SEMESTER III

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
MA0U20A	PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS	BSC	3	1	0	4	2020

i) PRE-REQUISITE: A basic course in partial differentiation and complex numbers.

ii) COURSE OVERVIEW:

This course introduces basic ideas of partial differential equations which are widely used in the modelling and analysis of a wide range of physical phenomena and has got application across all branches of engineering. The basic theory of functions of a complex variable, residue integration and conformal transformation are discussed.

iii) COURSE OUTCOMES

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

CO 1	Solve partial differential equations.	Apply
CO 2	Use appropriate methods to solve one dimensional wave equation and heat equation.	Apply
CO 3	Solve problems using analyticity of complex functions	Apply
CO 4	Find the image of regions under conformal mapping	Apply
CO 5	Find complex integrals using Cauchy's formulas to compute several kinds of integrals.	Apply
CO 6	Find the series expansion of complex functions	Apply

iv) SYLLABUS

Partial differential equations: Formation of partial differential equations, Solutions of a partial differential equations, Linear equations of the first order, Method of separation of variables.

One dimensional wave equation-derivation and solution -One dimensional heat equation, derivation and solution

Complex Differentiation: Analytic functions, Cauchy-Riemann equations, harmonic functions, Conformal mappings- standard mappings, Linear fractional transformation .

Complex integration: Line integrals in the complex plane, Contour integrals, Cauchy integral theorem, Cauchy Integral formula

Taylor's series and Laurent's series, zeros of analytic functions, singularities, Residues, Cauchy Residue theorem, Evaluation of definite integral using residue theorem.

v) (a) TEXT BOOKS

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.
2) Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016.

(b) REFERENCES

1) J. Stewart, Essential Calculus, Cengage, 2nd Edition, 2017.
2) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3) Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition 2012.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration, Linear equations of the first order-Lagrange's linear equation, Non-linear equations of the first order - Charpit's method. Boundary value problems, Method of separation of variables.	**12**
II	One dimensional wave equation- vibrations of a stretched string, Derivation. Solution of wave equation using method of separation of variables, Fourier series solution of boundary value problems involving wave equation, D'Alembert's solution of the wave equation. One dimensional heat equation, derivation. Solution of the heat equation, using method of separation of variables, Fourier series solutions of boundary value problems involving heat equation-solution of Laplace's equations by method of separation of variables.	**13**
III	Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations-harmonic functions, finding harmonic conjugate-Conformal mappings- mappings of $w = z^2, w = e^z, w = \frac{1}{z}, w = sinz$	**12**
IV	Complex integration, Line integrals in the complex plane, Basic properties, first evaluation method, second evaluation method, use of representation of a path-Contour integrals, Cauchy integral theorem (without proof) on simply connected domain, on multiply connected domain (without proof). Cauchy Integral formula (without proof), Cauchy Integral formula for derivatives of an analytic function Taylor's series and Maclaurin series.	**11**
V	Laurent's series (without proof)-zeros of analytic functions, singularities, poles, removable-singularities, essential singularities, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral using residue theorem-Residue integration of real integrals –integrals of rational functions of $cos\theta$ and $sin\theta$, integrals of improper integrals of the form $\int_{-\infty}^{\infty} f(x)dx$ with no poles on the real axis. ($\int_A^B f(x)dx$ whose integrand become infinite at a point in the interval of integration is excluded from the syllabus).	**12**
	Total hours	**60**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	10 marks
CA Exams (2 numbers)	:	25 marks
Assignment/Project/Case study etc.	:	15 marks
Total	:	**50 marks**

viii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1U20A	CIRCUITS AND NETWORKS	PCC	2	2	0	4	2020

i) PRE-REQUISITE: MA0U10B Vector Calculus, Differential Equation and Transforms, ES0U10D Introduction to Electrical and Electronics Engineering

ii) COURSE OVERVIEW: The goal of this course to enhance the problem-solving skills by using various techniques to solve different types of AC and DC circuits. Time Domain analysis will help students to understand the transient and the steady-state response of R, L, C circuits. The course also aims to introduce two port network modelling and network functions.

iii) COURSE OUTCOMES

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

CO1	Apply circuit theorems to simplify and solve complex DC and AC electric networks.	Apply
CO2	Analyse dynamic DC and AC circuits to obtain the complete response to excitations.	Analyse
CO3	Solve dynamic circuits by applying transformation to s-domain.	Apply
CO4	Analyse three-phase unbalanced networks in Y and Δ configurations.	Analyse
CO5	Solve series /parallel resonant circuits.	Apply
CO6	Analyse the representation of two-port networks using network parameters.	Analyse

iv) SYLLABUS

Network theorems - DC and AC steady state analysis.

Time domain analysis of dynamic circuits -steady state and transient response analysis -Introduction to Laplace Transform -Application of Laplace transform in series and parallel circuits with step and sinusoidal responses.

Coupled circuits -Dot convention -Analysis of simple coupled circuits, Unbalanced three phase systems - three phase three wire and four wire system - concept of neutral shift -Resonance in series and parallel circuits.

Two port network -network parameters -interrelationship of network parameters - driving point and transfer immittance function.

v) (a) TEXT BOOKS

1) Hayt and Kemmerly, *Engineering Circuit Analysis,* McGraw Hill Education, New Delhi, 9th Edition, 2019.
2) Ravish R. Singh, *Network Analysis and Synthesis*, McGraw-Hill Education, 2013.

3) Sudhakar and Shyam Mohan, *Circuits and Networks: Analysis and Synthesis*, McGraw Hill Education, 5th Edition, 2015.
4) F. F. Kuo, *Network Analysis and Synthesis*, John Wiley Inc Publications, 1966.

(b) REFERENCES

1) Joseph A. Edminister and Mahmood Nahvi, Electric Circuits, McGraw Hill, 7th Edition, 2017.
2) A. Chakrabarti, Circuit Theory Analysis and Synthesis, Dhanpat Rai & Co., 7thRevised edition,2018.
3) Choudhury Roy D., Networks and Systems, New Age International Pvt Ltd Publishers, 2nd Edition,2013.
4) Van Valkenberg, Network Analysis, Prentice Hall India Learning Private Limited, 3rdEdition, 2011.
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) James W. Nilsson and Susan A. Riedel, Electric Circuits, Pearson Education Publications, 9th Edition, 2011.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Circuit theorems:** DC and Sinusoidal steady state analysis of circuits with dependent and independent sources applying Superposition principle, Source transformation, Thevenin's, Norton's and Maximum Power Transfer theorems - Reciprocity theorem.	**12**
II	**Analysis of first and second order dynamic circuits:** Formulation of dynamic equations of RL, RC and RLC series and parallel networks with dc excitation and initial conditions and complete solution using Laplace Transforms - Time constant - Complete solution of RL, RC and RLC circuits with sinusoidal excitation using Laplace Transforms -Damping ratio -Over damped, under damped, critically damped and undamped RLC networks.	**13**
III	**Transformed circuits in s-domain:** Transform impedance/admittance of R, L and C -Mesh analysis and node analysis of transformed circuits in s-domain. Transfer Function representation - Poles and zeros. Analysis of Coupled Circuits: Dot polarity convention -Sinusoidal steady state analysis of coupled circuits - Linear Transformer as a coupled circuit - Analysis of coupled circuits in s-domain.	**12**
IV	**Three phase networks and resonance:** Complex Power in sinusoidal steady state. Steady state analysis of three-phase three-wire and four-wire unbalanced Y circuits, Unbalanced Delta circuit, Neutral shift.	**11**

	Resonance in Series and Parallel RLC circuits: Quality factor - Bandwidth -Impedance Vs Frequency, Admittance Vs Frequency, Phase angle Vs frequency for series resonant circuit.	
V	**Two port networks:** Driving point and transfer functions -Z, Y, h and T parameters - Conditions for symmetry & reciprocity -relationship between parameter sets interconnections of two port networks (series, parallel and cascade) -T-π transformation.	**12**
	Total hours	**60**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	10 marks
CA Exams (2 numbers)	:	25 marks
Assignment/Project/Case study etc.	:	15 marks
Total	:	**50 marks**

viii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1U20B	MEASUREMENTS AND INSTRUMENTATION	PCC	3	1	0	4	2020

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

ii) COURSE OVERVIEW:

This course deals with the construction and principle of operation of basic analog and digital instruments used for measurement of current, voltage, power, energy etc. It provides a detailed study of resistance, inductance and capacitance measuring methods. The course includes an elaborate discussion about potentiometers and instrument transformers. It introduces students to the operation of various transducers to measure the physical quantities.

iii) COURSE OUTCOMES

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

CO 1	Compare the different types of measuring instruments, their construction, operation and characteristics.	Understand
CO 2	Explain the construction and working of Watt meters, Energy meters and DC potentiometers.	Understand
CO 3	Use different bridges to measure the Resistance, Inductance and Capacitance	Apply
CO 4	Illustrate the methods for magnetic measurement, high voltage and high current measurements.	Apply
CO 5	Summarise the construction and working of various transducers to measure the physical quantities and explain the concepts of digital measurement.	Understand

iv) SYLLABUS

General principles of measurements, Classification of meters, Ammeters and voltmeters - moving coil, moving iron meters

Measurement of power and energy: Dynamometer type wattmeter, Induction type 1 phase energy meter, DC potentiometers, High voltage and high current measurements- Current transformers and potential transformers

Measurement of resistance, self-inductance, capacitance and frequency: Ammeter voltmeter method-Kelvin's double bridge, Wheatstone bridge, earth resistance, Maxwell's Inductance bridge, Schering's, Wien's bridge, DC potentiometer.

Magnetic Measurements: flux meter, BH curve and permeability measurement - ballistic galvanometer. Lloyd Fisher square.

Oscilloscopes- Principle of operation of general purpose CRO, Digital voltmeters and frequency meters using electronic counters, DMM, Clamp on meters.

Transducers - Definition and classification. Photoconductive Transducers-Photovoltaic cells, LVDT, Piezoelectric force transducer, Load cell, Strain gauge, RTD, Thermistors, thermocouple. Digital Measurement of Electrical Quantities

v) (a) TEXT BOOKS

1) Sawhney A. K., *A course in Electrical and Electronic Measurements and instrumentation*, Dhanpat Rai & Co. (P), 10th Edition, 2015.
2) Golding E.W., Widdis F. C., *Electrical Measurements and Measuring Instruments*, Wheeler Publications, 15th Edition, 1998.
3) Albert Helfrick D., Cooper William D., *Modern Electronic Instrumentation and Measurement Techniques*, Pearson Education, 2016.

(b) REFERENCES

1) Gupta J. B., *A course in Electronic and Electrical Measurement and Instrumentation*, S K Kataria & Sons, 13th Edition, 2007.
2) Kalsi H. S., *Electronic Instrumentation*, Tata McGraw Hill, 3rd Edition, New Delhi, 2012.
3) Stout M. B., *Basic Electrical Measurements*, Prentice Hall, 2nd Edition, 1973.
4) Bernard Oliver M., John Cage M., *Electronic Measurements and Instrumentation*, McGraw Hill, 2000.
5) Er. Yogita Kumari, Dr. Hrisheekesha P.N., Er. Shiv Prakash Bihari, *Digital Measurement Techniques,* JBC Press, 1st Edition, 2015.
6) Rathore T. S., *Digital Measurement Techniques*, Narosa publications, 2nd Edition, 2004.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Measurement standards–Errors-Types of Errors- Statistics of errors, Need for calibration. Classification of instruments, secondary instruments–indicating, integrating and recording operating forces - essentials of indicating instruments - deflecting, damping, controlling torques. Ammeters and voltmeters - moving coil, moving iron, constructional details and operation, principles shunts and multipliers – extension of range.	**11**
II	Measurement of power: Dynamometer type wattmeter –Construction and working - 3- phase power measurement-Low Power factor wattmeters. Measurement of energy: Induction type watt-hour meters- Single phase energy meter – construction and working, two element three phase energy meters, Digital Energy meters -Time of Day(TOD) and Smart metering (description only). Current transformers and potential transformers – principle of working - ratio and phase angle errors. Extension of range using instrument transformers, Hall effect multipliers. Phasor Measurement Unit (PMU) (description only).	**13**
III	Classification, measurement of low, medium and high resistance- Ammeter voltmeter method(for low and medium resistance measurements)-Kelvin's double bridge, Wheatstones bridge- loss of charge method, measurement of	**12**

	earth resistance. Measurement of self inductance-Maxwell's Inductance bridge, Measurement of capacitance –Schering's, Measurement of frequency-Wien's bridge. Calibration of Ammeter, Voltmeter and Wattmeter using DC potentiometers. High voltage and high current in DC measurements-voltmeters, Sphere gaps, DC Hall effect sensors.	
IV	Magnetic Measurements: Measurement of flux and permeability - flux meter, BH curve and permeability measurement - hysteresis measurement- ballistic galvanometer – principle- determination of BH curve - hysteresis loop. Lloyd Fisher square — measurement of iron losses. Oscilloscopes- Principle of operation of general purpose CRO-basics of vertical and horizontal deflection system, sweep generator etc. DSO-Characteristics-Probes and Probing techniques. Digital voltmeters and frequency meters using electronic counters, DMM, Clamp on meters.	**12**
V	Transducers - Definition and classification. Measurement luminous intensity-Photoconductive Transducers-Photovoltaic cells, Temperature sensors-Resistance temperature detectors-negative temperature coefficient Thermistors-thermocouples-silicon temperature sensors. LVDT, Electromagnetic and Ultrasonic flow meters, Piezoelectric transducers-modes of operation-force transducer, Load cell, Strain gauge. Introduction to Virtual Instrumentation systems- Simulation software's (description only)	**12**
	Total hours	**60**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	10 marks
CA Exams (2 numbers)	:	25 marks
Assignment/Project/Case study etc.	:	15 marks
Total	:	**50 marks**

viii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1U20C	ANALOG ELECTRONICS	PCC	3	1	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 solid-state devices and linear integrated circuits. This course introduces the various concepts and design of oscillators, feedback amplifiers, multivibrators.

iii) COURSE OUTCOMES

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

CO 1	Explain the various wave shaping circuits using diodes and biasing circuits for BJT.	Understand
CO 2	Design BJT and FET amplifier circuits.	Apply
CO 3	Describe the various multistage, power and feedback amplifiers	Understand
CO 4	Design oscillator circuits using BJT.	Apply
CO 5	Identify Op-Amp circuits for various applications.	Apply
CO 6	Demonstrate multivibrator circuits using 555 timer IC for generating delay circuits.	Apply

iv) SYLLABUS

Diode clipping circuits, Clamping circuits, Design of Zener Voltage Regulators.

Review of BJT characteristics, Operating point of a BJT – DC load line and Q point, Biasing circuits, Bias compensation using diode and thermistor.

BJT Amplifier - Common Emitter amplifier, AC Equivalent. JFET and MOSFET construction - working and characteristics. JFET Amplifiers - small signal model and analysis of CS amplifier, Frequency response of Amplifiers.

Multistage amplifiers - Gain of Multistage amplifiers, Types, Power amplifiers using BJT- Class A, Class B and Class. Feedback Amplifiers- Basic feedback topologies. Oscillators – RC oscillators and LC oscillators.

Operational Amplifiers - Analysis of fundamental differential Amplifier, Op-Amp Parameters, Inverting and Non-Inverting Amplifiers, Open loop and Closed loop Configurations, Concept of virtual short.

OP-AMP Circuits, Waveform generation using Op-Amps. Timer 555 IC - Internal diagram of 555 IC, Astable and Mono-stable multivibrators using 555 IC.

v) (a) TEXT BOOKS

1) Boylestad R. L. and Nashelsky L., *Electronic Devices and Circuit Theory*, Pearson Education, 10th Edition, 2009.
2) Millman J. and Halkias C. C., *Integrated Electronics: Analog and Digital Circuits and Systems,* Tata McGraw-Hill, 2nd Edition, 2010.
3) Roy D. C. and Jain S. B., *Linear Integrated Circuits,* New Age International, 3rd Edition, 2010.

(b) REFERENCES

1) Bernard Etkin, Dyn Floyd T. L., *Fundamentals of Analog Circuits*, Pearson Education, 2nd Edition, 2012.
2) Robert Paynter T. and John Clemons, *Paynter's Introductory Electronic Devices & Circuits*, Prentice Hall Career & Technology, 3rd Edition, 1994.
3) Bell D. A., *Electronic Devices and Circuits*, Prentice Hall of India, 2007.
4) Streetman B. G. and Banerjee S., *Solid State Electronic Devices*, Pearson Education Asia, 2006.
5) Gayakward R. A., *Op-Amps and Linear Integrated Circuits*, PHI Learning Pvt. Ltd., 2012.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Diode Circuits:** Diode Clipping and Clamping circuits. **Bipolar Junction Transistors:** Review of BJT characteristics- Operating point of BJT – Factors affecting stability of Q point. DC Biasing–Biasing circuits: fixed bias, collector to base bias, voltage divider bias, role of emitter resistance in bias stabilisation. Stability factor (Derivation of stability factors for Voltage Divider Biasing only). Numerical problems. Bias compensation using diode and thermistor. **BJT Model**- h-parameter model of BJT in CE configuration. Small signal low frequency ac equivalent circuit of CE amplifier –Role of coupling capacitors and emitter bypass capacitor. Calculation of amplifier gains and impedances using h parameter equivalent circuit.	**13**
II	**Field Effect Transistors:** Review of JFET and MOSFET (enhancement mode only) construction, working and characteristics- JFET common drain amplifier- Design using voltage divider biasing. **Frequency response of Amplifiers:** Internal Capacitances at high frequency operations of BJT- Low and high frequency response of Common Emitter amplifier. Frequency response of CE amplifier, Gain bandwidth product.	**12**
III	**Multistage amplifiers:** Direct, RC, transformer coupled Amplifiers, Applications. **Power amplifiers using BJT:** Class A, Class B, Class AB, Class C and Class D.	**12**

	Conversion efficiency – derivation (Class A and Class B). Distortion in power amplifiers. **Feedback in Amplifiers**-Effect of positive and negative feedback. **Oscillators:** Barkhausen Criterion–RC oscillators (RC Phase shift oscillator and Wein Bridge oscillator) –LC oscillators (Hartley and Colpitt's)– Derivation of frequency of oscillation- Crystal oscillator.	
IV	**Operational Amplifiers:** Fundamental differential amplifier- Modes of operation. Properties of ideal and practical Op-amp - Gain, CMRR and Slew rate. Parameters of a typical Op-amp IC 741. Open loop and Closed loop Configurations-Concept of virtual short. Negative feedback in Op-amps. Inverting and non- inverting amplifier circuits. Summing and difference amplifiers, Instrumentation amplifier.	**11**
V	**OP-AMP Circuits:** Differentiator and Integrator circuits-practical circuits – Design –Comparators: Zero crossing and voltage level detectors, Schmitt trigger. Comparator IC: LM311. **Waveform generation using Op-Amps:** Square, triangular and ramp generator circuits using Op-Amp- Effect of slew rate on waveform generation. **Timer 555 IC:** Internal diagram of 555IC–Astable and Monostable multi-vibrators using 555 IC.	**12**
	Total hours	**60**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	10 marks
CA Exams (2 numbers)	:	25 marks
Assignment/Project/Case study etc.	:	15 marks
Total	:	**50 marks**

viii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
HS0U20A	PROFESSIONAL ETHICS	MNC	2	0	0	-	2020

i) COURSE OVERVIEW:

To enable students to create awareness on ethics and human values.

ii) COURSE OUTCOMES

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

CO 1	Infer the core values that shape the ethical behaviour of a professional.	Understand
CO 2	Apply philosophical concepts discussed in the course to personal and contemporary issues.	Apply
CO 3	Explain the role and responsibility of engineer in technological development without compromising personal ethics and legal ethics.	Understand
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.	Apply
CO 5	Demonstrate the concept of Corporate Social Responsibility, and explore its relevance to ethical business activity	Understand
CO 6	Apply the knowledge of human values and social values to contemporary ethical values and global issues.	Apply

iii) SYLLABUS

Morals, values and Ethics – Integrity- Academic Integrity-Work Ethics- Service Learning- Civic Virtue- Respect for others- Living peacefully- Caring and Sharing- Honestly- Courage-Cooperation commitment- Empathy-Self Confidence -Social Expectations.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional Roles-Theories about right action –Self-Interest-Customs and Religion- Uses of Ethical Theories.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism- A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality- Role of confidentiality in moral Integrity-Conflicts of interest- Occupational crime- Professional rights- Employee right- IPR Discrimination.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics - Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and Advisors-Moral leadership.

iv) (a) TEXT BOOKS

1) M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
2) R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi, 2006.

(b) REFERENCES

1) Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
2) Charles D Fledder mann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
3) Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states, 2005.
4) http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

v) COURSE PLAN

Module	Contents	No. of hours
I	Morals, values and Ethics, Integrity, Academic Integrity, Work Ethics Service Learning, Civic Virtue, Respect for others, Living peacefully Caring and Sharing, Honesty, Courage, Co-operation commitment Empathy, Self Confidence, Social Expectations.	**6**
II	Senses of Engineering Ethics, Variety of moral issues, Types of Inquiry-Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Profession & Professionalism, Models of professional roles, Theories about right action-Self-interest-Customs and Religion, Uses of Ethical Theories.	**6**
III	Engineering as Experimentation, Engineers as responsible Experimenters-Codes of Ethics, Plagiarism, A balanced outlook on law-Challenger case study, Bhopal gas tragedy.	**6**
IV	Collegiality and loyalty, Managing conflict, Respect for authority. Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest-Occupational crime, Professional rights, Employee right, IPR, Discrimination.	**6**
V	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics-Role in Technological Development, Moral leadership-Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors.	**6**
	Total hours	**30**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	10 marks
CA Exams (2 numbers)	:	25 marks
Assignment/Project/Case study etc.	:	15 marks
Total	:	**50 marks**

vii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
NC0U20A	SUSTAINABLE ENGINEERING	MNC	2	0	0	NIL	2020

i) COURSE OVERVIEW

The objective of this course is to expose the students to the concept of sustainability, the global initiatives towards attaining sustainable development goals and the various sustainable practices. The students should realize the potential of technology in addressing environmental issues and bringing in sustainable solutions.

ii) COURSE OUTCOMES

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

CO 1	Explain the relevance and the concept of sustainability and the global initiatives towards attaining sustainable development.	Understand
CO 2	Identify sustainable solutions for different types of environmental pollution problems.	Apply
CO 3	Discuss the environmental regulations and standards, various tools for environmental management and clean development mechanism.	Apply
CO 4	Explain the concept of circular economy, bio-mimicking and the sustainable framework developed in industrial ecology and industrial symbiosis.	Apply
CO 5	Choose the best practice of nonconventional and sustainable energy depending on the available resources and its utilization.	Apply
CO6	Demonstrate the broad perspective of sustainable practices applicable for energy efficient buildings, green engineering, sustainable cities, sustainable urbanization, and sustainable transport.	Apply

iii) SYLLABUS

Sustainability- need and concept, Technology and Sustainable Development, Sustainable Development Goals.

Environmental Pollution: Natural resources and their pollution, Carbon credits, Zero waste concept and 3 R concepts, Clean Development Mechanism: Carbon Trading and Carbon foot print, legal provisions for environmental protection.

Environmental management standards: ISO 14001:2015 frame work, Life Cycle Analysis, Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

Resources and its utilisation: Basic concepts of Conventional and non-conventional energy.

Sustainability practices: Sustainable habitat, Green buildings, green materials, Sustainable urbanization.

iv) (a) TEXTBOOKS

1) Bradley, A.S., Adebayo,A.O., Maria, P.,*Engineering applications in sustainable design and development*, Cengage learning, 1st Edition, 2015.
2) Allen, D. T. and Shonnard, D. R., *Sustainability Engineering: Concepts, Design and Case Studies*, Prentice Hall, 1st Edition, 2011

3) Purohit, S.S., *Green Technology: An Approach for Sustainable Environment*, Agrobios (India), 1st Edition, 2021.
4) Janine, M.B., *Biomimicry: Innovation Inspired by Nature,* William Morrow Paperbacks, 2002

(b) REFERENCES

1) Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
2) ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System.

v) COURSE PLAN

Module	Contents	No. of hours
I	Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs).	**6**
II	Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Clean Development Mechanism (CDM):Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.	**6**
III	Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.	**6**
IV	Resources and its utilisation: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.	**6**
V	Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.	**6**
	Total hours	**30**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	10 marks
CA Exams (2 numbers)	:	25 marks
Assignment/Project/Case study etc.	:	15 marks
Total	:	**50 marks**

vii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1U28A	CIRCUITS AND MEASUREMENTS LAB	PCC	0	0	3	2	2020

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW:

The main objective of the course is to expose the students to hands on experience of various measuring devices and measurements, standardization and calibration of meters, characteristics of transducers.

iii) COURSE OUTCOMES

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

CO 1	Verify DC network theorems by setting up various networks	Apply
CO 2	Calibrate various meters used in electrical systems	Apply
CO 3	Examine transformer parameters, electrical parameters and power in single and three phase circuits.	Analyze
CO 4	Extend the range of ammeter and voltmeter.	Apply
CO 5	Determine the characteristics of transducers and magnetic characteristics of various specimens.	Analyze

iv) LIST OF EXPERIMENTS

- Verification of Superposition theorem and Thevenin's theorem.
- Determination of impedance, admittance and power factor in RLC series/ parallel circuits.
- 3-phase power measurement using a two-wattmeter method and determination of reactive/apparent power drawn.
- Resistance measurement using Kelvin's Double Bridge and extension of range of Ammeters.
- Resistance measurement using Wheatstone's bridge and extension of range of Voltmeters.
- Extension of instrument range by using Instrument transformers (CT and PT).
- Calibration of ammeter using Slide Wire potentiometer.
- Calibration of voltmeter using Vernier Potentiometer.
- Calibration of 1-phase Energy meter at various power factors (minimum 4 conditions).
- Calibration of 1-phase Energy meter using direct loading.
- Determination of B-H curve a magnetic specimen.
- Measurement of Self-inductance, Mutual inductance and Coupling coefficient of a 1-phase transformer.
- Set Up an instrumentation amplifier using Op Amps.
- Determination of characteristics of LVDT and Load-cell.
- Determination of characteristics of Thermistor, Thermocouple and RTD.

- Demo Experiments:
  (a) Measurement of energy using Electronic Energy meter
  (b) Measurement of electrical variables using DSO
  (c) Harmonic analysers

v) REFERENCES

1) Sawhney A. K., *A course in Electrical and Electronic Measurements and instrumentation*, Dhanpat Rai, 10th Edition, 1994.
2) Golding E. W., *Electrical Measurements & Measuring Instruments*, AH WHEELER & Company, 5th Edition 1993.
3) Gupta J. B., *A course in Electrical & Electronic Measurement & Instrumentation*, S K Kataria & Sons, 2008.

vi) COURSE PLAN

Experiment No.	List of exercises/experiments	No. of hours
I	Verification of Superposition theorem and Thevenin's theorem.	3
II	Determination of impedance, admittance and power factor in RLC series/ parallel circuits.	3
III	3-phase power measurement using two-wattmeter method and determination of reactive/apparent power drawn.	3
IV	Resistance measurement using Kelvin's Double Bridge and extension of range of ammeters.	3
V	Resistance measurement using Wheatstone's Bridge and extension of range of voltmeters.	3
VI	Extension of instrument range by using Instrument transformers (CT and PT).	3
VII	Calibration of Ammeter using Slide Wire Potentiometer.	3
VIII	Calibration of Voltmeter using Vernier Potentiometer.	3
IX	Calibration of 1-phase Energy meter at various power factors (minimum 4 conditions)	3
X	Measurement of Self-inductance, Mutual inductance and Coupling coefficient of a 1-phase transformer	3
XI	Determination of B-H curve of a magnetic specimen.	3
XII	Determination of characteristics of LVDT and Load-cell	3
XIII	Determination of characteristics of Thermistor, Thermocouple and RTD.	3
XIV	Calibration of 1-phase Energy meter using direct loading	3
XV	Demo Experiments/Simulation study:	3

	(a) Measurement of energy using Electronic Energy meter (b) Measurement of electrical variables using DSO (c) Harmonic analysers	
	Total hours	**45**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	15 marks
CA Exams (1 number)	:	30 marks
Assignment/Project/Case study etc.	:	30 marks
Total	:	**75 marks**

viii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	75	75	3 hours

ix) END SEMESTER EXAMINATION PATTERN

a)	Preliminary work	:	15 marks
b)	Implementing the work/Conducting the experiment	:	20 marks
c)	Performance, result and inference (usage of equipment and troubleshooting):	:	15 marks
d)	Viva voce	:	20 marks
e)	Record	:	5 marks
	Total	**:**	**75 marks**

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1U28B	ANALOG ELECTRONICS LAB	PCC	0	0	3	2	2020

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

ii) COURSE OVERVIEW:

The main objective of the course is to expose the students to hands-on experience of designing and testing various electronic circuits and to validate the results.

iii) COURSE OUTCOMES

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

CO 1	Choose suitable electronic components according to the given requirements.	Apply
CO 2	Design and test voltage regulator using Zener diodes.	Apply
CO 3	Design and test amplifier circuits using BJT and JFET.	Apply
CO 4	Design and test oscillator circuits using BJT and Op-amp.	Apply
CO 5	Design and test various waveform generation circuits using Op-amps, Comparators and 555 timer IC packages.	Apply
CO 6	Simulate electronic circuits using PSPICE simulation software.	Apply

iv) LIST OF EXPERIMENTS

- Clipping and Clamping circuits using diodes – 2 sessions
- Design and testing of Shunt Zener and Series voltage regulator – 2 sessions
- Frequency response of RC coupled amplifier using BJT in CE configuration
- Frequency response of RC coupled amplifier using JFET in CS configuration
- Determination of Op-amp parameters.
- Design and testing of RC phase shift and Weinbridge oscillator using op-amp - 2 sessions
- Basic op-amp circuits- 3 sessions
- Design of Astable and Monostable Multivibrators using 555 timer IC
- Square wave and Triangular waveform generator using op-amp
- Simulation of electronic circuits using PSPICE software

v) REFERENCES

1) Boylestad R. L. and Nashelsky L., *Electronic Devices and Circuit Theory*, Pearson Education, 10th Edition, 2009.
2) Floyd T. L., *Fundamentals of Analog Circuits*, Pearson Education, 2012.
3) Theraja B. L., Sedha R. S., *Principles of Electronic Devices & Circuits*, S. Chand Limited, 2007.
4) Roy D. C. and Jain S. B., *Linear Integrated Circuits,* New Age International, 3rd Edition, 2010.

vi) COURSE PLAN

Expt. No.	Contents	No. of hours
I	Clipping circuits using diodes	3
II	Clamping circuits using diodes	3
III	Design and testing of shunt Zener voltage regulator	3
IV	Design and testing of Series voltage regulator using Zener diode	3
V	RC coupled amplifier using BJT in CE configuration-Measurement of gain, BW and plotting of frequency response.	3
VI	JFET amplifier - Measurement of gain, BW and plotting of frequency response.	3
VII	Determination of Op-amp parameters.	3
VIII	Phase shift oscillator using Op-amps.	3
IX	Wein's Bridge oscillator using Op-amps.	3
X	Op-amp circuits – Design and set up of inverting and non-inverting amplifier	3
XI	Basic comparator and Schmitt trigger circuits using Op-amp (Use comparator ICs such as LM311).	3
XII	Op-amps circuits – Summer, integrator, and differentiator.	3
XIII	Waveform generation– Square, triangular and sawtooth waveform generation using OPAMPs.	3
XIV	Astable and Monostable circuit using 555 IC.	3
XV	Introduction to circuit simulation using any circuit simulation software.	3
	Total Hours	**45**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	15 marks
CA Exams (1 number)	:	30 marks
Assignment/Project/Case study etc.	:	30 marks
Total	:	**75 marks**

viii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	75	75	3 hours

ix) END SEMESTER EXAMINATION PATTERN

a)	Preliminary work	:	15 marks
b)	Implementing the work/Conducting the experiment	:	20 marks
c)	Performance, result and inference (usage of equipment and troubleshooting):	:	15 marks
d)	Viva voce	:	20 marks
e)	Record	:	5 marks
	Total	**:**	**75 marks**

B.Tech (S3 - MINOR)

Basket	Course Number	Course	L-T-P	Credit
I	EE0M20A	Electric Circuits	3-1-0	4
II	EE0M20B	Introduction to Power Engineering	3-1-0	4
III	EE0M20C	Dynamic Circuits and Systems	4-0-0	4
IV	EE0M20D	Basics of Illumination Science and Lighting Design	4-0-0	4

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

Course Number	Course	L-T-P	Credit
MA0M20A	Advanced Linear Algebra	3-1-0	4

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE0M20A	ELECTRIC CIRCUITS	VAC	3	1	0	4	2020

i) PRE-REQUISITE: Basics of Electrical Engineering / Introduction to Electrical Engineering

ii) COURSE OVERVIEW:

This course deals with circuit theorems applied to DC and AC electric circuits. Steady and transient state response of electric circuits is discussed. Network analysis is introduced with network parameters and transfer functions. This course serves as the most important pre-requisite of many advanced courses in electrical engineering.

iii) COURSE OUTCOMES

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

CO 1	Apply circuit theorems to simplify and solve DC and AC electric networks.	Apply
CO 2	Analyse dynamic DC circuits and develop the complete response.	Apply
CO 3	Analyse coupled circuits in s-domain	Apply
CO 4	Analyse three-phase networks in Y and Δ configurations.	Apply
CO 5	Develop the representation of two-port networks using Z and Y parameter.	Apply

iv) SYLLABUS

Circuit theorems: Review of Nodal and Mesh analysis method. DC and AC circuits analysis with dependent and independent sources applying Network theorems – Superposition theorem, Thevenin's theorem and Norton's theorem.

Steady state and transient response: Review of Laplace Transforms. DC response of RL, RC and RLC series circuits with initial conditions and complete solution using Laplace Transforms - Time constant.

Transformed circuits and analysis – Mutual inductance, coupling coefficient, dot rule. Analysis of coupled coils – mesh analysis and node analysis of transformed circuits in s-domain.

Three phase networks: Three phase power in sinusoidal steady state-complex power, apparent power and power triangle. Steady state analysis of three-phase three-wire and four wire balanced and unbalanced Y circuits, Balanced and unbalanced Delta circuit. Three phase power measurement and two-wattmeter method.

Two port networks: Driving point and transfer functions – Z and Y parameters- Conditions for symmetry & reciprocity – Z and Y parameters. Relationship between Z and Y parameters.

v) (a) TEXT BOOKS

1) Joseph A. Edminister and MahmoodNahvi, "*Theory and Problems in Electric circuits*", McGraw Hill, 5th Edition, 2010.
2) Ravish R. Singh, "*Network Analysis and Synthesis*", McGraw-Hill Education, 2nd Edition, 2019.

(b) REFERENCES

1) Hayt and Kemmerly, "*Engineering Circuit Analysis*", McGraw Hill Education, New Delhi, 8th Edition, 2013.
2) Van Valkenberg, "*Network Analysis*", Prentice Hall India Learning Pvt. Ltd., 3rd Edition, 1980.
3) K. S. Suresh Kumar, "*Electric Circuit Analysis*", Pearson Publications, 1st Edition, 2013.
4) Chakrabarti, "*Circuit Theory Analysis and Synthesis*", Dhanpat Rai & Co., 7th Edition, 2018.
5) B. R. Gupta, "*Network Analysis and Synthesis*", S. Chand & Company Ltd, 3rd Edition, 2013.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Circuit theorems:** Review of Mesh and Nodal analysis methods, Dependent and independent current and voltage sources, Superposition theorem, Thevenin's theorem and Norton's theorem - Application to the analysis of DC and AC circuits with dependent and independent sources.	**14**
II	**Steady state and transient response:** Review of Laplace Transforms – Formulae of Laplace Transforms of common functions/signals, Initial value theorem and final value theorem, Inverse Laplace Transforms – partial fraction method. DC response of RL, RC and RLC series circuits with initial conditions and complete solution using Laplace Transforms - Time constant	**12**
III	**Transformed circuits and analysis:** Mutual inductance and Coupling Coefficient, Dot rule and polarity convention, Mesh analysis of transformed circuits in s-domain, Nodal analysis of transformed circuits in s-domain.	**11**
IV	**Three phase networks:** Three phase power in sinusoidal steady state-complex power, apparent power and power triangle, Steady state analysis of three-phase three-wire and four-wire balanced and unbalanced Y circuits, Steady state analysis of three-phase three-wire and four-wire balanced and unbalanced Delta circuits, Three phase power measurement and two-wattmeter method.	**12**

V	**Two port networks:** Two port networks: Terminals and Ports, Driving point and transfer Functions, Z and Y parameters - Equivalent circuit representation, Conditions for symmetry & reciprocity - Z and Y-parameters, Relationship between Z and Y parameters.	**11**
	Total hours	**60**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	10 marks
CA Exams (2 numbers)	:	25 marks
Assignment/Project/Case study etc.	:	15 marks
Total	:	**50 marks**

viii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE0M20B	INTRODUCTION TO POWER ENGINEERING	VAC	3	1	0	4	2020

i) PRE-REQUISITE: Basics of Electrical & Electronics Engineering

ii) COURSE OVERVIEW: This course introduces various conventional energy sources. This course also introduces the design of transmission system and distributions system. It also introduces the economics of power generation.

iii) COURSE OUTCOMES

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

CO 1	Describe various conventional sources of energy generation	Understand
CO 2	Illustrate the economics of power generation	Apply
CO 3	Illustrate the economics of power factor improvement	Apply
CO 4	Design mechanical parameters of a transmission system.	Apply
CO 5	Design electrical parameters of a transmission system.	Apply
CO 6	Classify different types of ac and dc distribution systems	Understand

iv) SYLLABUS

Generation of power Conventional sources: Hydroelectric Power Plants- Steam Power Plants Diesel Power Plant Gas Turbine Power Plant Nuclear Power Plants.

Economics of power generation Types of loads, Load curve Cost of electrical energy. Power factor improvement.

Transmission system Different types of transmission system, Mechanical design of overhead transmission line. String efficiency- Corona -Sag - calculation.

Electrical design of transmission line Constants of transmission line – Resistance, inductance and capacitance with symmetrical and unsymmetrical spacing.

Distribution system Types of DC distributors – distributor fed at one end and at both ends.

Introduction to types of AC distributors.

Smart Grid – Introduction and architecture.

v) (a) TEXT BOOKS

1) D P Kothari and I Nagrath, "Power System Engineering," 2nd Edition,Tata McGraw Hills, 2008.
2) Wadhwa, “Electrical Power system”, Wiley Eastern Ltd, 2005
3) V K Mehta,Rohit Mehta “ Principles of Power System”,S Chand and Company,4th Edition, 2008.

(b) REFERENCES

1) A.Chakrabarti, M L. Soni, P. V. Gupta, V .S. Bhatnagar, "A text book of Power system Engineering", Dhanpat Rai, 2000.
2) Grainer J.J, Stevenson W.D, "Power system Analysis", McGraw Hill.
3) I. J. Nagarath & D.P. Kothari, "Power System Engineering", TMH Publication.
4) A Stuart Borlase, "Smart Grids, Infrastructure, Technology and Solutions", CRC Press, 2013.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Generation of power Conventional sources: Hydroelectric Power Plants- Selection of site. General arrangement of hydel plant, Components of the plant, Classification of the hydel plants -Water turbines: Pelton wheel, Francis, Kaplan and propeller turbines, Small hydro generation. Steam Power Plants: Working of steam plant, Power plant equipment and layout, Steam turbines Diesel Power Plant: Elements of diesel power plant, applications Gas Turbine Power Plant: Introduction Merits and demerits, selection site, fuels for gas turbines, General arrangement of simple gas turbine power plant, comparison of gas power plant with steam power plants Nuclear Power Plants: Nuclear reaction, nuclear fission process, nuclear plant layout, Classification of reactors.	**12**
II	Economics of power generation Types of loads, Load curve, terms and factors, peak load and base load Cost of electrical energy – numerical problems Power factor improvement – causes of low power factor, disadvantages - methods of power factor improvement, calculations of power factor correction, economics of power factor improvement.	**12**
III	Transmission system Different types of transmission system - High voltage transmission - advantages Mechanical design of overhead transmission line: Main components of overhead lines – types of conductors, line supports Insulators–Types-String efficiency – methods of improving string efficiency Corona – Critical disruptive voltage - Visual Critical Voltage – corona loss - Factors affecting corona, advantages and disadvantages, methods of reducing corona Sag – calculation.	**12**
IV	Electrical design of transmission line Constants of transmission line – Resistance, inductance and capacitance Inductance and capacitance of a single-phase transmission line Inductance and capacitance of a three-phase transmission line with symmetrical and unsymmetrical spacing – transposition of lines.	**12**
V	Distribution system Types of distribution systems Types of DC distributors – calculations – distributor fed at one end and at both ends.	**12**
	Total hours	**60**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	10 marks
CA Exams (2 numbers)	:	25 marks
Assignment/Project/Case study etc.	:	15 marks
Total	:	**50 marks**

viii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE0M20C	DYNAMIC CIRCUITS AND SYSTEMS	VAC	4	0	0	4	2020

i) PRE-REQUISITE: MA0U10B Vector Calculus, Differential Equation and Transforms, ES0U10D Introduction to Electrical and Electronics Engineering

ii) COURSE OVERVIEW: This course introduces the application of circuit analysis techniques to dc and ac electric circuits. Analysis of electric circuits both in steady state and dynamic conditions are discussed. Network analysis using network parameters and transfer functions is also included.

iii) COURSE OUTCOMES

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

CO 1	Apply circuit theorems to simplify and solve complex DC and AC electric networks.	Apply
CO 2	Analyse dynamic DC and AC circuits to develop the complete response to excitations.	Analyse
CO 3	Solve dynamic circuits by applying transformation to s-domain.	Apply
CO 4	Analyse three-phase networks in Y and Δ configurations.	Analyse
CO 5	Solve series /parallel resonant circuits.	Apply

iv) SYLLABUS

Network theorems – DC and AC steady state analysis – Dependent and Independent Sources.

Time domain analysis of dynamic circuits – steady state and transient response analysis – Introduction to Laplace Transform – Application of Laplace transform in series and parallel circuits with step and sinusoidal responses.

Mesh and Nodal analysis of transformed circuits in s-domain- Coupled circuits – Dot convention – Analysis of simple coupled circuits.

Resonance in Series and Parallel RLC circuits.

Two port network – network parameters – interrelationship of network parameters - driving point and transfer immittance function.

v) (a) TEXT BOOKS

1) Joseph. A. Edminister and Mahmood Nahvi, *Electric Circuits*, McGrawHill, 7th Edition, 2017.
2) Ravish R. Singh, *Network Analysis and Synthesis*, McGraw-Hill Education, 2nd Edition, 2019.
3) James W. Nilsson and Susan A. Riedel, *Electric Circuits*, Pearson Education Publications, 9th Edition, 2011.
4) F. F. Kuo, *Network Analysis and Synthesis*, John Wiley Inc Publications, 1966.

(b) REFERENCES

1) Hayt and Kemmerly, *Engineering Circuit Analysis,* McGraw Hill Education, New Delhi, 9th Edition, 2019.
2) Sudhakar and Shyam Mohan, *Circuits and Networks: Analysis and Synthesis*, McGraw Hill Education, 5th Edition, 2015.
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) Van Valkenberg, *Network Analysis*, Prentice Hall India Learning Private Limited, 3rd Edition, 2011.
6) Dr. B.R. Gupta, *Network Analysis and Synthesis*, S. Chand & CompanyLtd, 3rd Edition, 2013.
7) C. A. Desoer, E. S. Kuh*, Basic Circuit Theory*, McGraw-Hill, New York, 1969.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Circuit theorems:** DC and Sinusoidal steady state analysis of circuits with dependent and independent sources applying Superposition principle, Source transformation, Thevenin's, Norton's and Maximum Power Transfer theorems - Reciprocity theorem.	**12**
II	**Analysis of first and second order dynamic circuits:** Formulation of dynamic equations of RL, RC and RLC series and parallel networks with dc excitation and initial conditions and complete solution using Laplace Transforms - Time constant - Complete solution of RL, RC and RLC circuits with sinusoidal excitation using Laplace Transforms – Damping ratio – Over damped, under damped, critically damped and undamped RLC networks.	**13**
III	**Transformed circuits in s-domain:** Transform impedance/admittance of R, L and C – Mesh analysis and node analysis of transformed circuits in s-domain. Transfer Function representation – Poles and zeros. **Analysis of Coupled Circuits: –** Dot polarity convention – Sinusoidal steady state analysis of coupled circuits - Linear Transformer as a coupled circuit - Analysis of coupled circuits in s-domain.	**11**
IV	**Resonance in Series and Parallel Circuits:** Resonance in Series and Parallel RLC circuits – Quality factor – Bandwidth – Impedance Vs Frequency, Admittance Vs Frequency, Phase angle Vs frequency for series resonant circuit.	**12**
V	**Two port networks:** Driving point and transfer functions – Z, Y, h and T parameters - Conditions for symmetry & reciprocity – relationship between parameter sets – interconnections of two port networks (series, parallel and cascade) — T-π transformation.	**12**
	Total hours	**60**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	10 marks
CA Exams (2 numbers)	:	25 marks
Assignment/Project/Case study etc.	:	15 marks
Total	:	**50 marks**

viii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EETM20D	BASICS OF ILLUMINATION SCIENCE AND LIGHTING DESIGN	VAC	4	0	0	4	2020

i) PRE-REQUISITE: NIL

ii) COURSE OVERVIEW

Main goal of this course is to introduce basics of illumination technology and lighting design aspects to students. Also enable them to understand lighting design considerations for interior and exterior applications. This course will impart knowledge about energy efficient lighting and get detailed insight of indoor and outdoor illumination system components and its controls.

iii) COURSE OUTCOMES

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

CO 1	Compare different types of lighting schemes; different artificial light sources.	Understand
CO 2	Apply Laws of Illumination to calculate the illuminance level at a point.	Apply
CO 3	Choose lamps based on its application in indoor and outdoor work places.	Understand
CO 4	Design the layout of the luminaries based on the design standards and design factors that determine the indoor and outdoor lighting.	Apply
CO 5	Select suitable control methods for lighting and demonstrate various features of aesthetic lighting.	Apply

iv) SYLLABUS

Light, sight & colour - Sources of light - Methods of artificial lighting - Lighting schemes - Lighting systems - Quality of lighting - Good Practices in Lighting

Measurement of light - Lamp efficiency - Concept of polar curve - Laws of illumination - Lighting calculations - Photometric data sheets - National Lighting Code 2010

The balance of lighting in indoor and outdoor workplaces – Daylight - Task lighting - Glare - Specular reflection - Sunlight shading - Light sources - Introduction to LED Lighting

Design of Interior and Outdoor lighting- Indian Standards - Selection of appropriate lamps - Calculation and Layout of luminaires.

Features of Interior Lighting - Lighting Control - Daylight sensors and occupancy sensors - Features of Aesthetic Lighting - Computer Aided Lighting design.

v) (a) TEXT BOOKS

1) Pritchard D.C., *Lighting*, Routledge, 6th Edition, 2014.

2) Jack L. Lindsey, FIES, Scott C. Dunning, *Applied Illumination Engineering*, Fairmont Press, 3th Edition, 2015.

(b) REFERENCES

1) Giridharan M. K., *Electrical Systems Design*, I K International Publishers, New Delhi, 2nd Edition, 2016.
2) Rüdiger Ganslandt, Harald Hofmann, *Handbook of Lighting*, ERCO Edition, 1997.
3) John Matthews, *Introduction to the Design and Analysis of Building Electrical Systems*, Springer, 1993.
4) SLL *Lighting Handbook*, CIBSE, 2018.
5) Cayless M. A., *Lamps and Lighting*, Routledge, 1996.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Light, sight & colour: Sources of light - Day light, artificial light sources - energy radiation, visible spectrum of radiation. Incandescence, dependence of light output on temperature. Perception of light and colour - optical system of human eye - eye as visual processor. Quality of lighting- visual comfort, visual performance, safety, shadow, glare, reflection, colour rendering, colour appearance and stroboscopic effect Methods of artificial lighting: Lighting systems- direct, indirect, semi direct, semi indirect, Lighting schemes-ambient, task, accent lighting. General and localised- Artificial lighting as substitute to natural light. Good Practices in Lighting.	11
II	Measurement of light: Luminous flux, Luminous intensity, Lumen, Illuminance, Luminance, Candle power- M.H.C.P, M.S.C.P - Lamp efficiency. Concept of polar curve - Laws of illumination - Inverse square law and Lambert's Cosine law. Lighting calculations- Point by point method and Average Lumen method. Photometric data sheets- Finding Lux using Lux meters - Indian standard recommendation and standard practices for illumination levels in various areas – National Lighting Code 2010.	11
III	Balance of lighting in indoor and outdoor workplaces: Daylight- Room brightness- Task lighting - Glare - Specular reflection - Balance of daylight and electrical light- Colour appearance of lamps - Sunlight shading. Light sources: Different types of lamps and its evolution - Incandescent lamp - Fluorescent Lamp, Compact Fluorescent Lamp (CFL). Sodium Vapour lamp, Metal halide Lamps, Argon Neon lamps for signboards. Introduction to LED Lighting.	11
IV	Design of Interior Lighting: Interior Lighting Design Standards - Maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilisation and factors affecting it - Illumination required for various work planes, Space to mounting height ratio (SHR) - DLOR and	13

	ULOR - Selection of lamp and luminance - Selection of utilisation factor, reflection factor and maintenance factor - Calculation of wattage of each lamp and no of lamps needed - Layout of luminaires. Design of Outdoor Lighting: Street Lighting. Flood lighting- Beam angle- Selection of lamp and projector- Recommended method for aiming of lamp- Calculation of SHR.	
V	Special features of Interior Lighting: Entrance, corridors, industrial buildings. Introduction to Lighting Controls - Methods of control, Selection of Lighting Controls - Dimmers for various lamps - Daylight sensors and occupancy sensors. Special Features of Aesthetic Lighting: Monument and statue lighting, Sports lighting, Hospital lighting, Auditorium lighting, Facade Lighting, Retail Lighting. Computer Aided Lighting design: Role of computers in design - Softwares used for lighting design.	**14**
	Total hours	**60**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	10 marks
CA Exams (2 numbers)	:	25 marks
Assignment/Project/Case study etc.	:	15 marks
Total	:	**50 marks**

viii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
MA0M20A	ADVANCED LINEAR ALGEBRA	VAC	3	1	0	4	2020

i) PRE-REQUISITE: A basic course in matrix algebra.

ii) COURSE OVERVIEW

This course introduces the concept of a vector space which is a unifying abstract frame work for studying linear operations involving diverse mathematical objects such as n-tuples, polynomials, matrices and functions. Students learn to operate within a vector and between vector spaces using the concepts of basis and linear transformations. The concept of inner product enables them to do approximations and orthogonal projections and with them solve various mathematical problems more efficiently.

iii) COURSE OUTCOMES

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

CO 1	Identify many of familiar systems as vector spaces and find their basis and dimension.	Apply
CO 2	Use linear transformations and its characteristics to solve problems.	Apply
CO 3	Finding orthonormal basis and orthogonal projections using the concept of real and complex inner product spaces.	Apply
CO 4	Compute Eigen values, Eigen vectors and Diagonalize matrices.	Apply
CO 5	Apply the concept of vector spaces to decompose complex matrices into simpler components, find least square approximations, solution of systems of differential equations etc.	Apply

iv) SYLLABUS

Vector Spaces, Subspaces - Linear independence of vectors, Linear span, Bases and dimension, Co-ordinate representation of vectors. Row space, Column space and null space of a matrix.

General linear transformation, Matrix of transformation. Kernel and range of a linear mapping - Rank Nullity theorem. Change of basis, Isomorphism.

Inner Product: Real and complex inner product spaces, Cauchy-Schwarz inequality, Orthogonality, Orthonormal basis, Gram Schmidt orthogonalization process. Orthogonal projection. Orthogonal subspaces, orthogonal compliment and direct sum representation.

Eigen values, eigenvectors and eigen spaces of linear transformation and matrices, exponential of a matrix, Diagonalization of matrices, Power method for finding dominant eigen value.

LU decomposition, QR Decomposition -Singular value decomposition -Least square solution -Curve fitting -Solving systems of differential equations.

v) (a) TEXT BOOKS

1) Richard Bronson, Gabriel B. Costa, *Linear Algebra-an introduction,* 2nd Edition, Academic press, 2007.
2) Howard Anton, Chris Rorres, *Elementary linear algebra: Applications versio,* 9th Edition, Wiley.

(b) REFERENCES

1) Gilbert Strang, Linear Algebra and It's Applications, 4th Edition, Cengage Learning, 2006.
2) Seymour Lipschutz, Marc Lipson, Schaum's outline of linear algebra, 3rd Edition., Mc Graw Hill,2017
3) David C Lay, Linear algebra and its applications,3rd Edition, Pearson.
4) Stephen Boyd, Lieven Vandenberghe, Introduction to Applied Linear Algebra: Vectors, Matrices,and Least Squares, Cambridge University Press, 2018
5) W. Keith Nicholson, Linear Algebra with applications, 4th Edition, McGraw-Hill,2002.

(v) COURSE PLAN

Module	Contents	No. of hours
I	Vector spaces, Definition and examples -Subspaces -Linear dependence, Basis, dimension - Row space, column space, rank of a matrix – Co- ordinate representation.	**12**
II	General linear transformation, matrix representation of linear transformation, Kernel and range of a linear mapping - Properties of linear transformations, Rank Nullity theorem. Change of basis, Isomorphism, Inverse transformations.	**12**
III	Inner Product: Real and complex inner product spaces, Properties of inner product, length and distance - Triangular inequality, Cauchy-Schwarz inequality - Orthogonality, Orthogonal complement, Orthonormal bases, Gram Schmidt orthogonalization process, orthogonal projection - Direct sum representation.	**12**
IV	Eigen values and Eigen vectors of a linear transformation and matrices, Properties of Eigen values and Eigen vectors, Diagonalization, orthogonal diagonalization, Power method, Diagonalizable linear transformation. Evaluation of exponential of a matrix in the diagonalizable case.	**12**
V	Matrix decompositions: LU-decomposition, QR-decomposition, Singular value decomposition, Least squares solution of inconsistent linear systems, curve-fitting by least square method, solution of linear systems of differential equations by diagonalization.	**12**
	Total hours	**60**

vi) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	10 marks
CA Exams (2 numbers)	:	25 marks
Assignment/Project/Case study etc.	:	15 marks
Total	:	**50 marks**

vii) MARK DISTRIBUTION

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours