CURRICULUM AND DETAILED SYLLABI

FOR

B. TECH DEGREE PROGRAMME

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTERS III & IV

2022 SCHEME

(AUTONOMOUS)

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY
(Approved by AICTE, Autonomous Institution Affiliated to APJ Abdul Kalam Technological University)
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MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B. TECH DEGREE PROGRAMME

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM AND DETAILED SYLLABI

Items	Board of Studies (BOS)	Academic Council (AC)
Date of Approval	22.02.2023	20.03.2023

Sd/-

Head of Department
Chairman, Board of Studies

Sd/-

Principal
Chairman, Academic Council

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

Vision and Mission of the Institution

Vision:

To be an Institution moulding globally competent professionals as epitomes of Noble Values.

Mission:

To transform the Youth as technically competent, ethically sound and socially committed professionals, by providing a vibrant learning ambience for the welfare of humanity.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Vision and Mission of the Department

Vision:

To be a Centre of Excellence in Electrical & Electronics Engineering Education, Research and Application of knowledge to benefit the society at large.

Mission:

To mould quality Electrical Engineers, fostering creativity and innovation to address global issues.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates will succeed as Professionals in Industry or as Entrepreneurs in Electrical and Electronics Engineering and related disciplines.

PEO2: Graduates will be able to adapt to the advances in Technology by continuously acquiring knowledge and skills, with an urge for innovation.

PEO3: Graduates will be socially committed individuals, exhibiting professional ethics in addressing technical and engineering challenges.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will have the ability to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Engineering Graduates will have the ability:

1. To apply the knowledge in Electrical and Electronics Engineering for the design of Power Generation, Transmission, Distribution and Utilization systems.
2. To demonstrate the knowledge required to design, develop, test, and implement Electrical & Electronic systems.

CURRICULUM

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech. Programme in Electrical and Electronics Engineering

For the students admitted from Academic Year 2022-23

SEMESTER III						
Slot	**Cate-gory**	**Course Code**	**Courses**	**L-T-P**	**Hours**	**Credit**
A	BSC	MA0U20A	Partial Differential Equation and Complex Analysis	3-1-0	4	4
B	PCC	EE1U20B	Measurements and Instrumentation	3-1-0	4	4
C	PCC	EE1U20C	Analog Electronics	3-1-0	4	4
D	PCC	EE1U20F	Digital Electronics	3-1-0	4	4
E	ESC	ES0U20A	Design and Engineering	2-0-0	2	2
F	MNC	NC0U20B	Constitution of India	2-0-0	2	-
S	PCC	EE1U28B	Analog Electronics Lab	0-0-3	3	2
T	PCC	EE1U28D	Digital Electronics Lab	0-0-3	3	2
R/M	VAC		Remedial/Minor Course	4-0-0/ 3-1-0	4	4
				TOTAL	**26/30**	**22/26**

SEMESTER IV						
Slot	**Cate-gory**	**Course Code**	**Courses**	**L-T-P**	**Hours**	**Credit**
A	BSC	MA0U20C	Probability, Random Processes and Numerical Methods	3-1-0	4	4
B	PCC	EE1U20A	Circuits and Networks	2-2-0	4	4
C	PCC	EE1U20D	DC Machines and Transformers	3-1-0	4	4
D	PCC	EE1U20G	Microcontroller and Applications	3-1-0	4	4
E	HSC	HS0U20A	Professional Ethics	2-0-0	2	2
F	MNC	NC0U20C	Universal Human Values	2-0-0	2	-
S	PCC	EE1U28A	Circuits and Measurements Lab	0-0-3	3	2
T	PCC	EE1U28F	Microcontroller Lab	0-0-3	3	2
R/M/H	VAC		Remedial/Minor/Honours Course	4-0-0/ 3-1-0	4	4
				TOTAL	**26/30**	**22/26**

B.Tech (MINOR)

Semester	BASKET I				BASKET II				BASKET III				BASKET IV			
	Embedded Systems for Industrial Applications				Architectural Lighting and Electrical System Design				Clean and Sustainable Energy				Electric Vehicle Systems			
	Course Code	Course	L-T-P	Credit	Course Code	Course	L-T-P	Credit	Course Code	Course	L-T-P	Credit	Course Code	Course	L-T-P	Credit
S3	EE0M20I	Micro Controllers and Embedded Systems	4-0-0	4	EE0M20J	Basics of Illumination Science and Lighting Design	4-0-0	4	EE0M20K	Sustainable Energy Systems	4-0-0	4	EE0M20L	Electric Machinery	4-0-0	4
S4	EE0M20M	Hardware Interfacing using Arduino -C Platform	4-0-0	4	EE0M20N	Electric Power Supply and Distribution Systems	4-0-0	4	EE0M20P	Renewable Energy in Power Grids	4-0-0	4	EE0M20Q	Power Electronics and Energy Storage Devices	4-0-0	4

BTech (HONOURS)

Semester	GROUP I				GROUP II				GROUP III			
	Course Code	Course	L-T-P	Credit / Credit	Course Code	Course	L-T-P	Credit	Course Code	Course	L-T-P	Credit
S4	EE1H20A	Network Analysis and Synthesis	3-1-0	4	EE1H20A	Network Analysis and Synthesis	3-1-0	4	EE1H20A	Network Analysis and Synthesis	3-1-0	4

SYLLABUS

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	2022

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:

CO1	Solve partial differential equations.	Apply
CO2	Use appropriate methods to solve one dimensional wave equation and heat equation.	Apply
CO3	Solve problems using analyticity of complex functions.	Apply
CO4	Construct the image of regions under conformal mapping.	Apply
CO5	Apply Cauchy's integral formula to evaluate complex integrals.	Apply
CO6	Develop complex functions as infinite series expansion.	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 - Laplace's equations - Derivation and solution 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
EE1U20B	MEASUREMENTS AND INSTRUMENTATION	PCC	3	1	0	4	2022

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:

CO1	Compare the different types of measuring instruments, their construction, operation and characteristics.	Understand
CO2	Explain the construction and working of Watt meters, Energy meters and DC potentiometers.	Understand
CO3	Use different bridges to measure the Resistance, Inductance and Capacitance	Apply
CO4	Illustrate the methods for magnetic measurement, high voltage and high current measurements.	Apply
CO5	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's 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, Wheatstone's bridge - loss of charge method, measurement of earth resistance. Measurement of self-inductance-Maxwell's Inductance bridge, Measurement of capacitance –	12

	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	2022

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:

CO1	Explain the various wave shaping circuits using diodes and biasing circuits for BJT.	Understand
CO2	Construct BJT and FET amplifier circuits.	Apply
CO3	Explain the various multistage, power and feedback amplifiers	Understand
CO4	Build oscillator circuits using BJT.	Apply
CO5	Identify Op-Amp circuits for various applications.	Apply
CO6	Develop 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. BJT Amplifier - Common Emitter amplifier- h parameter model.

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, 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 stabilization. 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 source amplifier. **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. 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.	**12**
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.	**11**

	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.	
V	**OP- AMP Circuits:** Differentiator and Integrator circuits-practical circuits – Design –Comparators: Zero crossing and voltage level detectors, Schmitt trigger. **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
EE1U20F	DIGITAL ELECTRONICS	PCC	3	1	0	4	2022

i) PRE-REQUISITE: Nil

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:

CO1	Classify various number systems, binary codes and formulate digital functions using Boolean algebra.	Apply
CO2	Construct various Combinational logic circuits.	Apply
CO3	Model various Sequential logic circuits.	Apply
CO4	Compare the operation of various analog to digital and digital to analog conversion circuits.	Understand
CO5	Explain the basic concepts of Programmable Logic devices and VHDL	Understand

iv) SYLLABUS

Introduction to various number representations –Signed numbers- representation, addition and subtraction, Fixed point and floating-point representation. Error detection and correction, A/D and D/A converter, Comparison of CMOS and TTL performance of Logic gates

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

Programmable Logic Devices - ROM, PLA, PAL, FPGA - VHDL Coding.

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, 5th Edition, 2018.

(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, Analog to Digital Converter. Programmable Logic Devices - PAL, PLA, FPGA (basic concepts). Introduction to Verilog - Implementation of logic gates and combinational circuits.	**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
ES0U20A	DESIGN ENGINEERING	ESC	2	0	0	2	2022

i) PRE-REQUISITE: Nil.

ii) COURSE OVERVIEW: The 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:

CO1	Demonstrate the different stages involved in design engineering process	Understand
CO2	Compose a problem statement with design objectives taking into account the customer requirements, design constraints and functionality.	Create
CO3	Develop innovative solutions to the Design problem through brainstorming and ideation.	Apply
CO4	Identify the concepts of Biomimicry, Aesthetics and Ergonomic factors in designs to add more value to it.	Apply
CO5	Apply the Design communication tools to model an idea.	Apply
CO6	Apply 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", 3rd Edition, Cengage Learning, 2017.
2) Linda C. Schmidt, George Dieter, "Engineering Design", McGraw Hill Education; 4th Edition, 2017.
3) Pavan Soni, "Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-Solving", Penguin Random House India Private Limited, 2022.
4) Voland, G., "Engineering by Design", Pearson India, 2nd Edition, 2014.

(b) REFERENCES

1) Clive L Dym, Engineering Design: "A Project Based Introduction", 4th 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 Edition, 2019.
3) Don Norman, "The Design of Everyday Things", Basic Books; 2nd Edition, 2013.
4) Dominique Forest, "Art of Things: Product Design Since 1945", Abbeville Press Inc.,U.S.; Special Edition, 2014.
5) Javier Abarca, Al Bedard, et al, "Introductory Engineering Design – A Projects-Based Approach", 3rd Edition, Regents of the University of Colorado, 2000.
6) Nigel Cross, "Design Thinking: Understanding How Designers Think and Work", Berg Publishers, 2011, 1st Edition, ISBN: 978-1847886361.
7) Pahl, G., Beitz, W., Feldhusen, J., Grote, K. H., "Engineering Design: A Systematic Approach", Springer 2007, 3rd Edition, ISBN 978-1-84628-319-2.
8) George Dieter, "Engineering Design: A Materials and Processing Approach", McGraw-Hill Education / Asia; 3rd Edition, 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**

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
NC0U20B	CONSTITUTION OF INDIA	MNC	2	0	0	---	2022

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW:

The study of the Constitution of India enables the students to

1) Understand the fundamental rights and 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.

iii) COURSE OUTCOMES

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

CO1	Explain the historical background of the constitution of India and its features.	Understand
CO2	Describe the fundamental rights, duties and directive principles of state policy.	Understand
CO3	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
CO5	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, 51th 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 background, 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	**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
EE1U28B	ANALOG ELECTRONICS LAB	PCC	0	0	3	2	2022

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:

CO1	Choose suitable electronic components according to the given requirements.	Apply
CO2	Develop and test voltage regulator using Zener diodes.	Apply
CO3	Construct and test amplifier circuits using BJT and JFET.	Apply
CO4	Model and test oscillator circuits using BJT and Op-amp.	Apply
CO5	Build and test various waveform generation circuits using Op-amps, Comparators and 555 timer IC packages.	Apply
CO6	Utilize simulation software to simulate electronic circuits.	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.	List of exercises/Experiments	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.	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 Exam (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
EE1U28D	DIGITAL ELECTRONICS LAB	PCC	0	0	3	2	2022

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:

CO1	Construct digital functions using Boolean Algebra and verify experimentally.	Apply
CO2	Develop combinational logic circuits.	Apply
CO3	Model sequential logic circuits.	Apply
CO4	Develop VHDL programs for combinational circuits	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

Expt 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 Johnson counter.	3
XV	VHDL implementation of full adder, 4 bit magnitude comparator	3
	Total hours	**45**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	15 marks
CA Exam (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	2½ 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 MINORS

Basket	Course Code	Course Name	L-T-P	Credits
I	EE0M20I	Microcontrollers and Embedded Systems	4-0-0	4
II	EE0M20J	Basics of Illumination Science and Lighting Design	4-0-0	4
III	EE0M20K	Sustainable Energy Systems	4-0-0	4
IV	EE0M20L	Electric Machinery	4-0-0	4

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE0M20I	MICROCONTROLLERS AND EMBEDDED SYSTEMS	VAC	4	0	0	4	2022

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW: The aim of this course is to introduce embedded C programs. Students will be familiarized with 8051 microcontroller and will get an overview of what an embedded system is. This course also provides a brief introduction to various open-source prototyping platforms.

iii) COURSE OUTCOMES

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

CO1	Describe the concepts of an Embedded system.	Understand
CO2	Compare Microprocessor and Microcontroller and explain the architecture of 8051.	Understand
CO3	Develop 8051 Embedded C programs for Data Operations and Timer/Counter.	Apply
CO4	Construct 8051 Embedded C programs for Serial Communication and Interfacing.	Apply
CO5	Explain different Open-Source Prototyping platforms.	Understand

iv) SYLLABUS

Overview of Embedded Systems: Characteristics, Architecture, Categories, Design process, Challenges, Trends.

Introduction to Microprocessor and Microcontrollers, 8051 architecture.

8051 programming in C – I/O programming, programming on Data Conversions, Timer/Counter programs, 8051 embedded c serial communication programs, Interfacing of ADC, DAC, LCD, DC motor.

Introduction to different open-source prototyping platform - Arduino, Raspberry Pi, Galileo.

v) (a) TEXT BOOKS

1) Mohammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Pearson, 2nd Edition,2007.
2) Kenneth J. Ayala, The 8051 Microcontroller Architecture, Programming and Application, Cengage Learning, 3rd Edition,2012.
3) Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson Education, 2nd Edition, 2012.

(b) REFERENCES

1) Shibu K. V., “Introduction to Embedded Systems”, 2nd Edition, McGraw Hill Education India, 2016.

2) Uday Shankar V., Mallikarjun Swamy, "The 8051 Microcontroller", McGraw Hill, 2009.
3) Dr. Uma Rao K., Dr. Andhe Pallavi, "The 8051 Microcontroller", Sanguine, 2009.
4) Steve Heath, "Embedded Systems Design", Newnes, 2nd Edition, 2002.
5) Simon Monk, "Programming Arduino", Mc Graw Hill, 2nd Edition.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Overview of Embedded System**: Definition, Application areas, Design of embedded systems, Recent trends and challenges in embedded systems. Brief introduction to embedded microcontroller cores CISC, RISC, ARM, DSP and SoC.	**12**
II	**Microprocessors and microcontroller-** Introduction, Microprocessors and Microcontrollers, RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture.8051 Architecture - Introduction, 8051 Microcontroller Hardware, Pin diagram, Memory organisation, External memory interfacing, Stack.	**12**
III	**8051 Programming in C:** Data types and time delays in 8051C, I/O programming, logic operations, data conversion programs, accessing code ROM space, data serialization. **Timer / Counter Programming in 8051**: Programming 8051 Timers, Counter Programming, programming timers 0 and 1in 8051C.	**12**
IV	**8051 Serial Communication:** Basics of Serial Communication, 8051 connections to RS-232, 8051 Serial communication Programming, Programming the second serial port, Serial port programming in C. **8051 Interfacing and Applications:** Interfacing 8051 to LCD, Keyboard, parallel and serial ADC, DAC, Stepper motor interfacing, DC motor interfacing and PWM.	**12**
V	**Introduction to Open-source prototyping platforms**: Arduino, Raspberry Pi, ARM Cortex, Intel Galileo, Basic Arduino programming; Extended Arduino libraries; Arduino-based Internet communication; Raspberry pi; ARM Cortex Processors; Intel Galileo boards; Sensors and Interfacing: Temperature, Pressure, Humidity.	**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
EE0M20J	BASICS OF ILLUMINATION SCIENCE AND LIGHTING DESIGN	VAC	4	0	0	4	2022

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW: The 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:

CO1	Compare different types of lighting schemes; different artificial light sources.	Understand
CO2	Apply Laws of Illumination to calculate the illuminance level at a point.	Apply
CO3	Choose lamps and luminaires for specific application.	Apply
CO4	Design interior and exterior lighting systems.	Apply
CO5	Choose 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) D.C. Pritchard, “Lighting”, Routledge, 6th Edition, 2014.
2) Jack L. Lindsey, FIES, Scott C. Dunning, “Applied Illumination Engineering”, Fairmont Press, 3rd Edition, 2015.

(b) REFERENCES

1) M. K. Giridharan, “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) M.A. Cayless, "Lamps and Lighting", Routledge, 1996.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Light, sight and 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 localized - 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.	10
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 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 design- Flood lighting- Beam angle- Selection of lamp and projector	15
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.	13

	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.	
	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
EE0M20K	SUSTAINABLE ENERGY SYSTEMS	VAC	4	0	0	4	2022

i) PRE-REQUISITE: Nil.

ii) COURSE OVERVIEW: The aim of this course is to introduce the students about current and potential future energy system, extraction, conversion and applications, with emphasis on meeting regional and global energy needs in sustainable manner and also have an increased awareness on issues in the areas of sustainability.

iii) COURSE OUTCOMES

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

CO1	Explain the concept and need of sustainability.	Understand
CO2	Explain the classification of energy sources, potentials, achievements and applications.	Understand
CO3	Illustrate production of energy from solar and wind.	Understand
CO4	Discuss energy sources like biomass, tides, ocean, geothermal and hydro.	Understand
CO5	Explain the concept of various types of energy storage systems.	Understand

iv) SYLLABUS

Energy Fundamentals- Sustainability, Need and concept of sustainability, Social, environmental and economic sustainability concepts.

General classification of energy- Conventional and non-conventional, Global and Indian energy sources.

Solar and Wind Energy- Applications- Merits and demerits-Global uptake and future possibilities of solar and wind energy.

Production of ocean, geothermal and hydro energy –Energy conversion- Global and Indian scenario- Global uptake and future possibilities of ocean, geothermal and hydro energy.

Energy production from biomass and wastes-Biomass resources- Biomass conversion technologies- Fuel cells- types and applications.

Energy Storage and Conservation - Characteristics and uses of Energy Storage System- Energy Conservation Methods-Case Studies.

v) (a) TEXT BOOKS

1) Boyle, Godfrey, “Renewable Energy”, 3rd Edition, Oxford University Press, 2012.
2) Bansal N. K., Kleemann M., Michael Meliss, “Renewable Energy Sources & Conversion Technology”, Tata McGraw Hill publishing Company, New Delhi 1990.
3) Rai G. D., “Non-conventional Energy Sources”, Khanna Publishers, 2011.

(b) REFERENCES

1) Gary L. Johnson, “Wind Energy System”, Prentice Hall Inc, 1995.
2) Earnest J., Wizelius T., “Wind Power Plants and Project Development”, PHI Learning Pvt Ltd, 2nd Edition, 2015.

3) Rai G. D., "Solar Energy Utilization", Khanna Publishers, 1995.
4) Sayigh A. A. M., "Solar Energy Engineering", Academic Press, 1977.
5) Abbasi S. A., Abbasi N., "Renewable Energy Sources and Their Environmental Impact", Prentice Hall of India, 2001.
6) Khan B. H., "Non-Conventional Energy Resources", Tata McGraw Hill, 2009.
7) Sawhney G. S., "Non-Conventional Energy Resources", PHI Learning, 2012.
8) Allen D. T., Shonnard D. R., "Sustainability Engineering: Concepts, Design and Case Studies", Pearson; Illustrated Edition, 2011.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Introduction and Energy Fundamentals**- Sustainability, Need and concept of sustainability, Social, environmental and economic sustainability concepts, Sustainable development, Challenges for sustainable development-Increasing energy demand and climate change **General classification of energy**- Conventional and non-conventional, Global and Indian energy sources, Environmental aspects of energy utilization, Energy planning, Renewable energy sources, potentials, achievements and applications	**12**
II	**Solar Energy**- Solar radiation, Solar thermal systems-Flat plate and concentrating collectors, Solar desalination, Solar pond, Solar dryers, Solar cookers, Solar thermal electric power plant, Solar photovoltaic conversion, Merits and limitations of solar energy **Wind Energy** – Availability of wind energy, Site characteristics, Wind turbine types, Wind power plants, Merits and limitations of wind energy Carbon footprint, global uptake and future possibilities for solar and wind energy	**12**
III	**Production of ocean, geothermal and hydro energy**-Ocean thermal electrical conversion, Tidal energy conversion Geothermal energy conversion -Hydropower-Global and Indian scenario - Positive and negative attributes of hydropower-Electricity from hydropower - Small hydroplants. Carbon footprint, global uptake and future possibilities for ocean, geothermal and hydropower.	**12**
IV	**Energy production from biomass and wastes**-Biomass resources, Biomass conversion technologies- direct combustion, pyrolysis, biomass gasification, Biogas production, Bioethanol, Biodiesel, Hydrogen as fuel, Biohydrogen production, Storage of hydrogen, Carbon footprint, global uptake and future possibilities for bioenergy. **Fuel cells**-types and applications.	**12**
V	**Energy Storage and Conservation** - Characteristics & uses of Energy Storage System- Flywheel storage, Compressed air storage, Battery Storage, Pumped Hydro Energy Storage-Energy Conservation Methods **Case Studies** – Sustainability assessment of conventional energy systems, Sustainability assessment of alternative energy systems.	**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
EE0M20L	ELECTRIC MACHINERY	VAC	4	0	0	4	2022

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

ii) COURSE OVERVIEW: The goal of this course is to expose students to the fundamental concepts of DC machines, transformers, induction motors and synchronous machines including constructional details, principle of operation, performance and applications. 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:

CO1	Explain the principle of operation and characteristics of DC machines.	Understand
CO2	Apply emf equation and power flow equations to solve problems of DC Machines.	Apply
CO3	Develop the phasor diagram and equivalent circuit of a transformer, and to calculate its losses and efficiency.	Apply
CO4	Discuss principle of operation and types of three phase and single-phase Induction motors.	Understand
CO5	Illustrate the principle of operation of alternators and synchronous motors and to compute regulation of alternators.	Understand

iv) SYLLABUS

DC generators: principle of operation -emf equation-types of excitations- armature reaction, OCC.

Principle of operation of DC motors - torque and speed equations- characteristics- applications of DC shunt, series and compound motors - starters - losses and efficiency – load test.

Transformers – principle of operation – emf equation- phasor diagram- losses and efficiency – OC and SC tests - equivalent circuits - maximum efficiency – all day efficiency – auto transformers.

Three phase induction motors- types - principle of operation – torque slip characteristics- no load and blocked rotor tests - Circle diagram - methods of starting.

Single phase Induction motor- principle of operation - resistance split phase motor – capacitor start motor.

Synchronous machines: construction– emf equation of alternator – regulation of alternator by emf method - synchronous motors- methods of starting- V curves, synchronous condenser.

v) (a) TEXT BOOKS

1) Bhimbra P. S., “Electric Machines”, Khanna Publishers, 2nd Edition, 2017.
2) Kothari D. P. and I. J. Nagrath, “Electrical Machines”, Tata McGraw Hill, 2004.

3) Fitzgerald A. E., Kingsley C. and Umans S., "Electric Machinery", McGraw Hill, 6th Edition, 2003.
4) Mehta V. K. and R. Mehta, "Principles of Electrical and Electronics", S. Chand & Company Ltd., 1996.

(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) Theraja B. L. and A. K. Theraja, "A Text Book of Electrical Technology", S. Chand & Company Ltd., 2008.
4) S.K. Bhattacharya, "Electrical Machines", Tata McGraw-Hill Publishing Company Limited, New Delhi.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**DC generators**: Principle of operation -emf equation-types of excitations. Separately excited, shunt and series excited DC generators, compound generators. Concept of armature reaction-OCC and load characteristics-Power flow diagram - simple numerical problems.	**12**
II	**DC motors:** Principle of operation-torque and speed equations-characteristics of DC motors- applications of DC shunt, series and compound motors - concept of starters - Power flow diagram – losses and efficiency– load test- simple numerical problems.	**12**
III	**Transformers** – principle of operation – emf equation- phasor diagram-losses and efficiency – OC and SC tests - equivalent circuits - maximum efficiency –regulation- all day efficiency -simple numerical problems- auto transformers.	**12**
IV	**Three phase induction motors**- slip ring and squirrel cage types - principle of operation – rotating magnetic field- torque slip characteristics- no load and blocked rotor tests - Circle diagram - methods of starting – star-delta starting, auto transformer starting, rotor resistance starting.	**12**
V	**Single phase Induction motor**- principle of operation of single-phase induction motors – double field revolving theory- types -resistance split phase motor – capacitor start motor- capacitor start run motor. **Synchronous machines**: construction– emf equation of alternator – regulation of alternator by emf method. Principles of operation of synchronous motors- methods of starting- V curves, synchronous condenser.	**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

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	2022

i) PRE-REQUISITE: MA0U10B: Vector Calculus, Differential Equations and Transforms.

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 familiarizes 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:

CO1	Identify the different discrete random experiments and find the probabilities of their occurrence.	Apply
CO2	Identify the different continuous random experiments and find the probabilities of their occurrence.	Apply
CO3	Examine random processes using autocorrelation, power spectrum and Poisson process model as appropriate.	Apply
CO4	Find roots of equations, definite integrals and interpolating polynomial on given numerical data using standard numerical techniques.	Apply
CO5	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, 10th 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.probabilitycourse.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 - Numerical Integration - Trapezoidal rule and Simpson's 1/3rd rule with proof (derivation of other methods/ formulae not required in this module).	**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. Linear Correlation-Basic ideas of Multiple regression. Solution of ODE-Euler, Modified Euler and Classical Runge - Kutta methods of second and fourth order, Adams-Moulton predictor-corrector methods.	**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	2022

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 is to expose students to the fundamental concepts of AC and DC circuits, enhance the problem-solving skills by using various techniques to solve different types of 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 obtain responses in complex DC and AC electric networks.	Apply
CO2	Solve DC and AC circuits to obtain the complete response to various excitations.	Apply
CO3	Solve dynamic circuits by applying transformation to s-domain.	Apply
CO4	Solve series /parallel resonant circuits.	Apply
CO5	Develop two-port network representation using network parameters.	Apply

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, 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., 7th Revised 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, 3rd Edition, 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	Review of circuit elements, fundamental laws, AC representation. Circuit theorems: Thevenin theorem, Norton's theorem, Superposition theorem, Maximum Power transfer Theorem, Reciprocity theorem. DC and Sinusoidal steady state analysis of circuits with dependent and independent sources.	**12**
II	Time domain analysis of first and second order dynamic circuits: Formulation of dynamic equations of RL, RC and RLC 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.	**12**
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.	**12**
IV	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. 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-pi 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
EE1U20D	DC MACHINES AND TRANSFORMERS	PCC	3	1	0	4	2022

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

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:

CO1	Describe the construction, principle of operation and types of DC Machines.	Understand
CO2	Explain the performance characteristics and speed control of DC Motors.	Understand
CO3	Explain the principle of operation and compute the efficiency of transformers.	Understand
CO4	Develop the phasor diagram and equivalent circuit of a transformer and predetermine the regulation.	Apply
CO5	Select 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,2010.

(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,2016.
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 – demagnetizing and cross magnetizing 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 – 3 point 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, magnetizing 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.	12

	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.	
	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
EE1U20G	MICROCONTROLLER AND APPLICATIONS	PCC	3	1	0	4	2022

i) PRE-REQUISITE: ES0U10E - Programming in C, EE1U20A - Digital Electronics.

ii) COURSE OVERVIEW: This course is designed to introduce microcontroller assembly language programming. Students will be taught the basic use of an assembly as well as embedded C programming environment to control peripheral devices. Students will also understand the interfacing of various peripheral elements with microcontroller to design an automated system. The course prepares the student with a set of concepts common to many different embedded systems.

iii) COURSE OUTCOMES

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

CO1	Illustrate the Architecture of 8051 microcontroller.	Understand
CO2	Develop assembly language and Embedded C program for 8051 microcontrollers.	Apply
CO3	Construct embedded C program for serial port communication and time delay using timers/counters of 8051.	Apply
CO4	Construct Embedded C programs to interface different peripheral devices with 8051 and for interrupt handling.	Apply
CO5	Explain the general characteristics of embedded system and also classify the system with its life cycle development.	Understand

iv) SYLLABUS

Introduction to the concepts of RISC, CISC, Harvard and Von Neumann architectures,

Types of microcontrollers, Applications of microcontrollers, Architecture of Intel 8051 microcontroller, Assembly language Programming and instruction set of 8051, addressing modes, 8051 programming in C.

8051 Timer/Counter programming in embedded C, 8051 serial port programming in embedded C, Introduction of Keil Software to simulate Assembly and embedded C programs.

8051 Interrupt programming in embedded C, Interfacing: LCD, seven segment display, DIP switches, ADC & DAC, Motor control.

Overview of Embedded Systems, Application domain of embedded systems, Categories of embedded systems, Design and Development life cycle model, Introduction to ARM processors (Basic concepts only).

v) (a) TEXT BOOKS

1) Douglas V. Hall, “Microprocessors and Interfacing”, Tata McGraw Hill, Education Pvt.Ltd, 2012 Edition.
2) Mathur A., “Introduction to Microprocessors”, Tata McGraw Hill, New Delhi, 2015 Edition.
3) Ramesh Gaonkar, “Microprocessor, Architecture, Programming and Applications”, Pen ram, 5th Edition, 2000.

4) Muhammad Ali Maidu and Janice Gillespie, "The 8051 Microcontroller and Embedded Systems – using assembly and C", Pearson, 2nd Edition 2007.
5) Kenneth J. Ayala, "The 8051 Microcontroller", 3rd Edition, Thomson/Cengage Learning, 2007.
6) A. K Ray and K. M. Bhurchandani, "Advanced microprocessors and peripherals", TMH, 2nd Edition, 2006.
7) Han Way Huang, "Using the MCS-51 family", Oxford University Press, 2000.
8) Craig Steiner, "Microcontroller: Architecture Assembly", WP Publishers / Microsoft Press, 2007.

(b) REFERENCES

1) Ramesh Gaonkar, "Fundamentals of Microcontrollers and Applications in Embedded Systems (with the PIC18 Microcontroller Family)", January 2010.
2) Manish K Patel, "The 8051 Microcontroller Based Embedded Systems", McGraw Hill, 2017, ISBN: 978-93-329-0125-4.
3) Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2011.
4) K.Uma Rao & Andhe Pallavi, "The 8051 microcontrollers, architecture and programming and applications", Pearson, 2010.
5) Ajay V. Deshmukh, "Microcontrollers and application", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
6) D. Karuna Sagar, "Microcontroller", Alpha Science International Ltd., 2010-12.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Introduction to the concepts of microprocessors, microcontrollers, RISC, CISC, Harvard and Von Neumann architectures. **Types of microcontrollers:** Overview of the 8051 family, Selection of microcontrollers, Applications of microcontrollers, Architecture of Intel 8051 microcontroller, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pins of 8051.	**12**
II	**Assembly programming of 8051:** Instruction set of 8051, Introduction to 8051 assembly programming, Data types and Assembler directives, 8051 Addressing Modes, Assembly programs - bit manipulation, port programming, data conversion. **8051 programming in C**: Data types and time delay in 8051C, I/O programming in 8051C, Logic operations in 8051 C, Data conversion program in 8051 C.	**13**
III	**8051 Timer/Counter programming in embedded C:** Programming 8051 timers, Counter programming, Programming timers 0 and 1 in 8051 C. **8051 serial port programming in embedded C:** Basics of serial communication, 8051 connections to RS232, serial port programming in 8051 C.	**13**

	Introduction of **Keil** Software to simulate Assembly and embedded C programs.	
IV	**8051 Interrupt programming in embedded C:** 8051 interrupts, Programming timer, external hardware and serial communication interrupt, Interrupt priority in 8051/52, Interrupt programming in C. **Interfacing:** LCD, seven segment display, DIP switches, ADC & DAC. **Motor control:** Relays and opto isolators, stepper motor interfacing, DC motor interfacing and PWM using 8051	**11**
V	**Overview of Embedded Systems** - Application domain of embedded systems, features and characteristics, overview of embedded system architecture; recent trends in embedded systems, Categories of embedded systems-Hard and soft, Design and Development life cycle model - Embedded system design process – Challenges in Embedded system design, Introduction to ARM processors (Basic concepts only).	**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
HS0U20A	PROFESSIONAL ETHICS	HSC	2	0	0	2	2022

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW: The goal of this course is to create awareness among the students on ethics and human values.

iii) COURSE OUTCOMES

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

CO1	Infer the core values that shape the ethical behaviour of a professional.	Understand
CO2	Apply philosophical concepts discussed in the course to personal and contemporary issues.	Apply
CO3	Explain the role and responsibility of engineers in technological development without compromising personal ethics and legal ethics.	Understand
CO4	Solve moral and ethical problems through exploration and assessment by established experiments.	Apply
CO5	Demonstrate the concept of Corporate Social Responsibility, and explore its relevance to ethical business activity	Understand
CO6	Apply the knowledge of human values and social values to contemporary ethical values and global issues.	Apply

iv) SYLLABUS

Morals, values and Ethics – Work Ethics - Service Learning Civic Virtue - Respect for others - Caring and Sharing - Empathy-Self Confidence - Social Expectations.

Senses of Engineering Ethics - Moral dilemmas – Consensus and Controversy Profession and Professionalism - Customs and Religion - Uses of Ethical Theories.

Engineering as Experimentation – Codes of Ethics Plagiarism - A balanced outlook on law.

Collegiality and loyalty – Managing conflict - Respect for authority - Role of confidentiality in moral Integrity - Conflicts of interest Professional rights.

Multinational Corporations - Role in Technological Development - Moral leadership.

v) (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.

vi) 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**

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
NC0U20C	UNIVERSAL HUMAN VALUES	MNC	2	0	0	-	2022

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW:

The objectives of the course are:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS'.
2. To facilitate the development of a Holistic perspective among students towards life and profession leading towards a value-based living.
3. To help the students to have ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with nature.

iii) COURSE OUTCOMES

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

CO1	Explain more of themselves and their surroundings (family, society, nature).	Understand
CO2	Show more responsibility in life to handle problems with sustainable solutions keeping human relationships and human nature in mind.	Understand
CO3	Demonstrate more Commitment towards human values, human relationship and human society.	Understand
CO4	Apply what they have learnt about Harmony to their real life.	Apply

iv) SYLLABUS

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I

Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration

Continuous Happiness and Prosperity- A look at basic Human Aspirations

Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority

Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

(Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking)

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'

Understanding the needs of Self ('I') and 'Body' - happiness and physical facility

Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)

Understanding the characteristics and activities of 'I' and harmony in 'I'

Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

Programs to ensure Sanyam and Health.

(Include practice sessions to

the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease)

Module 3: Understanding Harmony in the Family and Society- Harmony in Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness;

Trust and Respect as the foundational values of relationship

Understanding the meaning of Trust; Difference between intention and competence

Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship

Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

(Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives)

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature

Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature

Understanding Existence as Co-existence of mutually interacting units in all pervasive space

Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values

Definitiveness of Ethical Human Conduct

Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

Competence in professional ethics:

a. Ability to utilize the professional competence for augmenting universal human order

b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems,

c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems

Strategy for transition from the present state to Universal Human Order

a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers.

b. At the level of society: as mutually enriching institutions and organizations Sum up.

(Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg.To discuss the conduct as an engineer or scientist etc.).

v) (a) TEXT BOOKS

1) Gaur P.R, Asthana R, Bagaria G.P, "Human Values and Professional Ethics", (2nd revised Edition) Excel Books, New Delhi, 2019
2) Tripathi A. N, "Human Values", New Age Intl. Publishers, New Delhi, 2004.

(b) REFERENCES

1) Gaur R.R, Sangal R, Bagaria G P, "A Foundation Course in Human Values and Professional Ethics (Teacher Manual)", Excel Books, 1st Edition, 2013.
2) Nagaraj A, Jeevan Vidya Prakashan, Amarkantak, "Jeevan Vidya: Ek Parichaya", 1999.
3) Mohandas K Gandhi, "The story of my Experiments with Truth", Fingerprint, 2009.
4) Cecile Andrews, "Slow is Beautiful", New Society Publishers, 2006.
5) Kumarappa J C, "Economy of Permanence", Sarva Seva Sangh Prakashan, 2017.

vi) MODE OF CONDUCT OF COURSE

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions. In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. Depending on the nature of topics, worksheets, home assignment and/or activity are included.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.

vii) COURSE PLAN

Each Lecture hour and Tutorial hour can be structured as given below for the efficient delivery of the course content.

MODULE	CONTENT	No.of Hours (L/T)
1	Understanding Value Education	L1
	Self-Exploration as the process for Value Education	L2
	Sharing about oneself	T1
	Understanding Happiness and Prosperity-the Basic Human Aspirations	L3

	Right Understanding, Relationship, Physical Facility	L4
	Exploring Human Consciousness	T2
	Happiness and Prosperity- Current Scenario	L5
	Method to Fulfill the Basic Human Aspirations	L6
	Exploring Natural Acceptance	T3
2	Understanding Human Being as the Co-existence of the Self and Body	L7
	Distinguishing between the needs of the Self and the Body	L8
	Exploring the difference of needs of the Self and the Body	T4
	The Body as an Instrument of the Self	L9
	Understanding Harmony in the Self	L10
	Exploring Sources of Imagination in the Self	T5
	Harmony of the Self with the Body	L11
	Programme to ensure Self-Regulation and Health	L12
	Exploring Harmony of Self with the Body	T6
3	Harmony in the Family-the Basic unit of Human Interaction	L13
	Values in the Human-to-Human Relationship	L14
	'Trust' – the foundation Value in Relationship	L15
	Exploring the feeling of Trust	T7
	'Respect'- as the Right Evaluation	L16
	Exploring the feeling of Respect	T8
	Understanding Harmony in the Society	L17
	Vision for the Universal Human Order	L18
	Exploring Systems to fulfill Human Goal	T9
4	Understanding Harmony in the Nature	L19
	Interconnectedness, self-regulation and Mutual Fulfillment among the four orders of Nature	L20
	Exploring the four orders of Nature	T10
	Realizing Existence as Co-Existence at all Levels	L21
	The Holistic Perception of Harmony in Existence	L22
	Exploring Co-Existence in Existence	T11
5	Natural Acceptance of Human Values	L23
	Definitiveness of (Ethical) Human Conduct	L24
	Exploring Ethical Human Conduct	T12
	A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order	L25
	Competence in Professional Ethics	L26
	Exploring Humanistic Models in Education	T13
	Holistic Technologies, Production Systems and Management-Models - Typical Case Studies	L27

	Strategies for Transition towards Value –based Life and Profession	L28
	Exploring Steps of Transition towards Universal Human Order	T14

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	**5 marks**
CA Exams (2 numbers)	:	**15 marks**
Assignment/Project/Case study etc.	:	**20 marks** Self-Assessment - 5 marks Peer Assessment - 5 Marks Peer Assessment can be done on group-wise basis by dividing the class into suitable groups
Total	:	**50 marks** Two Continuous Assessment Tests of 15 marks each, average of which can be taken as final marks. Tests may be conducted as written examination/quiz/viva –voce.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1U28A	CIRCUITS AND MEASUREMENTS LAB	PCC	0	0	3	2	2022

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:

CO1	Experiment with DC network theorems.	Apply
CO2	Develop test set up to calibrate various meters used in electrical systems.	Apply
CO3	Identify transformer parameters, electrical parameters and power in single and three phase circuits.	Apply
CO4	Choose methods to extend the range of ammeter and voltmeter.	Apply
CO5	Build the electrical characteristics of transducers and magnetic characteristics of various specimens.	Apply

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.
- Determination of B-H curve a magnetic specimen.
- Measurement of Self-inductance, Mutual inductance and Coupling coefficient of a 1-phase transformer.
- Set Up a circuit to determine unknown capacitance.
- 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.

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

Expt. No.	Contents	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 by direct loading	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. Set up a circuit to measure unknown capacitance using Schering's bridge	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 phantom loading	3
XV	Demo Experiments/Simulation study: (a) Measurement of energy using Electronic Energy meter (b) Measurement of electrical variables using DSO	3
	Total Hours	**45**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	15 marks
CA Exam (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
EE1U28F	MICROCONTROLLER LAB	PCC	0	0	3	2	2022

i) PRE-REQUISITE: ES0U10E: Programming in C.

ii) COURSE OVERVIEW: The main objective of the course is to develop logic and coding skills that have wide scope in automation and various fields of engineering. The course also exposes students to the operation of typical microprocessor (8085) trainer kit. The course will prepare students to be able to solve different problems by developing different programs.

iii) COURSE OUTCOMES

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

CO1	Develop and execute assembly language programs for solving arithmetic and logical problems using microcontroller.	Apply
CO2	Develop 8051 C programs for arithmetic and logical solutions.	Apply
CO3	Develop embedded C programs for interfacing 8051 microcontroller with various peripheral devices.	Apply
CO4	Design a microcontroller-based system with the help of various interfacing devices.	Create

iv) LIST OF EXPERIMENTS

- ALP programming for Data transfer: Block data movement, exchanging data, sorting, finding largest element in an array.
- ALP programming for Arithmetic operations: Addition, subtraction, multiplication and division.
- ALP for Computation of square and cube of 8-bit numbers.
- ALP programming for the implementation of counters: HEX up and down counters, BCD up/down counters.
- ALP programming for implementing Boolean and logical instructions: bit manipulation.
- ALP programming for implementing conditional call and return instructions: Toggle the bits of port 1 by sending the values 55H and AAH continuously, Factorial of a number.
- Embedded C programming for implementing code conversion– BCD to ASCII, ASCII to BCD, ASCII to decimal, Decimal to ASCII, Hexadecimal to Decimal and Decimal to Hexadecimal.
- C Programs for stepper motor control.
- C Programs for DC motor speed control.
- C Programs for Alphanumerical LCD panel/ keyboard interface.
- C Programs for ADC interfacing.
- Interfacing D/A converter- generation of simple waveforms-triangular, ramp etc.
- 8051 C Program for Serial port communication.
- Simple Project Work Including Multiple Interfaces.

v) REFERENCES

1) Ramesh Gaonkar, "Microprocessor Architecture Programming and Applications", Penram International Publishing, 6th Edition, 2014.
2) R Kenneth J. Ayala, "The 8051 Microcontroller", Cengage learning, 3rd Edition, 2007.
3) R. Lyla B.Das, Microprocessors and Microcontrollers, Pearson Education, India, 2011.
4) R Soumitra Kumar Mandal, "Microprocessors and Microcontrollers Architecture, Programming & Interfacing Using 8085, 8086 and 8051", McGraw Hill Education, 2011.
5) R Nagoorkani, "Microprocessors and Microcontrollers", 2nd Edition, McGraw Hill Education, 2012.
6) R Muhammed Ali Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2nd Edition, 2007.
7) R I. Scott Mackenzie, Raphel C.-W Phan, "The 8051 Microcontroller", 4th Edition, 2006.

vi) COURSE PLAN

Expt. No.	Contents	No. of hours
I	ALP programming for Data transfer: Block data movement, exchanging data, sorting, finding largest element in an array.	3
II	ALP programming for Arithmetic operations: Addition, subtraction, multiplication and division.	3
III	ALP for Computation of square and cube of 8-bit numbers.	3
IV	ALP programming for the implementation of counters: HEX up and down counters, BCD up/down counters.	3
V	ALP programming for implementing Boolean and logical instructions: bit manipulation	3
VI	ALP programming for implementing conditional call and return instructions: Toggle the bits of port 1 by sending the values 55H and AAH continuously, Factorial of a number.	3
VII	Embedded C programming for implementing code conversion– BCD to ASCII, ASCII to BCD, ASCII to decimal, Decimal to ASCII, Hexadecimal to Decimal and Decimal to Hexadecimal.	3
VIII	C Programs for stepper motor control, DC motor speed control	3
IX	C Programs for Alphanumerical LCD panel/ keyboard interface.	3
X	C Programs for ADC interfacing.	3
XI	Interfacing D/A converter- generation of simple waveforms-triangular, ramp etc.	3
XII	8051 C Program for Serial port communication	3
XIII	Demo Experiments using 8051/Cloud platforms.	3
XIV	Simple project work including multiple interfaces	3
	Total Hours	**45**

vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	15 marks
CA Exam (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

x) 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 S4 MINORS

Basket	Course Code	Course Name	L-T-P	Credits
I	EE0M20M	Hardware Interfacing using Arduino-C Platform	4-0-0	4
II	EE0M20N	Electric Power Supply and Distribution Systems	4-0-0	4
III	EE0M20P	Renewable Energy in Power Grids	4-0-0	4
IV	EE0M20Q	Power Electronics and Energy Storage Devices	4-0-0	4

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE0M20M	HARDWARE INTERFACING USING ARDUINO-C PLATFORM	VAC	4	0	0	4	2022

i) PRE-REQUISITE: ES0U10E: Programming in C

ii) COURSE OVERVIEW: The goal of this course is to expose the students to learn how the Arduino platform works in terms of the physical board and libraries and the IDE (Integrated Development Environment). The course will cover programming the Arduino using C code and accessing the pins on the board via the software to control external devices. This course also provides an Introduction to the shields used to extend the capabilities of an Arduino based system.

iii) COURSE OUTCOMES

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

CO1	Explain the composition of the Arduino development board and Arduino IDE.	Understand
CO2	Discuss the basic Embedded C programming used in Arduino.	Understand
CO3	Utilize the Debugging process and wiring of various electrical circuits on Breadboard.	Apply
CO4	Interpret the Interfacing of various sensors and actuators.	Understand
CO5	Explain the shields used to extend the capabilities of an Arduino based system.	Understand

iv) SYLLABUS

Arduino platform – Arduino Board, Direct programming, Arduino Schematics, Arduino IDE, Compiling Code, Arduino Shields and library, Arduino basic set up, C Programming – Variables, Operators, Conditionals, Loops, Functions, Global Variables. Debugging, Debug Environments, Debug via Serial, UART Protocol, UART Synchronization, UART Parity and stop , Serial on Arduino, Reading from Serial, Electrical circuits - Electrical properties - Ohm's Law-Electrical components - Diodes – Switches, Potentiometers, Push Button – Wiring Arduino tool chain, Cross compilation, Arduino sketches, Classes, Sketch structure, Pins, Input and output, Blink example, Debugging, Debug Environments, Debug via Serial, UART Protocol, UART Synchronization, UART Parity and stop , Serial on Arduino, Reading from Serial Electrical circuits - Electrical properties - Ohm's Law-Electrical components - Diodes – Switches, Potentiometers, Push Button - Wiring.

v) (a) TEXT BOOKS

1) Banzi Massimo, "Getting Started with Arduino: The Open Source", Shroff Publishers and Distributors Pvt. Ltd. ,3rd Edition, 2015.

2) Ashwin Pajankar, "ARDUINO Made Simple", BPB Publication, 1st Edition, January 2018.

3) Michael Margolis, "Arduino Cookbook", O'Reily Publication, 2nd Edition, December 2011.

(b) REFERENCES

1) Jeremy Blum, "Exploring Arduino: Tools and Techniques for Engineering Wizardry", Wiley Publications, 1st Edition, 2013.
2) John Nussey, "Arduino for Dummies", 2nd Edition, Kindle.
3) Mark Geddes, "Arduino Project Handbook: 25 practical projects to get you started",1st Edition, 2016.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Arduino platform – Arduino Board, Direct programming, Arduino Schematics, Arduino IDE, Compiling Code, Arduino Shields and library, Arduino basic set up	**12**
II	C Programming – Variables, Operators, Conditionals, Loops, Functions, Global Variables. Arduino tool chain, Cross compilation, Arduino sketches, Classes, Sketch structure, Pins, Input and output, Blink example	**12**
III	Debugging, Debug Environments, Debug via Serial, UART Protocol, UART Synchronization, UART Parity and stop, Serial on Arduino, Reading from Serial Electrical circuits- Electrical properties -Ohm's Law-Electrical Components-Diodes –Switches, Potentiometers, Push Button -Wiring	**12**
IV	Sensors- Resistive Sensors- Actuators - Analog Actuators-Pulse Width Modulation - Making Sounds Arduino libraries- EEPROM-Masking – I2C Communication – I2C Transactions – Sending bits – Wire library – Master Communication – Slave operation.	**12**
V	Arduino Shields – Ethernet Shield – Ethernet library – Client examples – Ethernet server – WiFi Shield.	**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
EE0M20N	ELECTRIC POWER SUPPLY AND DISTRIBUTION SYSTEMS	VAC	4	0	0	4	2022

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW: The aim of this course is to provide a comprehensive understanding of the various components, characteristics, and technologies involved in electrical power generation, transmission, distribution, and management.

iii) COURSE OUTCOMES

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

CO1	Compare the efficiency and reliability of various electrical power generation and transmission methods and technologies.	Understand
CO2	Discuss load flow analysis, state estimation, short circuit analysis, and harmonic analysis in power systems.	Understand
CO3	Explain generation control and dispatch, load control, power system protection and stability analysis.	Understand
CO4	Discuss the characteristics and benefits of distributed energy resources, types of microgrids, their control and protection and integration with the main grid.	Understand
CO5	Describe smart grid technologies, renewable energy sources integration, energy storage systems and future trends in electrical power supply systems.	Understand

iv) SYLLABUS

Introduction to Electric Power Supply Systems, Overview of electrical power systems, Electrical power generation methods and technologies, AC/DC transmission and distribution systems

Power System Analysis: Load flow analysis, State estimation, Short circuit analysis, Harmonic analysis

Power System Control and Protection, Generation control and dispatch, Load control, Power system protection, Power system stability analysis

Distributed Energy Resources and Microgrids, Overview of distributed energy resources, Types of microgrids and their applications, Control, and protection of microgrids, Integration of microgrids with the grid

Emerging Technologies in Electric Power Supply Systems, Smart grid technologies, Renewable energy sources and their integration into power systems, Energy storage systems and their applications. Future trends and developments in electrical power supply systems.

v) (a) TEXT BOOKS

1) Ned Mohan, “Electric Power Systems: A first Course”, Wiley India, 2012.

2) J. Duncan Glover, Thomas Overbye, Mulukutla S. Sarma, "Power System Analysis and Design", 4th Edition, Thomson learning, 2008.
3) V.K. Mehta and Rohit Mehta, "Principles of Electric Power Systems", 3rd Edition, S. Chand Publications, 2005.
4) James L. Kirtley, "Electric Power Principles: Sources, Conversion, Distribution and Use", 2nd Edition, Wiley Publication, 2020.

(b) REFERENCES

1) Ned Mohan, "Electric Power Systems: A First Course", John Wiley and Sons Inc., 2012.
2) F C Chan, "Electric Power Distribution Systems", 3rd Edition, McGraw Hill, 1994.
3) K.R. Padiyar, "Power System Dynamics: Stability and control", Anshan Ltd., 2004.
4) Turan Gonen, "Electric Power Distribution Engineering", 3rd Edition, CRC Press, 2014.
5) James Momoh, "Smart Grid: Fundamentals of Design and Analysis", Wiley- IEEE Press, 2012.
6) "Handbook on Microgrids for power quality", Asian Development bank.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Overview of electrical power systems**: Types of electrical power systems, components of power systems, power system characteristics. Electrical power generation methods and technologies: Conventional power generation (thermal, hydro, nuclear), renewable energy sources (solar, wind, geothermal). AC/DC transmission and distribution systems: Advantages and disadvantages of AC and DC transmission, high voltage AC and DC transmission, sub-transmission, and distribution systems	**10**
II	**Load flow analysis:** Load flow equations, Newton-Raphson method, Gauss-Seidel method, Decoupled load flow method, fast decoupled load flow method. **State estimation:** State estimation theory, weighted least squares state estimation, Kalman filtering. **Short circuit analysis:** Symmetrical components, sequence impedance, fault analysis, symmetrical fault analysis, unsymmetrical fault analysis. Harmonic analysis: Harmonic sources, harmonics in power systems, power system harmonics standards, harmonic mitigation techniques.	**12**
III	**Generation control and dispatch:** Power system control, power system stability, generation control and dispatch, economic dispatch. Load control: Load control techniques, direct load control, indirect load control, real-time pricing. Power system protection: Principles of power system protection, protection zones, relay types, protection coordination. Power system stability analysis: Transient stability analysis, steady-state stability analysis, dynamic stability analysis.	**12**

IV	**Overview of distributed energy resources:** Characteristics of distributed energy resources, benefits and challenges of distributed energy resources. Types of microgrids and their applications: Types of microgrids, microgrid topologies, microgrid control and protection, microgrid planning and design. Control and protection of microgrids: Microgrid control, microgrid protection, microgrid stability, microgrid reliability. Integration of microgrids with the grid: Integration of microgrids with the main grid, microgrid interconnection, microgrid power quality, microgrid market integration.	**13**
V	**Smart grid technologies:** Smart grid concepts, communication technologies for the smart grid, smart grid applications, smart grid security. Renewable energy sources and their integration into power systems: Renewable energy sources and their impact on power systems, integration of renewable energy sources into power systems, grid integration of renewable energy sources, grid codes for renewable energy sources. Energy storage systems and their applications: Energy storage systems, applications of energy storage systems, energy storage system design and analysis, energy storage system control and management. Future trends and developments in electrical power supply systems: Future trends in electrical power supply systems, energy systems integration, energy systems optimization, energy systems automation.	**13**
	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
EE0M20P	RENEWABLE ENERGY IN POWER GRIDS	VAC	4	0	0	4	2022

i) PRE-REQUISITE: ES0U10D: Basics of Electrical and Electronics Engineering, NC0U10A: Sustainable Engineering.

ii) COURSE OVERVIEW: The goal of this course is to expose the students to the fundamental concepts of the integration of renewable energy sources to power grids. The course also intends to cover the basic concepts of various power converter circuits for renewable energy systems.

iii) COURSE OUTCOMES

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

CO1	Describe the basic concepts of Distributed Generation and Microgrids.	Understand
CO2	Illustrate the various types of Distributed Energy Resources in Microgrids.	Understand
CO3	Enumerate the various protection issues of microgrids and the impact of DG integration on power quality.	Understand
CO4	Apply the working of DC-DC converters for solar photovoltaic applications	Apply
CO5	Utilize the working of inverters and AC-AC converters for wind integrated Grid applications	Apply

iv) SYLLABUS

Distributed generation and Microgrid concept - Distributed generation, Need for integration of Distributed Energy Resources, Active distribution network, Concept of Microgrid.

Distributed energy resources - Combined heat and power systems, Wind energy conversion systems, Solar Photovoltaic systems, Small-scale hydroelectric power generation, Storage devices. Protection Issues for Microgrids – Islanding.

Impact of DG Integration on Power Quality - Introduction, Power Quality Disturbances-Power quality sensitive customers, Existing power quality improvement technologies, Impact of DG Integration.

Power Electronics interface for distributed generation – Ideal Switch, Types of Power Semiconductor Devices. DC-DC Converters – Buck, Boost and Buck-Boost topologies.

Switched Mode Inverters - Single phase half bridge, full bridge and three phase bridge Voltage Source Inverters, AC-AC Converters - Grid integrated wind energy conversion systems, single phase and three phase AC voltage controllers.

v) (a) TEXT BOOKS

1) Ali Keyhani, “Design of Smart Power Grid Renewable Energy Systems”, Wiley Publications, 3rd Edition, 2019.

2) Chowdhury S., Chowdhury S. P., Crossley P., "Microgrids and Active Distribution", Institution of Engineering and Technology, 2009.
3) Dugan R. C., Granaghen M. F., Beaty H. W., "Electrical Power System Quality", McGraw- Hill, 2nd Edition, 2017.
4) Ned Mohan, Tore M. Undeland, William P. Riobbins, "Power Electronics: Converters, Applications, and Design", John Wiley and Sons Inc., New York, 3rd Edition, 2009.
5) Robert W. Erickson, Dragan Maksimovic, "Fundamentals of Power Electronics", Springer, 3rd Edition, 2022.

(b) REFERENCES

1) James Momoh, "Smart Grid: Fundamentals of Design and Analysis", Wiley IEEE Press, 2015.
2) Remus Teodorescu, MarCOLiserre, Pedro Rodriguez, "Grid Converters for Photovoltaic and Wind Power Systems", Wiley Publications, 1st Edition, 2011.
3) Rashid M. H., "Power Electronics – Circuits, Devices and Applications", Prentice Hall of India, New Delhi, 4th Edition, 2014.
4) Robert Bausiere, Francis Labrique, Guy Seguier, "Power Electronic Converters: DC-DC Conversion", Springer, 2013.
5) Bimbhra P. S., "Power Electronics", Khanna Publishers, New Delhi, 6th Edition, 2018.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Distributed generation and Microgrid concept –** Distributed generation, Need for integration of Distributed Energy Resources, Active distribution network, Concept of Microgrid, A typical Microgrid configuration, Technical and economic advantages of Microgrid, Challenges and disadvantages of Microgrid development, Dynamic interactions of Microgrid with main grid.	12
II	**Distributed energy resources –** Introduction, Combined heat and power (CHP) systems, Wind energy conversion systems (WECS), Solar photovoltaic (PV) systems, Small-scale hydroelectric power generation, Other renewable energy sources, Storage devices. **Protection Issues for Microgrids –** Introduction, Islanding: separation from utility, Different islanding scenarios, Major protection issues of stand-alone Microgrid - Microgrid distribution system protection, Protection of microsources.	12
III	**Impact of DG Integration on Power Quality –** Introduction, Power Quality Disturbances- Transients, Voltage sags and swells, Over-voltages and under-voltages, Outage, Harmonic distortion, Voltage notching, Flicker, Electrical noise, Power quality sensitive customers, Existing power quality improvement technologies, Impact of DG Integration.	12

IV	**Power Electronics interface for distributed generation –** Power Devices: The ideal switch, Characteristics of ideal switches, Types of Power Semiconductor Devices - Power ratings. **DC-DC converters –** Block diagram of solar photo voltaic system, Types of solar PV system-stand-alone operation and grid integrated solar PV system, Need for DC-DC converters, Buck, Boost and Buck-Boost topologies-inductor volt-sec balance, voltage conversion ratio, Need for isolated dc-dc converters-Types only.	**12**
V	**Switched Mode Inverters –** Single phase half bridge, full bridge and three phase bridge Voltage Source Inverters-square wave operation, PWM inverters, Grid connected inverters. **AC-AC Converters –** Grid integrated wind energy conversion systems, single phase and three phase AC voltage controllers, Back-to-Back converters, Matrix converter.	**12**
	Total hours	**60**

vii) ASSESSMENT PATTERN

Bloom's Taxonomy Level	Continuous Assessment Exams (Marks)		End Semester Exam (Marks)
	CA Exam I	CA Exam II	
Remember	20	10	30
Understand	30	40	70
Apply			
Analyse			
Evaluate			
Create			

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
EE0M20Q	POWER ELECTRONICS AND ENERGY STORAGE DEVICES	VAC	4	0	0	4	2022

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

ii) COURSE OVERVIEW: The goal of this course is to expose the students to the fundamental concepts of Power Electronic Devices. It also includes the circuit analysis of various power converter circuits. The course also provides an insight into the different energy storage devices.

iii) COURSE OUTCOMES

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

CO1	Explain the operation of modern power semiconductor devices and its characteristics.	Understand
CO2	Illustrate the working of controlled rectifiers.	Understand
CO3	Explain the working of AC voltage controllers and inverters	Understand
CO4	Choose different DC-DC converters based on their performance and applications.	Apply
CO5	Summarize different energy storage techniques	Understand

iv) SYLLABUS

Structure and principle of operation of power devices: Power diode, Power MOSFET & IGBT – switching characteristics - comparison, SiC, GaN

SCR- Structure, characteristics di/dt& dv/dt protection – Turn-on methods of SCR, Gate drive circuit: Triggering circuit-gate drive circuit-Isolation

AC-DC converters: Single phase half wave controlled, fully controlled, semi controlled ac-dc converter Three phase full wave Controlled converter

AC voltage controllers: Single phase AC voltage controller with R & RL load.

Inverters –Single phase half bridge and full bridge inverter, Three Phase inverters

DC choppers–Step up chopper –step down chopper -buck &boost switching regulators

Energy Storage: Battery based energy storage -Fuel Cell based energy storage, Super capacitor and Hydrogen energy storage. Hybridization of different energy storage devices.

v) (a) TEXT BOOKS

1) Rashid M H, “Power Electronics – Circuits, Devices and Applications”, Prentice Hall of India, New Delhi, 4th Edition, 2014.
2) M.D. Singh and K.B. Khanchandani, “Power Electronics”, Tata McGraw Hills Publishing Company Limited, 2nd Edition, 2006.

(b) REFERENCES

1) Ned Mohan, Tore M. Undeland, William P. Robbins, “Power Electronics: Converters, Applications, and Design”, Wiley India, 3rd Edition, 2018.

2) Dubey G K, “Fundamentals of Electrical Drives”, Narosa Publishing House, New Delhi, 2nd Edition, 2012.
3) Robert W. Erickson, Dragan Maksimovic, “Fundamentals of Power Electronics”, Springer, 3rd Edition, 2001.
4) Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.
5) 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.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Structure and principle of operation of power devices**- Power Diode, Power MOSFET & IGBT –Basic principles of wideband gap devices-SiC, GaN. **SCR-** Structure, Static characteristics & Switching (turn-on & turn-off) characteristics - di/dt& dv/dt protection – Turn-on methods of SCR. **Gate triggering circuits**- Requirements of isolation and synchronization in gate drive circuits, Opto and pulse transformer-based isolation.	**12**
II	**Controlled Rectifiers (Single Phase)** – Half-wave controlled rectifier with R load– Fully controlled and half controlled bridge rectifier with R, RL and RLE loads (continuous & discontinuous conduction) – Average Output voltage equation. **Controlled Rectifiers (3-Phase) -** 3-phase half-wave controlled rectifier with R load – Fully controlled bridge converter with RLE load (continuous conduction, ripple free) – Output voltage equation-Waveforms for various triggering angles (detailed mathematical analysis not required).	**12**
III	**AC voltage controllers (ACVC)** – 1-phase full-wave ACVC with R, & RL loads – Waveforms – RMS output voltage **Inverters** – Voltage Source Inverters– 1-phase half-bridge & full bridge inverter with R and RL loads – THD in output voltage – 3-phase bridge inverter with R load – 120° and 180° conduction modes– Current Source Inverters-1-phase capacitor commutated CSI-Pulse width modulation	**12**
IV	**DC-DC converters** – Step down and Step up choppers – Single-quadrant, Two-quadrant and Four quadrant chopper – Pulse width modulation & current limit control in dc-dc converters. **Switching regulators** – Buck, Boost–Operation with continuous conduction mode – Waveforms	**12**
V	Energy Storage: Energy Storage Requirements, Battery based energy storage -Battery parameters: C-rating -SoC- DoD- Specific Energy-Specific power, Fuel Cell based energy storage, Super capacitor and Hydrogen energy storage. Hybridization of different energy storage devices,	**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

B.TECH S4 HONOURS

Group	Course Code	Course Name	L-T-P	Credits
I/II/III	EE1H20A	Network Analysis and Synthesis	3-1-0	4

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EE1H20A	NETWORK ANALYSIS AND SYNTHESIS	VAC	3	1	0	4	2022

i) PRE-REQUISITE: MA0U20A: Partial Differential Equation and Complex Analysis, EE1U20D: 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, Fourier 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 concept of Fourier series and Fourier transforms for electrical circuit applications.	Apply
CO2	Apply network topology concepts in the formulation and solution of electric network problems.	Apply
CO3	Apply two-port network parameters 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.	Understand
CO5	Construct a one-port network from its functions using Foster and Cauer methods.	Apply

iv) SYLLABUS

Dynamic circuits with periodic input - Exponential Fourier series - trigonometric Fourier series - Circuit applications - Fourier transforms – application to simple circuits.

Network topology – incidence matrix – 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.

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. Introduction of network functions to MATLAB simulation.

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, Mahmood Nahvi, "Electric Circuits", Mc GrawHill, 7th Edition, 2017.
3) Chakrabarti A., "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. Gupta B. R., "Network Analysis and Synthesis", S. Chand & Company Ltd, 3rd Edition, 2013.
6) Desoer C. A., Kuh E. S., "Basic Circuit Theory", McGraw-Hill, New York, 1969.
7) Bhattacharya S. K., "Network Analysis and Synthesis", Pearson Education India, 2015.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Dynamic circuits with periodic input** Periodic waveforms in circuit analysis - Exponential Fourier series - trigonometric Fourier series - condition for existence of Fourier series - Waveform symmetry and Fourier coefficients - Circuit applications - Average Power and RMS Values - Discrete magnitude and phase spectrum - Rate of decay of harmonic amplitude - Fourier integral - Fourier transforms – application to simple circuits - Normalised power in a periodic waveform and Parseval's theorem.	**12**
II	**Network topology** graph, tree, incidence matrix – properties of incidence matrix – fundamental cut sets – cut set matrix – tie sets – fundamental tie sets – tie set matrix – relationships among incidence matrix, cut set matrix and tie set matrix – duality - Kirchhoff's laws in terms of network topological matrices – formulation and solution of network equations using topological methods.	**12**
III	**Two port Networks:** Review of network parameter sets for two-port networks (Z, Y, h and T) [equivalent circuits and inter-relationship between parameters] - Image parameter description of a reciprocal two-port network - Image impedance - Characteristic impedance - propagation constant - derivation of characteristic impedance and propagation constant for T and Π networks under sinusoidal steady state - Attenuation constant and phase constant. **Filter terminology** Low pass, high pass, band-pass and band-reject filters - Design of constant k and m-derived filters.	**12**
IV	**Network Functions** Review of Network functions for one port and two port networks – pole-zero location for driving point and transfer functions -	**12**

	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, Introduction of network function in MATLAB simulation.	
V	**Network Synthesis** Synthesis of one-port network – Properties of LC immittance functions - Synthesis of LC Driving point immittances - Properties of RL and RC Driving point immittances, Synthesis of RC and RL networks - by Foster and Cauer methods - Form I and II.	**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