysis- Duality –Cut set matrix -Fundamental cut set matrix – Relation between circuit, cut set and incidence matrices – Kirchhoff's laws in fundamental cut-set formulation – Node-pair analysis – Analysis using generalized branch model (node, loop and node pair analysis) – Tellegen's theorem.	**12**
III	**Modeling Two-port networks** - application examples - amplifiers, transmission lines, passive filters. Review of network parameter sets for two-port networks (z, y, h, g, T parameters, equivalent circuits, and inter-relationship between parameters). (Review may be done using assignments/homeworks). Image parameter description of a reciprocal two-port network - Image impedance - Characteristic impedance - propagation	**12**

	constant—derivation of characteristic impedance and propagation constant for T and Pi networks under sinusoidal steady state - Attenuation constant and phase constant. **Filter terminology** Low pass, high pass, band-pass and band-reject filters. Constant k and m-derived filters - low pass, high pass, band-pass and band-stop filters – design - effect of cascading multiple sections. Resistive T, Pi, and lattice attenuators.	
IV	**Network Functions** Review of Network functions for one port and two port networks – pole zero location for driving point and transfer functions - Impulse response of Network functions from pole-zero plots- Sinusoidal steady-state frequency response from pole-zero plots. Hurwitz polynomials – properties - Positive real functions – Properties of positive real functions – passivity - necessary and sufficient conditions for positive real functions - physical realizability.	**12**
V	**Synthesis of one port networks** Synthesis of reactive one-ports by Foster's and Cauer methods (forms I and II) - Synthesis of LC, RC and RL driving-point functions.	**12**
	Total hours	**60**