Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION for 2018 batch - Academic Year 2020-21

B.E in Electrical and Electronics Engineering

Outcome Based Education (OBE) and Choice Based Credit System (CBCS**)**

V Semester

Sl. No	**Course and Course Code**		**Course Title**	**Teaching Dept.**	Teaching Hours / Week			**Examination**				Credits
					Theory Lecture (L)	**Tutorial (T)**	Practical (P)	**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	HS	18HS51	Management and Entrepreneurship	HS	03	00	00	03	050	050	100	03
2	PC	18EE51	Signals and Systems	EE	02	02	00	03	050	050	100	03
3	PC	18EE52	Field Theory	EE	04	00	00	03	050	050	100	04
4	PC	18EE53	Microcontroller	EE	03	00	00	03	050	050	100	03
5	PC	18EE54	Electrical Machine Design	EE	04	00	00	03	050	050	100	04
6	PE	18EE55x	Professional Elective-I	EE	03	00	00	03	050	050	100	03
7	PE	18xxE01	Open Elective-A	EE	03	00	00	03	050	050	100	03
8	PC	18EEL56	Control Systems Lab	EE	00	00	02	03	050	050	100	01
9	PC	18EEL57	DC Machines and Synchronous Lab	EE	00	00	02	03	050	050	100	01
				Total	**22**	**02**	**04**	**27**	**450**	**450**	**900**	**25**

Mini-project: To be carried out during the intervening vacations of V and VI semesters. The SEE examination will be conducted during VI semester. The credit prescribed for mini – project is added to VI semester credits. The mini-project is considered as a head of passing and is considered for the award of degree. Those, who do not take-up/complete the mini-project will be declared as failed and have to complete during subsequent SEE examination after satisfy the Mini-project requirements. Also, mini-project is considered for eligibility to VII semester.

Note: BC: Science Course, PC: Professional Core. HS: Humanities

Professional Elective-1(03 Credits)		
Sl. No	Course Code	Course Title
1	18EE551	Programmable Logic Controllers
2	18EE552	VLSI Circuits Design

Professional Elective-1(03 credits)		
Sl. No	Course Code	Course Title
3	18EE553	Modern Control Theory
4	18EE554	Embedded Systems

Open Elective-A(OE-A)		
Sl. No	Course Code	Course Title
1	18EEE01	Renewable Energy Sources

Subject Title : Signals and Systems

Sub.Code: 18EE51	No. of Credits:03=02:2:0 (L - T – P)	No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:52

Course Learning Objectives:

1 To learn the different types of signals and properties of Signals & Systems, convolution for LTI systems.

2 To explain the use of convolution, differential in analysing the response of LTI systems in continuous and discrete time domains and to provide a block diagram representation to it.

3 To visualize the relationship between the continuous-time, discrete-time Fourier series and Fourier transform of a signal.

4 To learn the applications of Fourier transform.

5 To explain the use of Z-transform in the complex exponential representation of discrete time signals and the analysis of systems

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	Introduction: Definition of A Signal and a System, Overview of Systems, Classifications of Signals, Basic Operation On Signals, Elementary Signals, And Systems Viewed as Interconnection of Operations, Properties of Systems. TEXT 1 and TEXT 2. Reference Book	10	L1,L2,L3.
2	Time Domain Representation for LTI Systems (Continuous & Discrete): Convolution, Impulse Response Representation, Properties of Impulse Response Representation, Solution of Differential & Difference Equations, Block Diagram Representation. TEXT 1 and TEXT 2. Reference Book	10	L1,L2,L3.
3	Frequency Domain Representation of Signals and Applications: Introduction, Fourier Representation of Continuous-Time Periodic Signals, Continuous Time Fourier Transform: Representation of Non Periodic Signals, Properties of Continuous Time Fourier Transforms. Application of Fourier Representation: Frequency Response of LTI Systems. Solutions of differential equation. TEXT 1 and TEXT 2. Reference Book	11	L1,L2,L3.
4	Discrete-Time Fourier Transform: Representation of non-periodic signals. The discrete time Fourier transforms (DTFT). Properties of Discrete Time Fourier Transform. Applications: Frequency Response of LTI Systems. Solution of Difference Equations Using System Function. Sampling of Continuous Time Signals & Signal Reconstruction. TEXT 1 and TEXT 2. Reference Book	10	L1,L2,L3.
5	Z- Transforms: Introduction, Z-transform, properties of ROC, properties of Z-transforms, inversion of Z-transform methods -	11	L1,L2,L3.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	power series and partial expansion, Transforms analysis of LTI systems, transfer function, stability and causality, unilateral Z-transform and its application to solve difference equations. TEXT 1 and TEXT 2. Reference Book		

Note 1: Unit 1 to 5 will have internal choice

Note2:
a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT presentation/subject quiz/project/seminar

Note:3 Out of 5 Units, Unit 5 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

Course Outcomes:

CO1 Characterize and analyse the properties of CT and DT signals and systems

CO2 Analyse LTI CT and DT systems in time domain using convolution & differential equation

CO3 Represent CT and DT signals in the Frequency domain using Fourier analysis tools.

CO4 Analyse Fourier transform for differential & difference equation applications.

CO5 Use Z-transform and properties of Z transform for the analysis of discrete time systems.

Course Outcomes Mapping with Programme Outcomes.

SI.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1.	CO1:	1,2,3	09	3	2	1					1		1		1
2.	CO2.	1,2,3	12	3	3	1	2				2		2		2
3.	CO3:	1,2	09	3	3	1	2				2		2		2
4.	CO4:	3,4	13	3	3	1	2				2		2		2
5.	CO5:	1,2,3	09	3	3	1					2		2		2
Average CO				3	3	1	2				2		2		2

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3		1
CO2	3		1
CO3	3		1
CO4	3	2	1
CO5	3	2	1
Average CO	**3**	**2**	**1**

Text Books.

1 Simon Haykin and Barry Vam Veen, "Signals & Systems", Reprint 2002 2nd edition , John Wiley & Sons, 2001

2 Alan V Oppenheim, Alan Willsky and S. Hamid Nawab , "Signals & Systems ", 2nd edition 1997, Pearson Education Asia , Indian Reprint 2002

3 Michael J Roberts, "Signals & Systems Analysis of signals through linear systems ", Tata McGraw Hill, 2003.

4 Nagoor Kani, "Signals and Systems ", 1st Edition 2010, Tata McGraw Hill.

Reference Text Books.

1 M J Roberts , "Signals & Systems ", Third edition , McGraw Hill, 2009

2 Dr D Ganesh Rao and Satish Tunga, "Signals & Systems ", Fourth edition , Sanguine, 2008

3 P Ramakrishna Rao and Shankar Prakriya , "Signal & Systems" Second edition Mcgraw Hill 2013

Web Links.

1 https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/

2 https://www.sanfoundry.com/signals-systems-questions-answers-mcqs/

Subject Title : Field Theory

Sub.Code: 18EE52	No. of Credits:04=04:0:0 (L - T – P)	No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:52

Course Learning Objectives:

1 To understand the concept of Coulomb's law, Gauss' law and divergence and its applications

2 To understand the concept of energy, density, conductor and dielectrics and the boundary conditions for an electric field

3 To understand the concept of Poisson's, Laplace law and magnetic field and its applications

4 To understand the concept of magnetic forces and magnetic materials

5 To understand the applications of Maxwell's equations and time varying fields

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**a) Coulomb's Law and electric field intensity:** Experimental law of Coulomb, Electric field intensity, Types of charge distributions. Field due to various charge distributions-Line charges, Surface charge, Volume charge. Fields due to infinite line charge, charged circular ring, infinite sheet charge. **b) Electric flux density, Gauss' law and divergence:** Electric flux and flux density, Flux density for various charge distributions-Line charge, surface charge, volume charge. Gauss' law, Divergence, Maxwell's First equation (Electrostatics), vector operator and divergence theorem. TEXT 1 TEXT 2 and TEXT 3. Reference Books	12	L1,L2,L3,L4
2	**a) Energy and potential:** Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and Potential, The potential field of a point charge and system of charges, Potential gradient, Energy density in an electrostatic field. **b) Conductors and dielectrics:** Current and current density, Continuity of current, metallic conductors, Conductor properties and boundary conditions, boundary conditions for perfect Dielectrics. TEXT 1 TEXT 2 and TEXT 3. Reference Books	10	L1,L2,L3,L4
3	**a) Poisson's and Laplace's equations:** Derivations of Poisson's and Laplace's Equations. Examples of the solutions of Laplace's and Poisson's equations. **b) The steady magnetic field:** Biot-Savart law, Ampere's circuital law, Curl, Stokes' theorem, magnetic flux and flux density, scalar and Vector magnetic potentials. TEXT 1 TEXT 2 and TEXT 3. Reference Books	10	L1,L2,L3,L4
4	**a) Magnetic forces and materials:** Force on a moving charge and differential current element, Force between differential current elements, Force and torque on a closed circuit.	10	L1,L2,L3,L4

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	b) Magnetic materials: Magnetization and permeability, Magnetic boundary conditions, Magnetic circuit, Potential energy and forces on magnetic materials. TEXT 1 TEXT 2 and TEXT 3. Reference Books		
5	**Time varying fields and Maxwell's equations:** Faraday's law, displacement current, General field relations for time varying Electric and Magnetic fields. Maxwell's equation in point and Integral form. TEXT 1 TEXT 2 and TEXT 3. Reference Books	10	L1,L2,L3,L4

Note 1: Unit 1 to 5 will have internal choice

Note2:
a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT presentation/subject quiz/project/seminar

Note:3 Out of 5 Units, Unit 5 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

Course Outcomes:

CO1 Able to define and state the behaviour of static electric fields in standard configurations.

CO2 Able to explain concepts of Energy and Potential to solve numerical problems.

CO3 Able to solve problems on Poisons and Laplace's equations, Biot-savarts law and Circuital laws.

CO4 Able to distinguish the behaviour of Electrostatic and electromagnetic fields between two dielectrics/conductor-dielectric boundaries

CO5 Able to apply Maxwell's equations for real time problems

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1.	**CO1**	**1,2**	**12**	3	3	2	1	1		1			1		2
2.	**CO2**	**1,2**	**10**	3	3	2				1			1		2
3.	**CO3**	**3**	**10**	3	3	2	1				1		1		1
4.	**CO4**	**4**	**10**	3	3	2	1			1			1		1
5.	**CO5**	**5**	**10**	3	3	2	1				1		1		2
Average CO				**3**	**3**	**2**	1	1		1	1		1		2

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2

CO5	2	2	2
Average CO	**2**	**2**	**2**

Text Books.

1 S. P. Basavaraju, "Field Theory", First Edition, Sunstar Publisher, 2014

2 William H Hayt Jr. and John A Buck, "Engineering Electromagnetics", 7th edition, Tata McGraw-Hill, 2006

3 J A Edminister, "Electromagnetics", 2nd edition, Tata McGraw-Hill, 2006

Reference Text Books.

1 John Krauss and Daniel A Fleisch , "Electromagnetics with Applications", 5th edition, Tata McGraw-Hill, 1999

2 Edward C. Jordan and Keith G Balmain, Prentice, "Electromagnetic Waves And Radiating Systems", 2nd edition, Hall of India, 2008

Web Links.

1 Markus Zahn, "Electromagnetic Field Theory A Problem Solving Approach", Massachusetts Institute of Technology

2 David H. Staelin, "Electromagnetics and Applications", Massachusetts Institute of Technology

Subject Title : MICROCONTROLLER

Sub.Code:18EE53	No. of Credits:03=03:0:0 (L - T – P)	No. of Lecture Hours/Week :03
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1. To understand the concept and Architecture of Microcontroller, logical Instruction & Assembly programming.
2. To learn branching Instructions & C- programming,
3. To learn timer operation, modes of operation, interrupts, serial programming,.
4. The learn programming languages instructions involved call and subroutine function
5. To make use of the Hardware Interfacing of ADC, DAC, Motor, LCD & Keyboard.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**The 8051 Architecture:** Introduction, 8051 microcontroller hardware, input/output pins, ports, circuits, external memory, counter and timers, serial data input/output, interrupts.	7	L2,L3,L4
2	**Addressing Modes and Operations**: Introduction, addressing modes, external data transfer, code memory, read only data moves/indexed addressing mode, push and pop. Data exchanges, example programs; byte level logical operations, bit level logical operations, rotate and swap operations, example programs. arithmetic operations: Flags, incrementing and decrementing, addition ,subtraction, multiplication and division, decimal arithmetic, program examples	8	L2,L3,L4
3	**Jump and Call Instructions:** The Jump and CALL program range, jumps, calls and subroutines, interrupts and returns, more details on interrupts, program example.8051 programming in c: data types and time delays in 8051 c, I/O programming, logic operations, data conversion programs, accessing code ROM space, data serialization.	7	L2,L3,L4
4	**Timer / Counter Programming in 8051**: Programming 8051 Timers, Counter programming, programming timers 0 and 1 using C/assembly language.	8	L2,L3,L4
5	**8051 Serial Communication**: Basics of serial communication, 8051 connections to RS-232, 8051 serial communication programming. **Interrupts Programming:** 8051 Interrupts, programming timer interrupts, programming external hardware interrupts, programming the serial communication interrupts, interrupt priority in the 8051/52. **8051 Interfacing Applications**: Interfacing 8051 to LCD, keyboard, parallel and serial ADC, DAC, stepper motor interfacing, DC motor interfacing and PWM.	9	L2,L3,L4

Note 1: Unit 1 to 5 will have internal choice

Note2:
a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT presentation/subject quiz/project/seminar

Note:3 Out of 5 Units, Unit 5 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

Course Outcomes:

CO1 Explain the architecture & difference between Microprocessor & Microcontrollers.
CO2 Use the arithmetic and logical instructions.
CO3 Use the instructions for writing assembly language and C program.
CO4 Use timers in Assembly Language and C program.
CO5 Use interrupts for serial and external peripherals interface.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				a	b	c	d	e	f	g	h	i	j	k	l
1.	CO1	2,3,4	10	3	3	2	2		1						1
2.	CO2	2,3,4	11	3	3	2	2		1						1
3.	CO3	2,3,4	11	3	3	2	2		1						1
4.	CO4	2,3,4	10	3	2	2	2		1						1
5.	CO5	2,3,4	10	3	3	2	2		1						1
Average CO				3	3	2	2		1						1

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	3	1
CO5	3	2	1
Average CO	**3**	**2**	**1**

Text Books.

1 Kenneth J Ayla,, "The 8051 Microcontroller Architecture, Programming & Applications", 2nd Edition, Thomson Learning l, 2005
2 Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded Systems-Using Assembly and C", 2 Vol, PHI Pearson, 2010
3 Manish K Patel,"The 8051 Microcontroller Based Embedded Systems", 1st Edition, Tata Mcgraw Hill, 2014.

Reference Text Books.

1. K M Bhurchandi, A K Ray, "Advanced Microprocessors and Peripherals: With ARM and an Introduction to Microcontrollers and Interfacing",", 3rd Edition, Tata Mc GrawHill, 2012
2. S.K Mandal, "Microprocessors and Microcontrollers: Architecture, Programming & Interfacing using 8085, 8086, and 8051"", 2nd edition, Tata Mc GrawHill, 2011
3. Salvador PinillosGimenez,S.K Mandal, "8051 Microcontrollers: Fundamental Concepts, Hardware, Software and Applications in Electronics", 1st edition, Springer, 2019
4. S .Subrata Ghoshal.K Mandal, "8051 Microcontroller: Internals, Instructions, Programming and Interfacing", 2nd edition, Pearson, 2010

Web Links.

1. https://www.circuitstoday.com/4-books-to-learn-8051-microcontroller
2. http://web.mit.edu/6.115/www/document/8051.pdf
3. https://www.quora.com/What-are-the-best-books-for-8051-microcontroller
4. https://books.google.co.in/books/about/The_8051_Microcontroller.html?id=l6lveWkWqF

Subject Title : : Electrical Machine Design

Sub.Code: 18EE54	No. of Credits:04=04:0:0 (L - T – P)	No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs	CIE+Assmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:52

Course Learning Objectives:

1. To introduce the knowledge on basic principles of design, limitations and different materials used in electrical machines.
2. To understand the design concepts of Transformers.
3. To understand the problems on design of Transformers to satisfy the requirements
4. To understand the design concepts of AC and DC rotating electrical machines.
5. To understand the problems on design of AC and DC rotating electrical machines to satisfy the requirements.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Principles of Electrical Machine Design:** Introduction, considerations for the design of electrical machines, limitations. Different types of conducting, magnetic and insulating materials used in electrical machines. Design of Transformers (Single Phase and Three Phase): Output equation for single phase and three phase transformers, choice of specific loadings, expression for volts/turn, determination of main dimensions of the core, types of windings and estimation of number of turns and conductor cross sectional area of primary and secondary windings. TEXT 1 and TEXT 2. Reference Book1	12	L1-L5
2	**Estimation of Leakage Reactance and Tank Design of Transformer:** Estimation of no load current, expression for leakage reactance and voltage regulation. Design of tank and cooling tubes (round and rectangular). TEXT 1 and TEXT 2 Reference Book1	10	L1-L5
3	**Design of DC machines:** Output equation, choice of specific loadings and choice of number of poles, design of main dimensions of the dc machines, design of armature slot dimensions, Commutator and brushes, magnetic circuit - estimation of ampere turns, design of yoke and pole, field windings – shunt, series. TEXT 1 TEXT 2 Reference Book 1	10	L1-L5
4	**Design of induction Motors:** Output equation, choice of specific loadings, main dimensions of three phase induction motor, stator winding design, choice of length of the air gap, estimation of number of slots for the squirrel cage rotor, design of rotor bars and end ring, design of slip ring induction motor, estimation of no load current. TEXT 1 and TEXT 2. Reference Book1	10	L1-L5

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
5	**Design of Synchronous Machines:** Output equation, choice of specific loadings, short circuit ratio, design of main dimensions, design of the field winding, armature slots and windings, slot details for the stator of salient and non-salient pole synchronous machines. TEXT 1 and TEXT 2. Reference Book1	10	L1-L5

Note 1: Unit 1 to 5 will have internal choice

Note 2:
a) a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT Presentation/Subject Quiz/Project/Seminar.

Note:3 Out of 5 Units, Unit 2 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

Course Outcomes:

CO1 Apply the basic principles of design, and to select the best materials used in electrical machines

CO2 Explain design concepts of static electrical machines.

CO3 Analyse the design concepts of rotating electrical machines for the optimized performance.

CO4 To solve the design problems of static electrical machines.

CO5 To design the rotating electrical machines for the optimized performance.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1.	CO1	**2**	**12**	2	3	3	1		1	1	1	1	1	1	1
1	CO2	**2**	**10**	2	3	2	1		1	1	1	1	1	1	1
3.	CO3	**4**	**10**	2	2	3	1		1	1	1	1	1	1	1
4.	CO4	**5**	**10**	2	3	2	1		1	1	1	1	1	1	1
5.	CO5	**5**	**10**	2	3	2	1		1	1	1		1		1
Average Co				2	3	2	1		1	1	1	1	1	1	1

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	3	1
CO5	3	2	1
Average CO	**3**	**2**	**1**

Text Books.

1. . A.K. Sawhney, "A Course In Electrical Machine Design", 4th edition, Dhanpatt Rai & Co, 2016
2. V. N. Mittle, " Performance And Design Of AC Machines ", 4th edition Standard Publishers Distributors

Reference Text Books.

1. M.G. Say, "Performance And Design Of AC Machines", edition, CBS Publishers and Distributors Pvt.Ltd.r, 2002
2. A. Shanmugasundarm, G. Gangadharan, R. Palani, "Design Data Handbook", edition,, year

Web Links.

1. https://www.quora.com/Where-can-I-get-a-A-K-Sawhney-PDF-of-a-course-in-electrical-machine-design
2. https://books.google.co.in/books/about/Design_Of_Electrical_Machines.html?id=7mTRGAAACAAJ

Subject Title : Control System Lab

Sub.Code: 18EEL56	No. of Credits:1=0:0:1 (L - T – P)	No. of Lecture Hours/Week : 02
Exam Duration:3 Hrs	CIE +SEE=50+50=100	Total No.of Contact Hours:26

Course Learning Objectives:

1 To study transient and steady state behaviour of linear control system.
2 To design compensating networks for improvement of stability.
3 To study frequency response of second order system.
4 To study time domain response characteristics of second order system.
5 To study AC/DC servomotor and P,I,D performance.

Expt No	Experiments	No.of Hours	Blooms Taxnomy level.
1.	Simulation of a typical second order system and determination of step response and evaluation of time- domain specifications using a software tool	2	L1-L4
2.	(a) Design of a passive RC lead compensating network for the given specifications, viz., the maximum phase lead and the frequency at which it occurs and to obtain its frequency response. (b) Experimental determination of transfer functions of a lead compensating network.	2	L1-L5
3	(a) Design of a RC lag compensating network for the given specifications. viz., the maximum phase lag and the frequency at which it occurs, and to obtain its frequency response. (b) Experimental determination of transfer functions of a lag compensating network.	2	L1-L5
4	Study of the effect of P, PI, PD and PID controller on the step response of a feedback control system (using control engineering trainer/process control simulator).	2	L1-L4
5	Speed – torque characteristic of a two - phase A.C. servomotor.	2	L1-L4
6	Speed torque characteristic of a D.C. servomotor.	2	L1-L4
7.	Experimental determination of frequency response of a second -order system and evaluation of frequency domain specifications	2	L1-L4
8.	Simulation of a D. C. position control system and its step response.	2	L1-L4
9	Determination of phase margin and gain margin of a transfer function by Bode Plots and verification by simulation.	2	L1-L4
10	Construction of root locus of transfer function and verification by simulation.	2	L1-L4
11	Synchro pair characteristics.	2	L1-L4
	Experiments beyond syllabus		
01	Determination of Observability and Controllability of a system in MATLAB.	2	L1- L4

Expt No	Experiments	No.of Hours	Blooms Taxnomy level.
02	Determination of phase margin and gain margin of a transfer function by Nyquist plot by MATLAB simulation.	2	L1-L4

Note 1: Laboratory report should be submitted to the subject faculty every week and evaluation will be done on the same week only.

Course Outcomes:

CO1 Understand and analyze the time and frequency domain specifications for a second order system.

CO2 Analyze the performance of servomotors.

CO3 Evaluating system performance using P,I,D controllers.

CO4 Design the control system with compensators.

CO5 Use MATLAB for simulation and validation of results obtained by analytical calculations.

Course outcomes Mapping with programme outcomes

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1:	**2**	**4**	**3**	**3**		**3**	**3**			**1**		**1**	**1**	**1**
2.	CO2:	**3**	**4**	**3**	**3**		**3**	**3**			**1**		**1**	**1**	**1**
3.	CO3:	**5**	**2**	**3**	**3**		**3**	**3**			**1**		**1**	**1**	**1**
4.	CO4:	**6**	**4**	**3**	**3**	**3**	**3**	**3**			**1**		**1**	**1**	**1**
5.	CO5:	**2**	**8**	**3**	**3**		**3**	**3**			**1**		**1**	**1**	**1**
Average CO				**3**	**3**	**3**	**3**	**3**			**1**		**1**	**1**	**1**

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	3	1
CO5	3	3	1
Average CO	**3**	**3**	**1**

Text Books.

1 Matlab user manual, Ogata.

References

1 Matlab by Rudrapratap.

Web Links.

1 http://vlabs.iitkgp.ernet.in/vlabs/vlab4/control/motorcontrol/closedloop/pidcontinuous/clpidc_aim.html

2 http://vlabs.iitkgp.ernet.in/vlabs/vlab4/control/motorcontrol/openloop/ol_aim.html

3 http://ialcoep.vlabs.ac.in/Expt6/Aim.html?domain=Electrical%20Engineering&lab=Industrial%20Automation%20Laboratory

4 http://209.211.220.205/vlabiitece/labs.php

Subject Title : DC MACHINES & SYNCHRONOUS MACHINES LAB

Sub.Code:18EEL57	No. of Credits:1=0:0:1(L - T – P)	No. of Lecture Hours/Week :02
Exam Duration:3 Hrs	CIE +SEE=50+50=100	Total No.of Contact Hours:26

Course Learning Objectives:

1 To introduce various testing methods for DC and synchronous machines.

2 To learn various losses occurring in DC machines and to find efficiency of a DC machines..

3 To learn the characteristics, performance and speed control of DC machines.

4 To determine voltage regulation of synchronous machines by various methods.

5 To study the behaviour of synchronous machine connected to infinite bus bars.

Expt No	Experiments Contents	No.of Hours	Blooms Taxnomy level.
1	Open circuit characteristics of DC machine.	2	L1, L2
2	Load characteristics of a D.C. shunt and compound generator - i) short shunt-cumulative and differential (ii) Long shunt-cumulative and differential.	2	L1,L2,L3.
3	Load test on a DC motor - determination of speed-torque and HP-efficiency characteristics.	2	L1, L2, L3,L4
4	Swinburne's test.	2	L1, L2, L3,
5	Hopkinson's test.	2	L1, L2, L3, L4
6	Speed control of DC motor by armature voltage control and flux control.	3	L1, L2, L3, L4
7.	Ward Leonard method of speed control of D.C. motor.	3	L1, L2, L3, L4
8.	Voltage regulation of an alternator by EMF and MMF method.	3	L1, L2, L3, L4
9	Voltage regulation of an alternator by ZPF method.	3	L1, L2, L3, L4
10	Slip test and determination of regulation.	3	L1, L2, L3, L4
11	Performance of synchronous generator connected to infinite bus under constant power and variable excitation.	3	L3.L4
12	V and Inverted V curves of a synchronous motor.		
	Experiments beyond syllabus		
01	Field's test on series motors.	3	L1, L2, L3, L4
02	Load test on series generator.	3	L1, L2, L3, L4

Note 1: Laboratory report should be submitted to the subject faculty every week and evaluation will be done on the same week only.

Course Outcomes:

CO1 Choose proper testing method to determine losses and efficiency of a DC machine and to determine voltage regulation of synchronous generator.

CO2 Explain the characteristics of DC machines and synchronous machines by conducting suitable tests.

CO3 Apply the basic concept for experimental determination of voltage regulation of synchronous generator.

CO4 Analyze the performance of DC machines on load and synchronous machines on infinite bus bars.

CO5 Evaluate the losses and efficiency of DC machines and performance of synchronous machines connected to infinite bus bars.

Course outcomes Mapping with programme outcomes

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1:	**1,2**	**4**	3	3			2				3			1
2.	CO2:	**1 - 3**	**5**	3	3			2				3			1
3.	CO3:	**1 - 3**	**5**	3	3			2				3			1
4.	CO4:	**1 - 4**	**5**	3	3			2				3			1
5.	CO5:	**1 - 4**	**5**	3	3	1		2				3			1
Average CO				3	3	1		2				3			1

Course outcomes mapping with Programme Specific Outcomes

Course Outcome	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	2	
CO3	3	2	2
CO4	3	2	
CO5	3	2	2
Average CO	**3**	**2**	

References Text Books.

1 Department manual.

Web Links.

1 http://vlab.amrita.edu/?sub=1&brch=75&sim=217&cnt=1

2 http://vlab.amrita.edu/?sub=1&brch=75&sim=322&cnt=1

Subject Title : PROGRAMMABLE LOGIC CONTROLLERS

Sub.Code: 18EE551	No. of Credits:03=03:0:0 (L - T – P)	No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1. The need of automation in the industry with basic controller mechanisms involved.
2. The programming concepts to achieve the desired goal or to define the various steps involved in the automation.
3. The programming languages involved with basic subroutine functions.
4. To make use of the internal hardware circuits of automation circuit to control the devices during various states with monitoring the timers and counters
5. To handle the data of the I/O devices to interface the data with the controller and auxiliary devices.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Introduction:** programmable logic controller (PLC). Role in automation (SCADA). Advantages and Disadvantages, Hardware of PLC, Internal Architecture, Sourcing and Sinking, **Input and Output Devices:** Characteristics of I/O devices, List of input devices- mechanical switches, proximity switches, photoelectric sensor and switches, temperature sensor. Output devices- relay, directional control valve and motor. Examples of applications- conveyor belt, lift and Liquid level monitoring. TEXT 1 and TEXT 2.	8	L1,L2,L3
2	**I/O Processing:** Input unit / Output unit, Signal conditioning- changing voltage level, Remote connection- serial and parallel communication, serial standard. Networks and its types. **Programming**: Ladder Diagrams- PLC ladder programming, Logic Functions, Latching, Multiple Outputs, Function Blocks- Logic gates, Boolean Algebra, Program Examples- Signal lamp task, Valve operation program. TEXT 1 and TEXT 2.	8	L2,L3
3	**Programming Methods**: Instruction Lists- Ladder programs and Instruction lists, Branch codes, Programming Examples- Signal lamp task and Valve operation program. Sequential Function Charts- Branching and convergence. Structured Text- Conditional statement and iteration statements **Internal Relays**: internal relay, ladder programs- programs with multiple input conditions and Latching programs, Battery-Backed relays. TEXT 1 and TEXT 2.	8	L1,L2,L3
4	**ii) Internal relays**: One-Shot Operation, Set and Reset, Program Examples- Fire alarm system and Loading system, Master control relay. **Jump and Call**: jump- jumps within jumps, Subroutines call. **Timers**: Types of Timers, On-Delay Timers, Excluded- sequencing and cascaded timers. Off-Delay Timer, Pulse Timers, Programming Examples- Flashing light and Traffic light sequence. Counters: Forms of	8	L2,L3,L4

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	Counter, Programming, Counter Application- Counting task. Up and Down counting. TEXT 1 and TEXT 2		
5	**Shift Registers**: Ladder Programs-4-bit shift register, Sequencing Application- sequencing cylinders and keeping track of faulty items. **Data Handling**: Registers and Bits, Data Handling- Data movement, Data comparison, Data Selection. Arithmetic Functions- Conversion BCD-to-binary and binary-to-BCD. TEXT 1	7	L3,L4

Note 1: Unit 1 to 5 will have internal choice

Note 2:
a) a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT Presentation/Subject Quiz/Project/Seminar.

Note:3 Out of 5 Units, Unit 2 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

Course Outcomes:

CO1 Need of automation and its various control strategies with its auxiliary devices.
CO2 Programs for various functional block consisting of multiple inputs and outputs and to control
CO3 Programming issues with subroutines and debugged
CO4 The use of auxiliary units of a controller with hardware exposure.
CO5 The data handling with simple hardware.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	d	e	f	g	h	i	j	k	l
1.	CO1:	L1,L2,L3	8	3	1	1	2								
2.	CO2:	L2,L3,	8	3		2	1							1	
3.	CO3:	L1,L2,L3	8		3	2	1	2							
4.	CO4:.	L2,L3,L4	8	3	1							1		2	2
5.	CO5:	L3,L4	7				3	2		1				1	1
Average CO				3	2	2	2	2		1		1		1	2

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1

CO4	3	3	1
CO5	3	2	1
Average CO	**3**	**2**	**1**

Text Books.

1 W Bolton, "Programmable Logic Controllers", 5th Edition, Elsevier- newness, 2009.

2 John W Webb, Ronald A Reis, "Programmable Logic Controllers - Principles and Applications", 5th Edition, Pearson Education, 2007

Reference Text Books.

1 L.A.Bryan, E. A Bryan, "Programmable Controller Theory and Applications", 2nd Edition, An Industrial Text Company Publication, 1997.

2 E. A Paar, "Programmable Logic Controllers", 3rd Edition, An Engineers Guide. Newness, 2003.

3 Garry Dunning, "Introduction to Programmable Logic Controller", 3rd Edition , Thomson Asia Pte Ltd. Publication , 2006

4 Rajesh Mehra, Vikrant Vij, "PLCs & SCADA - Theory and Practice", 2nd Edition, laxmi publication, 2017

5 Kevin Collins, "PLC Programming for Industrial Automation", 1st Edition, Kindle, 2016

Web Links.

1 news.mit.edu/topic

2 https://www.allaboutcircuits.com/textbook/digital/chpt-6/programmable-logic-controllers-

3 https://electrical-engineering-portal.com/download-center/books-and-guides/electrica

4 https://onlinecourses.nptel.ac.in

5 https://www.g-w.com/programmable-logic-controllers

Subject Title : VLSI Circuit Design

Sub.Code: 18EE552	No. of Credits:3=3:0:0(L-T-P)	No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1 To introduce the present technology applied in the MOS Fabrication.

2 To design and analyze the basic electrical properties of various transistors and its electrical equivalent models.

3 To teach the students regarding the classical representations of the various transistors and to enable the electrical engineers to calculate the circuit parameters involved in the scaling process

4 Issues arising during the architectural and structural design of a basic sequential and clocked circuit is discussed

5 Be able to design models of moderately sized CMOS circuits that realize specified digital functions

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**A Review of Microelectronics and an Introduction to MOS Technology:** Introduction to Integrated Circuit Technology. Introduction, VLSI Technologies, MOS Transistors, Fabrication, Thermal Aspects, Production of E-Beam Masks. TEXT 1 and TEXT 2. Reference Book 1 & 2	08	L1,L2,L3.
2	**Basic Electrical Properties of MOS and BICMOS Circuit:** Drain to Source Current I_{ds} Versus V_{ds} Relationships- BICMOS Latch Up Susceptibility. MOS Transistor Characteristics, Figure Of Merit, Pass Transistor NMOS And CMOS Inverters, Circuit Model, Latch Up In CMOS Circuits TEXT 1 and TEXT 2. Reference Book 1 & 2	08	L1,L2,L3.
3	**MOS and BICMOS Circuit Design Processes:** MOS Layers, Stick Diagrams, Design, Symbolic Diagrams. **Basic Circuit Concepts and Scaling of MOS Circuits:** Sheet Resistance, Capacitance Layer Inverter Delays, Wiring Capacitance, Choice of Layers. Scaling Model and Scaling Factors- Limitations Due to Current Density. TEXT 1 and TEXT 2. Reference Book 1 & 2	08	L2,L3,L4
4	**Subsystem Design and Layout:** Architectural Issues, Systems Considerations. Examples of Structural Design, Clocked Sequential Circuits. TEXT 1 and TEXT 2. Reference Book 1 & 2	07	L2,L3,L4
5	**Subsystem Design Processes: G**eneral Considerations, Illustration of Design Process, Observations. **Illustration of The Design Process:** Observation On the Design Process, Regularity Design of an ALU Subsystem. Design of 4-	08	L2,L3,L4

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	Bit Adder, Implementation of ALU Functions. TEXT 1 and TEXT 2. Reference Book 1 & 2		

Note 1: Unit 1 to 5 will have internal choice

Note 2:
c) a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
d) Group Activity for 5 Marks has to be evaluated through PPT Presentation/Subject Quiz/Project/Seminar.

Note:3 Out of 5 Units, Unit 5 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

Course Outcomes:

CO1 Impart knowledge of MOS transistor theory and CMOS technologies

CO2 Understand different properties of MOS and BICMOS circuits.

CO3 Analyze the design process of MOS and BICMOS circuits along with scaling of MOS circuits..

CO4 Understand and analyse subsystem design and layout.

CO5 To understand the process of subsystem design.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1:	**1**	**10**	**3**	**1**		**2**				**2**		**2**		**1**
2.	CO2	**2**	**11**	**3**	**1**		**2**				**2**		**2**		**1**
3.	CO3:	**3**	**11**	**3**	**1**		**2**				**2**		**2**		**1**
4.	CO4:	**4**	**10**	**3**	**1**		**2**				**2**		**2**		**1**
5.	CO5:	**5**	**10**	**3**	**1**		**2**				**2**		**2**		**1**
Average CO				**3**	**1**		**2**				**2**		**2**		**1**

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	2		1
CO2	2		1
CO3	2	2	1
CO4	2	2	1
CO5	2	2	1
Average CO	2	2	1

Text Books.

1 Neil Weste, "Introduction to CMOS VLSI Design-A Circuits and Systems Perspective", Third Education, Pearson Publisher, 2006

2 Douglas Pucknell & Eshragian, "Basic VLSI Design", Third Education, PHI Publisher, 2009

Reference Text Books.

1 Yuan TaunTak H Ning Cambridge Press,"Fundamentals of Modern VLSI Devices", South Asia Edition, Cambridge Press Publisher, 2003

2 Wayne wolf,, "Modern VLSI Design", Third Edition, Pearson Education publisher, 2003

Web Links.

1 https://nptel.ac.in/courses/117/106/117106092/

2 https://www3.nd.edu/~kogge/courses/cse40462-VLSI-fa18/www/links.html

3 https://www.smartzworld.com/notes/vlsi-circuits-and-design-notes-vtu-vcd/

Subject Title : MODERN CONTROL THEORY

Sub.Code: 18EE553	No. of Credits:03=03:0:0 (L - T – P)	No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1 To explain the concepts of basic and modern control system for the real time analysis and design of control systems.

2 To explain and apply concepts of state variables analysis.

3 To study and analyse nonlinear systems.

4 To analyse the concept of stability of nonlinear systems and categorization.

5 To apply the comprehensive knowledge of optimal theory for Control Systems.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**State Variable Analysis and Design**: Introduction, concept of state, state variables and state model, state modelling of linear systems, linearization of state equations. State space representation using physical variables, phase variables & canonical variables. TEXT 1 , TEXT 2 and TEXT 3. Reference Book 1 to 4	8	L1,L2,L3,L4
2	**Derivation of transfer function from state model**, Diagonalization, Eigen values, Eigen vectors, generalized Eigen vectors. Solution of state equation, state transition matrix and its properties, computation using Laplace transformation. TEXT 1, TEXT 2 and TEXT 3. Reference Book 1 to 4	8	L1,L2,L3,L4
3	**Concept of controllability & observability**, methods of determining the same, effect of pole zero cancellation, duality. TEXT 1, TEXT 2 and TEXT 3. Reference Book 1 to 4	7	L1,L2,L3,L4
4	**Pole Placement Techniques**: stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole placement, state regulator design. TEXT 1, TEXT 2 and TEXT 3. Reference Book 1 to 4	8	L1,L2,L3,L4
5	**Non-linear systems**: Introduction, behaviour of non-linear system, common physical non linearity-saturation, friction, backlash, dead zone, relay, multi variable non-linearity. Phase plane method, singular points, stability of nonlinear system, limit cycles, construction of phase trajectories. TEXT 1, TEXT 2 and TEXT 3. Reference Book 1 to 4	8	L1,L2,L3,L4

Note 1: Unit 1 to 5 will have internal choice

Note2:
a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/ Project/Seminar.

Note:3 Out of 5 Units, Unit 5 is a Webinar unit conducted through Google Classroom/Zoom/Cisco WebEx etc. and will be delivered by subject faculty.

Course Outcomes:

CO1 Understand the fundamentals of state variables, linear and nonlinear systems.

CO2 Analyze SISO and MIMO systems and obtain the state models.

CO3 Application of Eigen values for derivation of transfer functions.

CO4 Perform analysis on Controllability and Observability.

CO5 Improve stability of a given system by state feedback pole placement techniques.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1	**2**	**8**	**3**	**3**	**1**	**2**	**1**			**2**		**2**		**1**
2.	CO2	**4**	**8**	**3**	**3**	**1**	**2**	**1**			**2**		**2**		**1**
3.	CO3	**3**	**8**	**3**	**3**	**1**	**2**	**1**			**2**		**2**		**1**
4.	CO4	**4**	**7**	**3**	**3**	**1**	**2**	**1**			**2**		**2**		**1**
5.	CO5	**4**	**8**	**3**	**3**	**1**	**2**	**1**			**2**		**2**		**1**
Average CO				**3**	**3**	**1**	**2**	**1**			**2**		**2**		**1**

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	3	1
CO5	3	3	1
Average CO	**3**	**3**	**1**

Text Books.

1 M. Gopal, "Digital control & state variable methods.", 3rd Edition, TMH, 2008

2 I. J. Nagarath& M. Gopal, "Control system Engineering", 5th edition, New Age International (P) Ltd, 2007

3 Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Prentice Hall India, 1997

Reference Text Books.

1 Benjamin C. Kuo & Farid Golnaraghi, "Automatic Control Systems", 8th edition, John Wiley & Sons , 2009

2 D. Roy Choudary, "Modern Control Engineering", 4th reprint, PHI, 2009

3 Dorf & Bishop, "Modern control systems", 11th Edition, Pearson education, 2008

4 Katsuhiko Ogata, "State Space Analysis of Control Systems", 5th edition PHI, 1997

Web Links.

1 http://control.asu.edu/Classes/MMAE543/543Lecture01.pdf

2 http://eacademic.ju.edu.jo/alhusari/Material/ModernControlNotes.pdf

Subject Title : EMBEDDED SYSTEMS

Sub.Code:18EE554	No. of Credits:03=03:0:0 (L - T – P)	No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1 Provide the knowledge about basic concepts of Embedded Systems.

2 Outline the concepts of typical embedded systems

3 Real-time systems: Identify the unique characteristic, explain general structure and define the unique design problems and challenges of real-time system

4 Understand basics, program, design, implement and test an embedded system and issues in designing.

5 Describe the concepts of real time operating system based embedded systems and Design and Development of Embedded Firmware.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Concept of Embedded System:** Introduction, Embedded System vs. General Computing Systems, History of Embedded Systems, Components, classification, skills required. Core of Embedded systems, Embedded Memories ROM variants and RAM. Major applications areas of embedded system, Purpose of Embedded Systems Examples of Embedded systems, 'Smart' Running Shoes from Adidas-The Innovative Bonding of Lifestyle with Embedded Technology. TEXT 1 and Reference Book	08	L1,L2
2	**Technological Aspects of Embedded System:** Interfacing between analog and digital blocks, Signal conditioning, digital signal processing, DAC & ADC interfacing, Signal conditioning using DSP. **Hardware Software Co-Design and Program Modeling:** Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language, Hardware Software Trade-offs. TEXT 1 and TEXT 2. Reference Book	08	L1,L2
3	**Design Trade Offs Due to Process Incompatibility, Thermal Considerations:** Issues in embedded system design. Design challenge, design technology, trade-offs. Thermal considerations, Embedded Firmware Design Approaches, Embedded Firmware Development Languages. TEXT 1 and TEXT 3. Reference Book	08	L1,L2,L3.
4	**Software aspects of Embedded Systems:** Real time programming Languages, operating systems. Programming concepts and embedded programming in C. Round Robin, Round	07	L1, L2, L3, L4

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	Robin with interrupts, Real time OS architecture, selecting architecture. Introduction to RTOS, Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling. TEXT 1 and TEXT 2. Reference Book		
5	**Subsystem interfacing:** External system, user interfacing and Serial I/O devices, Parallel port interfaces: Input switches, Key boards and Memory interfacing. Trends in the Embedded Industry: Processor Trends in Embedded System, Embedded OS Trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks. TEXT 1 and TEXT 2. Reference Book	08	L1, L2, L3, L4

Note 1: Unit 1 to 5 will have internal choice

Note2:
a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/Project/Seminar.

Note:3 Out of 5 Units, Unit 4 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

Course Outcomes:

CO1 Apply the knowledge of Microcontrollers to understand & explain the concepts of Embedded systems

CO2 Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.

CO3 Design and Develop domain specific Embedded system applications.

CO4 Demonstrate understanding the facts of issues in embedded system design.

CO5 Design real time embedded systems using the concepts of RTOS and Analyze various examples of embedded systems by using the interfacing method.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1	**2**	**08**	**2**	**1**	**1**	**2**				**2**	**1**	**2**		**2**
2.	CO2	**2**	**08**	**3**	**3**	**1**	**1**				**2**		**2**		**2**
3.	CO3	**5**	**08**	**2**	**3**	**3**	**2**	**2**			**2**	**2**	**2**	**3**	**3**
4.	CO4	**4**	**07**	**3**	**3**	**1**	**2**				**2**		**2**		**3**
5.	CO5.	**5**	**08**	**3**	**3**	**1**	**2**				**2**		**2**		**3**
Average CO				**3**	**3**	**1**	**2**	**2**			**2**	**1**	**1**	**1**	**3**

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	1		
CO2	3	2	1

CO3	3	3	2
CO4	3	2	1
CO5	3	2	1
Average CO	**3**	**2**	**1**

Text Books.

1 Raj Kamal, "4.Embedded System, Architecture, Programming and Design", 2nd Edition, TMH, 2008

2 Valvano, J.W, "Embedded Microcomputer systems: Real time interfacing", 2nd Edition 5th Indian reprint, 2009

3 Shibu K V "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2009

Reference Text Books.

1 Frank Vahid/Tony Givargis, "A Unified Hardware/Software Introduction", Wiley student edition 2002. Choose an item., Choose an item.

2 Simon David, "Embedded Software Premier", Addison Wessly 2000.

Web Links.

1 Motorola and Intel Manuals

2 www.nptel.com

Subject Title :Renewable Energy Sources

Sub.Code: 18EEE01	No. of Credits:03=03:0:0 (L - T – P)	No. of Lecture Hours/Week :03
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1 To discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy,explain sun – earth geometric relationship, Earth – Sun Angles and their Relationships , discuss about solar energy reaching the Earth's surface and solar thermal energy ,applications.

2 To discuss types of solar collectors, their configurations and their applications. To explain the components of a solar cell system, equivalent circuit of a solar cell, its characteristics and applications.

3 To discuss benefits of hydrogen energy, production of hydrogen energy, storage its advantages and disadvantages. To discuss wind turbines, wind resources, site selection for wind turbine. To discuss geothermal systems, their classification and geothermal based electric power generation

4 To discuss biomass production, types of biomass gasifiers, properties of producer gas. To discuss biogas, its composition, production, benefits. To discuss tidal energy resources, energy availability, power generation.

5 To discuss principles of ocean thermal energy conversion and production of electricity.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India. Energy from Sun: Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications.TEXT1: and TEXT 2: Reference Book1	08	L1,L2,L3.
2	**Solar Thermal Energy Collectors**: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish. Solar Air Heating, Solar Dryers, Crop Drying, Space Cooling, Solar Cookers, Solar pond. TEXT1: TEXT 2: and TEXT 3 Reference Book 1	08	L1,L2,L3.
3	**Hydrogen Energy:** Benefits of Hydrogen Energy, Hydrogen Production Technologies, Hydrogen Energy Storage, Use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems Associated with Hydrogen Energy. **Wind Energy:** Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection. TEXT1:TEXT 2: Reference Book 1	08	L1,L2,L3.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
4	**Biomass Energy:** Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Chemistry of Reaction Process in Gasification, Updraft, Downdraft and Cross-draft Gasifiers and applications. **Biogas Energy**: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefits of Biogas, Factors Affecting the Selection of a Particular Model of a Biogas Plant-KVIC and Janatha models TEXT1: and TEXT 2: Reference Book 1:	08	L1,L2,L3.
5	**Tidal Energy:** Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Leading Country in Tidal Power Plant Installation, Energy Availability in Tides, Tidal Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy **Ocean Thermal Energy:** Introduction, Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants, Closed Cycle, Open Cycle, Advantages, Disadvantages and Benefits of OTEC TEXT1: and TEXT 2: Reference Book 1	07	L1,L2,L3.

Note 1: Unit 1 to 5 will have internal choice

Note2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5 and Group Activity for 5 Marks

Note:3 Out of 5 Units, Unit 5 is a Webinar unit and will be delivered by subject faculty using Zoom/Google meet/Gotomeet platforms.

Course Outcomes:

CO1 Understand and Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy. Explain renewable energy sources, Solar, Wind, Biomass, Geothermal, Ocean and Tidal systems.

CO2 Analyze and evaluate the implication of renewable energy. Concepts in solving numerical problems pertaining to solar radiation geometry.

CO3 Gain knowledge and Discuss energy from sun, energy reaching the Earth's surface and solar thermal energy, identify the applications and Discuss types of solar collectors, their configurations,solar cells and their characteristics

CO4 Apply engineering techniques and Gain knowledge, discuss various generation schemes of energy from hydrogen, Solar, wind,Biomass,Ocean thermal, Tidal and geothermal systems

CO5 Demonstrate self -learning capability to discuss production of energy from solar, Biomass and Biogas energy, Wind, Geothermal, Hydrogen, Tidal, Ocean thermal, world and Indian scenarios resources. Discuss production of energy from all the above.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1	**1,2**	**10**		**3**	**1**	**2**				**2**		**2**		**2**
2.	CO2	**3,2**	**12**	**3**	**3**	**1**	**2**				**2**		**2**		**2**
3.	CO3	**1, 2,3**	**12**	**3**	**3**	**1**	**2**				**2**		**2**		**2**
4.	CO4	**1, 2, 3**	**12**	**3**	**3**	**1**	**2**				**2**		**2**		**2**
5.	CO5	**2,3**	**10**	**3**	**3**	**1**	**2**				**2**		**2**		**2**
Average CO				**3**	**3**	**1**	**2**				**2**		**2**		**2**

Course Outcomes Mapping with PSOs

Sl.No	Course Outcome	PSO1	PSO2	PSO3
1.	CO1		**2**	**3**
2.	CO2		**2**	**3**
3.	CO3		**2**	**3**
4.	CO4		**2**	**3**
5.	CO5		**2**	**3**
Average CO			**2**	**3**

Text Books.

1 G D Rai, "Non- Conventional Energy Sources", Fourth Edition, Khanna Publisher, 1997

2 B H Khan, "Non-Conventional Energy Sources", Second edition, TMH,

3 S P Sukhatme, "Solar Energy for Thermal applications", Second edition, TMH, 2009

Reference Text Books.

1 S S Thipse, "Non- Conventional and Renewable energy Sources", Fourth edition, Narosa publishers, 2014

Web Links.

1 www.mnre.org

2 www.renewableenergyworld.com

3 www.powergridindia.com

4 www.saurenergy.com

5 https:nptel.ac.in

Dr. Ambedkar Institute of Technology, Bengaluru-560 056

SCHEME OF TEACHING AND EXAMINATION for 2018 batch - Academic Year 2020-21

B.E in Electrical and Electronics Engineering

Outcome Based Education (OBE) and Choice Based Credit System (CBCS**)**

VI Semester

Sl. No	**Course and Course Code**		**Course Title**	**Teaching Dept.**	Teaching Hours / Week			**Examination**				Credits
					Theory Lecture (L)	**Tutorial (T)**	Practical (P)	**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	HS	18HS61	Intellectual Property Rights(IPR)	HS	02	00	00	02	050	050	100	03
2	PC	18EE61	Power System Analysis-I	EE	04	00	00	03	050	050	100	04
3	PC	18EE62	High Voltage Engineering	EE	03	00	00	03	050	050	100	03
4	PC	18EE63	Digital Signal Processing	EE	03	02	00	03	050	050	100	04
5	PE	18EE64X	Professional Elective-2	EE	03	00	00	03	050	050	100	03
6	OE	18xxE02	Open Elective-B	EE	03	00	00	03	050	050	100	03
7	PC	18EEL65	Digital Signal Processing Lab	EE	00	00	02	03	050	050	100	01
8	PC	18EEL66	Micro controller Lab	EE	00	00	02	03	050	050	100	01
9	MP	18EEMP67	Mini-Project	EE	00	00	04	03	050	050	100	02
10	INT	18EEI68	Internship		00	00	00	00	000	000	000	00
Total					**18**	**02**	**08**	**26**	**450**	**450**	**900**	**24**

a) Internship: All the students admitted to III year of BE have to undergo mandatory internship of 4 weeks during the vacations of VI and VII semesters and /or VII and VIII semesters. A University examination will be conducted during VIII semester and prescribed credit are added to VIII semester. Internship is considered as a head of passing and is considered for the award of degree. Those, who do not take-up/complete the internship will be declared as failed and have to complete during subsequent University examination after satisfy the internship requirements

Note: BC: Science Course, PC: Professional Core. HS: Humanities, NCMC: Non-Credit Mandatory Course

$-Elective code of the Department offering the course, A-Students shall register for a course offered by the other departments

Professional Elective-2(PE-2)		
Sl. No	Course Code	Course Title
1	18EE641	Operating System
2	18EE642	Special Electrical Machines
3	18EE643	Artificial Intelligence to Electrical Engineering

Professional Elective-2(PE-2)		
Sl. No	**Course Code**	**Course Title**
4	18EE644	Electrical Vehicle Technology
5	18EE645	Smart Grid Technology
6	18EE646	OOPS with C++

Open Elective-A(OE-A)		
Sl. No	**Course Code**	**Course Title**
1	18EEE03	Renewable Energy Sources

Subject Title : Power Systems Analysis - I

Sub.Code: 18EE61	No. of Credits:04=04:0:0 (L - T – P)	No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs	CIE+Assignment +SEE=40+5+5+50=100	Total No.of Contact Hours:52

Course Learning Objectives:

1. Modelling of power system elements and representing the power system by single line diagrams.
2. Use symmetrical components in power system analysis.
3. Perform fault analysis on power system network.
4. Perform stability analysis on power system network
5. Evaluate the performance of induction machine under unbalanced supply conditions.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Representation of Power System Components:** Circuit models of transmission line, synchronous machines, transformers and load. Single line diagram, impedance and reactance diagrams. Per unit system, per unit impedance diagram of power system. **Symmetrical 3 - Phase Faults:** Transient, sub transient and steady state reactance's and currents of synchronous machines. Short-circuit currents of synchronous machines and power system, short circuit capacity of a bus. Selection of Circuit Breakers. TEXT 1,2 and Reference Book 1 & 4	12	L1-L4
2	**Symmetrical Components:** Introduction, three phase operator-a. Synthesis of unbalanced vector from its symmetrical components. Resolving the unbalanced phasors into their symmetrical components. Relation between symmetrical components of line & phase voltages in star connected system and line & phase currents in delta connected system. Phase shift of symmetrical components in transformer banks. Power in terms of symmetrical component. Analysis of unbalanced system using symmetrical components. Positive, negative and zero sequence networks of power system TEXT 1,2 and Reference Book 1	10	L1-L4
3	**Unsymmetrical Faults:** Introduction. Single line to ground fault (LGF), line to line fault (LLF) and double line to ground fault (LLGF): Determination of faults currents, terminal currents & voltages and connection of sequence networks. Fault with fault impedance. Fault on loaded synchronous generator. Unsymmetrical faults on power system. TEXT 1,2 and Reference Book 2 & 3	10	L1-L5
4	**Concept of System Stability:** Introduction, classification of stability, steady state and transient stability. Power angle equation of salient and non-salient pole machines. Power angle curves. Stability limits and methods to improving the stability. Rotor	10	L1-L5

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	dynamics and the swing equation. Equal area criterion and critical clearing angle & time. Apply equal area criterion for transient stability evaluation under different operating conditions of power system. TEXT 1,2 and Reference Book 3		
5	**Unbalanced Operation of Three Phase Induction Motors:** Open conductor faults in power system: sequence network connections. Analysis of three phase induction motor with one line open. Analysis of three phase induction motor with unbalanced supply. TEXT 2 Reference Book 3,4	08	L1-L5

Note 1: Unit 1 to 5 will have internal choice

Note 2:
a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group activity for 5 marks has to be evaluated through PPT presentation/ Subject Quiz/ Project/ Seminar

Note:3 Out of 5 Units, Unit 3 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

Course Outcomes:

CO1 Able to, recall the equivalent circuits of power system components and to draw the single line & impedance diagrams of power system network.

CO2 Apply concept of symmetrical components to power system network.

CO3 Analyze the behaviour of power system under different fault conditions.

CO4 Evaluate the steady state and transient stability of the Power Systems.

CO5 Investigate the effect of unbalanced operation and single phasing on the performance of three phase induction machines.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1:	2	08	3	2	2	3					1			2
2.	CO2:	3	08	3	2	2	2					1			2
3.	CO3:	4	08	3	2	3	2	1	1	2			1	2	2
4.	CO4:	5	08	3	3	3	3	1				1			2
5.	CO5:	5	07	3	3	3	1		1	1		1			1
Average CO				3	3	3	2		1	1		2	1	1	2

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3		1
CO2	3	2	1
CO3	3	2	1

CO4	3	2	1
CO5	3	2	
Average CO	**3**	**2**	**1**

Text Books.

1 W.D.Stevenson, "Elements of Power System Analysis", Fourth Edition, TMH, 2013

2. I.J.Nagrath and D.P.Kothari, "Modern Power System Analysis", 3rd Edition TMH, 2003

Reference

1 Hadi Sadat "Power System Analysis", Second Edition, TMH, 2009

2 R.Bergen, and Vijay Vittal, "Power System Analysis", 2nd edition, CRC Press, 2006.

3 G.L. Kusic. "Computer Aided Power system analysis", PHI.Indian Edition, 2010

4 W.D. Stevenson & Grainger, "Power System Analysis", Clarendon Press, Oxford, 1989.

5 Naser A and Boldea I, "Linear Electric Motors: Theory", First Edition,Prentice, 2003

Web Links.

1 https://onlinecourses.nptel.ac.in/https://www.eeeguide.com/analysis-of-unsymmetrical-faultshttps://www.eeeguide.com/analysis-of-unsymmetrical-faults//

2 https://www.bvmengineering.ac.in/syllabi/UG1920/EE/3EE02.pdf

3 http://www.brainkart.com/subject/Special-Electrical-Machines_185/

Subject Title : High Voltage Engineering

Sub.Code: 18EE62	No. of Credits:03=03:0:0 (L - T – P)	No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs	CIE+Assignment +SEE=45+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1 To introduce the need and basics and Applications of high voltage engineering.

2 Students will learn the break down mechanisms of insulating media.

3 Students will learn the concepts on generation of High AC. DC and impulse voltages and currents.

4 To learn techniques of measurement of High AC, DC and impulse voltages and currents.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Introduction:** Introduction to HV technology, role of insulation in electrical apparatus, types and applications of insulating materials used in transformers and Bushings and Rotating electrical machines. Need for generating high voltages in laboratory. Industrial applications of high voltages. **Conduction and breakdown in gaseous dielectrics:** Ionization: primary and secondary ionization processes. Criteria for gaseous insulation breakdown based on Townsend's theory. Limitations of Townsend's theory. Streamer's theory of breakdown in non-uniform fields. Corona discharges. Breakdown in electro negative gases. Paschen's law and its significance. Time lags of breakdown. **Solid dielectrics**: Breakdown in solid dielectrics: intrinsic breakdown, avalanche breakdown, thermal breakdown, and electro mechanical breakdown. **Liquid dielectrics**: Breakdown of liquid dielectrics: Suspended particle Theory, Cavity breakdown (Bubble's theory), and Stressed Oil Volume theory. Eco-friendly liquid dielectrics: introduction, Characteristic properties, advantages and disadvantages. TEXT 1 and TEXT 2. Reference 1	10	L1, L2, L3
2	**Generation of HVAC voltages:** HVAC-HV transformer; need for cascade connection and working of transformers units connected in cascade. Series resonant circuit- principle of operation and advantages. Tesla coil. **Generation of HVDC voltages:** Half and full wave rectifier circuits**,** voltage doubler circuit, Cockroft-Walton type high voltage generator set. Determination of voltage regulation, ripple and optimum number of stages for minimum voltage drop. Electrostatic generators - Van–de-Graff generator. TEXT 1 and TEXT 2 Reference 1	07	L1 -L4
3	**Generation of impulse voltage and current:** Introduction to standard lightning and switching impulse voltages. Analysis of single stage impulse generator-expression for output impulse voltage. Multistage impulse generator, working of modified Marx	8	L1-L4

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	multi stage impulse generator circuit. Rating of impulse generator. Components of multistage impulse generator. Triggering of impulse generator by three electrode gap arrangement. Trigatron gap and oscillograph time sweep circuits. Generation of switching impulse voltage generation of high impulse current. .TEXT 1 TEXT 2 Reference 1		
4	**Measurement of high voltages:** Electrostatic voltmeter-principle, construction and limitation. Chubb and Fortescue method for HVAC measurement. Generating voltmeter- principle, construction. Series resistance micro ammeter for HVDC measurements. Standard sphere gap- measurement of HVAC, HVDC, and impulse voltages; factors affecting the measurements. Potential Dividers-Resistance dividers, Capacitance dividers and mixed RC potential dividers. Measurement of high impulse currents- Magnetic links. TEXT 1 and TEXT 2. Reference Book 1	7	L1-L4
5	**High voltage tests on electrical apparatus**: Definitions of terminologies, tests on Insulators, Bushings and Transformers. Partial discharge measurements: Introduction, terminology used, methods of discharge detection- Straight discharge detection method and Balanced detection method. TEXT 1 and TEXT 2. Reference Book 1	7	L1-L5

Note 1: Unit 1 to 5 will have internal choice

Note 2:
a) a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT Presentation/Subject Quiz/Project/Seminar.

Note:3 Out of 5 Units, Unit 2 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

Course Outcomes:

CO1 Explain the need for high voltages and currents

CO2 Explain the physics of break down mechanisms of insulating media.

CO3 Compare the merits and demerits of generation of high voltage and currents.].

CO4 Select suitable method for measurement of high voltages and currents.

CO5 Explain the method of conducting the high voltage tests on different electrical equipment.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1	1	10	3	2	1				1			1		1
2.	CO2	2	7	3	2	1				1			1		1
3.	CO3	4	8	2	3	1			1	1			1		1
4.	CO4	5	7	2	1	3			1	1			1		1

5.	CO5	5	7	3	2	1				1			1		1
Average CO				3	2	2			1	1			1		1

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	2	2	1
CO3	3	1	1
CO4	2	1	1
CO5	3	1	1
Average CO	3	1	1

Text Books.

1 M.S.Naidu and Kamaraju, " High Voltage Engineering", 4th edition, TMH, , 2008

2 E.Kuffel and W.S. Zaengl, " High Voltage Engineering Fundamentals", 2nd Edition Elsevier Press, 2005.

Reference Text Books.

1 R.S. Jha, " High Voltage Engineering", edition, Dhanpat Rai & Sons, New Delhi , 1996

2 Mazen Abdel-Salam, Hussein Anis, Ahdab El- Morshedy, RoshdyRadwan, " High Voltage Engineering Theory and Practice", 2nd Edition,, 2003

Web Links.

1 https://www.academia.edu/12268238/High_Voltage_Engineering_CL_Wadhwa_PDF_BOok_Download

2 https://www.mv.helsinki.fi/home/tpaulin/Text/hveng.pdf

Subject Title : Digital Signal Processing

Sub.Code: 18EE63	No. of Credits:04=03:02:0 (L - T – P)	No. of Lecture Hours/Week : 05
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:65

Course Learning Objectives:

1 To understand DFT and its properties.

2 To learn FFT algorithm to find DFT.

3 To understand the structure of IIR & FIR system.

4 To learn Digital IIR filter design using analog filter transformation the applications of Fourier transform.

5 To learn Digital FIR filter design.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Discrete Fourier Transforms:** Definitions, properties-linearity, shift, symmetry etc., circular convolution – periodic convolution, use of tabular arrays, circular arrays, stock hams's method, linear convolution – two finite duration sequence, one finite & one infinite duration, overlap add and save methods. TEXT 1 and TEXT 2. Reference Book	13	L1,L2,L3.
2	**Fast Fourier Transforms Algorithms:** Introduction, decimation in time algorithm, number of computations, number of multiplications, computational efficiency, decimation in frequency algorithms, inverse decimation in time and inverse decimation in frequency algorithms, decomposition for a composite number N=9. TEXT 1 and TEXT 2. Reference Book	13	L1,L2,L3.
3	**Realization of Digital Systems:** Introduction, block diagrams and SFGs, realization of IIR systems- direct form, cascaded, parallel form, realization of FIR systems – direct form, cascade form, linear phase realization. TEXT 1 and TEXT 2. Reference Book	13	L1,L2,L3.
4	**Design of IIR Digital Filters:** Introduction, impulse invariant & bilinear transformations, all pole analog filters- Butterworth &chebyshev, design of digital Butterworth & chebyshev, frequency transformations. TEXT 1 and TEXT 2. Reference Book	13	L1,L2,L3.
5	**Design of FIR Digital Filters:** Introduction, windowing, rectangular, modified rectangular, Hamming, Hanning, blackman window(excluding Kaiser window), frequency sampling techniques.	13	L1,L2,L3.

Note 1: Unit 1 to 5 will have internal choice

Note2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5 and Group Activity for 5 Marks

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.

Note:3 Out of 5 Units, Unit 5 is a Webinar unit and will be delivered by subject faculty.

Course Outcomes:

CO1 Analyse and find DFT of signals.

CO2 Analyse and find DFT using FFT algorithms.

CO3 Realize structures for FIR & IIR systems.

CO4 Design IIR filters for the given specifications.

CO5 Design FIR filters for the given specifications.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1:.	1,2,3	13	3	3		2				1		1		1
2.	CO2.	1,2,3	13	3	3		2				1		1		1
3.	CO3:	1,2	12	3	3		2				1		1		1
4.	CO4:	3,4,5	13	3	3	2	2				1		1		1
5.	CO5:	3,4,5	14	3	3	2	2				1		1		1
Average CO's				3	3	2	2				1		1		1

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	3	2	1
CO3	3	1	1
CO4	3	2	1
CO5	3	2	1
Average CO	3	2	1

Text Books.

1 Dimitris Manolakis and Johm G Proakis, "Digital Signal Processing Principle, Algorithm & application ", 4th education, Pearson, 2009

2 Sanjeet. K. Mitra , "Digital Signal Processing ", 3rd edition, TMH, 2009

Reference Text Books.

1 Johnny R. Johnson , "Introduction to Digital Signal Processing ", 4th edition , PHI, 2009

2 Alan V Oppenheim, Ronald W. Schafer and John R Buck, "Discrete Time Signal Processing ", 2nd edition , Pearson, 2009

3 S.Salivahanan, A.Vallaraj, C.Gnanapriya , "Digital Signal Processing" Second edition Tata McGraw Hill 2010

Web Links.

1 https://usermanual.wiki/Document/SOLUTIONMANUAL4thDigitalSignalProcessingProakisandManolakis.530579026/help

2 https://www.engineeringbookspdf.com/digital-signal-processing-ramesh-babu/

Subject Title : Digital Signal Processing Lab

Sub.Code: 18EEL65	No. of Credits:1=0:0:1 (L - T – P)	No. of Lecture Hours/Week : 02
Exam Duration:3 Hrs	CIE +SEE=50+50=100	Total No.of Contact Hours:26

Course Learning Objectives: Students will learn

1 To write program for computation of DFT, Circular Convolution & Linear convolution
2 To write program to find Impulse response of LTI system.
3 To write program for IIR filter design.
4 To write program for FIR filter design

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	Direct Computation of N-point DFT.	2	L1, L2
2	IIR filter realization using cascade form, Parallel form	2	L1,L2,L3.
3	IIR Filter Design using Butterworth method.	2	L1, L2, L3,L4,L5
4	IIR Filter Design using Chebyshev type 1 prototype.	2	L1, L2, L3, L4,L5
5	FIR Filter Design using rectangular, hamming, window.	2	L1, L2, L3, L4,L5
6	FIR Filter Design using Hanning, Blackman window.	2	L1, L2, L3, L4,L5
7.	N-Point Circular Convolution and Proof in frequency domain.	2	L1, L2, L3
8.	Circular Convolution, Linear Convolution and Linear Convolution using Circular Convolution.	2	L1, L2, L3
9	Sampling Theorem.	2	L1, L2, L3
10	Impulse response from X[n] and y[n].	2	L1, L2, L3
11	Impulse response from difference equation and response to x[n].	2	L1, L2, L3
	Experiments beyond the Syllabus		
1	N-point DFT using decimation in Time and Frequency FFT.	2	L1, L2, L3
2	N-point IDFT using decimation in Time and Frequency FFT.	2	L1, L2, L3

Note 1: Laboratory report should be submitted to the subject faculty every week and evaluation will be done on the same week only.

Course Outcomes: The Students will be able to

CO1 Write & execute the program to find DFT, Circular Convolution & Linear convolution
CO2 Write & execute program to find Impulse response of LTI system.
CO3 Differentiate & Write program for FIR & IIR Filter Structures
CO4 Design & Write program for IIR filters.
CO5 Design & Write program for FIR filters.

Course outcomes Mapping with Programme Outcomes

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1:	2	08	3	3		1	2			2	2	2	2	1
2.	CO2:	2	06	3	3		1	2			2	2	2	2	1
3.	CO3:	2,3	02	3	3		1	2			2	2	2	2	1
4.	CO4:	3,4,5	06	3	3	3	2	2			2	2	2	2	1
5.	CO5:	3,4,5	04	3	3	1	2	2			2	2	2	2	1
Average CO				3	3	2	1	2			2	2	2	2	1

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	3	1
CO5	3	3	1
Average CO	**3**	**3**	**1**

Text Books.& References

1 S.Salivahanan, A.Vallaraj, C.Gnanapriya , "Digital Signal Processing ", Second Edition, Newnes , 2010

2 Robert J Schilling and Sandra L Harris, "Fundamentals of Digital Signal Processing using MATLAB", India Edition, Cengage Learning,2005.

3 Digital Signal Processing user Manual

Web Links.

1 http://www.geethanjaliinstitutions.com/engineering/labmanuals/downloads/ece/dsp%20lab.pdf

2 http://eceweb1.rutgers.edu/~orfanidi/ece348/labs-2011.pdf

Subject Title: MICROCONTROLLER LAB

Sub.Code:18EEL66	No. of Credits:1=0:0:1(L - T – P)	No. of Lecture Hours/Week :02
Exam Duration:3 Hrs	CIE +SEE=50+50=100	Total No.of Contact Hours:26

Course Learning Objectives:

1 To provide a practical introduction to microcontrollers assembly language & embedded C programming techniques, hardware interfacing circuit.

2 To explain writing ALP for data transfer, arithmetic, Boolean and logical instructions.

3 To explain writing assembly language programs for code conversions..

4 To perform interfacing of stepper motor and dc motor for controlling the speed.

5 To explain generation of different waveforms using DAC interface.

Expt No	Experiments Contents	No.of Hours	Blooms Taxnomy level.
I. PROGRAMMING:			
1	Data Transfer - Block move, Exchange, Sorting, Finding largest element in an array.	2	L2,L3,L4
2	Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube – (16 bits Arithmetic operations – bit addressable).	2	L2,L3,L4
3	Counters.	2	L2,L3,L4
4	Boolean & Logical Instructions (Bit manipulations).	2	L2,L3,L4
5	Conditional CALL & RETURN.	2	L2 L3,L4
6	Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII; HEX - Decimal and Decimal - HEX.	2	L2,L3,L4
7	Programs to generate delay, Programs using serial port and on-Chip timer / counter.	2	L2,L3,L4
II. INTERFACING 8051 CHIP USING C PROGRAMS			
8	Simple Calculator using 6 digit seven segment display and Hex Keyboard.	2	L2,L3,L4
9	Alphanumeric LCD panel and Hex keypad input.	2	L2,L3,L4
10	External ADC and Temperature control.	2	L2,L3,L4
	Experiments beyond the syllabus		

Expt No	Experiments Contents	No.of Hours	Blooms Taxnomy level.
1	Generation of different waveforms - Sine, Square, Triangular, Ramp etc. using DAC; changing the frequency and amplitude	2	L2,L3.L4
2	Stepper and DC motor control.	2	L2,L3.L4

Note 1: Laboratory report should be submitted to the subject faculty every week and evaluation will be done on the same week only.

Course Outcomes:

CO1 Understand different instruction set and architecture of 8051 Microcontroller.

CO2 Write &Analyze assembly language programming.

CO3 Understand usage of directives, Code Memory & external memory.

CO4 Write assembly language program using bit instructions.

CO5 Build Interfacing Circuit using embedded C programming.

Course outcomes Mapping with Programme Outcomes

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1:	2,3,4	2	3	1	1			2						2
2.	CO2:	2,3,4	2	3	1	1			2						2
3.	CO3:	2,3,4	2	3	1	1			2						2
4.	CO4:	2,3,4	2	3	1	1			2						2
5.	CO5:	2,3,4	2	3	1	1			2						2
Average CO				3	1	1			2						2

Course outcomes Mapping with Programme Specific Outcomes

Course Outcome	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	3	1
CO5	3	2	1
Average CO	**3**	**2**	**1**

Text Books & References:

1 Kenneth J Ayla, “Operate The 8051 Microcontroller Architecture, Programming & Applications System Principles”, 2nd Edition, Penram International, Thomson Learning, 2005

2 Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D McKinlay, “The 8051 Microcontroller and Embedded Systems-Using Assembly and C”, 2nd Edition, Pearson Publisher, 2006

Web Links.

1 https://www.svec.education/courses/eee-course-material-lab-manuals/

2. https://hsit.ac.in/dept-doc/EE/lab-manual/15EEL57-MC-LAB-MANUAL.pdf

Subject Title : OPERATING SYSTEMS

Sub.Code: 18EE641	No. of Credits:03=03:0:0 (L - T – P)	No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1 To learn the fundamentals of Operating Systems.

2 To learn the mechanisms of OS to handle processes and threads and their communication.

3 To learn the need of synchronization and to overcome the deadlocks and to familiarize the use of various memory and their accessibility in the operating system operations.

4 To learn the mechanisms involved in memory management in contemporary OS.

5 To learn the file system and its implementation, understanding of secondary storage structures.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Introduction to Operating System, System Structures:** What Operating System Do; Computer System Organization; Computer System Architecture; Operating System Structure; Operating System Operations; Process Management; Memory Management; Storage Management; Protection and Security; Distributed System; Special Purpose Systems; Computing Environments. **Operating System Services:** User - Operating System Interface; System Calls; Types of System Calls; System Programs; Operating System Design and Implementation; Operating System Structure; Virtual Machines; Operating System Generation. TEXT 1 Reference Book 1 to 3	07	L1,L2,L3
2	**Process Management:** Process Concept; Process Scheduling; Operations On Processes; Inter-Process Communication. **Multi-Threaded Programming:** Overview; Multithreading Models; Thread Libraries; Threading Issues. **Process Scheduling:** Basic Concepts; Scheduling Criteria; Scheduling Algorithms; Multiple-Processor Scheduling; Thread Scheduling. TEXT 1 Reference Book 1 to 3	08	

3	**Process Synchronization:** Synchronization: The Critical Section Problem; Peterson's Solution; Synchronization Hardware; Semaphores; Classical Problems of Synchronization; Monitors. **Deadlocks:** Deadlocks: System Model; Deadlock Characterization; Methods for Handling Deadlocks; Deadlock Prevention; Deadlock Avoidance; Deadlock Detection and Recovery from Deadlock. TEXT 1 Reference Book 1 to 3	08	
4	**Memory Management:** Memory Management Strategies: Background; Swapping; Contiguous Memory Allocation; Paging; Structure of Page Table; Segmentation. **Virtual Memory Management:** Background; Demand Paging; Copy-On-Write; Page Replacement; Thrashing. TEXT 1 Reference Book 1 to 3	08	
5	**File System, Implementation of File System:** File System: File Concept; Access Methods; Directory Structure; File System Mounting; File Sharing. File System Structure; File System Implementation; Directory Implementation; Allocation Methods. **Secondary Storage Structures:** Mass Storage Structures; Disk Structure; Disk Attachment; Disk Scheduling; Disk Management; Swap Space Management. TEXT 1 Reference Book 1 to 3	08	

Note 1: Unit 1 to 5 will have internal choice.

Note2:
a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/ Project/Seminar.

Note:3 Out of 5 Units, Unit 1 is a Webinar unit conducted through Google Classroom/Zoom/Cisco WebEx etc. and will be delivered by subject faculty.

Course Outcomes:

CO1 Analyze the structure of OS and basic architectural components involved in OS design.

CO2 Analyse the working of various processes, scheduling and the concept of multi-tasking.

CO3 Define and analyze the synchronization requirements and its importance during the operation and deadlocks effect.

CO4 Justify the allocation of the memory for various tasks and its memory management.

CO5 Understand & analyse: file system, its implementation and list out the importance of the need of secondary memory.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1	**4**	**7**	**3**	**1**			**2**		**2**	**2**	**1**	**2**		**2**
2.	CO2	**4**	**8**	**3**	**1**			**2**		**2**	**2**	**1**	**2**		**2**
3.	CO3	**2**	**8**	**3**	**1**			**2**		**2**	**2**	**1**	**2**		**2**
4.	CO4	**4**	**8**	**3**	**1**			**2**		**2**	**2**	**1**	**2**		**2**
5.	CO5	**2**	**8**	**3**	**1**			**2**		**2**	**2**	**1**	**2**		**2**
Average CO				**3**	**1**			**2**		**2**	**2**	**1**	**2**		**2**

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	2	1
CO5	3	3	1
Average CO	**3**	**3**	**1**

Text Books.

1 Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, “Operating System Principles”, 8th Edition, Wiley Publisher, 2009

Reference Text Books.

1 D.M Dhamdhere, “Operating Systems: A Concept Based Approach”, 2nd edition, TMH publisher, 2006

2 P.C.P. Bhatt, “Operating Systems”, 2nd edition, PHI publisher, 2008

3 Harvey M Deital, “Operating Systems”, 3rd edition, Pearson Education.

Web Links.

1 https://www.tutorialspoint.com/operating_system/index.htm

2 https://www.w3schools.in/operating-system-tutorial/intro/

3 http://www.sncwgs.ac.in/wp-content/uploads/2015/11/operating_system_tutorial.pdf

4 https://www.guru99.com/operating-system-tutorial.html

Subject Title : Special Electrical Machines

Sub.Code: 18EE642	No. of Credits:03=03:0:0 (L - T – P)	No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs	CIE+Assignment +SEE=40+5+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1 To understand the constructional aspects of Special electrical machines
2 To understand the speed torque characteristics of Special electrical machines
3 To analyse the necessity of sensors used in Special electrical machines
4 To understand the concepts of converters and control schemes of Special electrical machines
5 To understand the merits, demerits and applications of Special electrical machines

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Stepper Motor:** Types of motors, construction, working principle. Term & definitions- Step angle, resolution, slewing, etc. Excitation modes, switching circuits, open and closed loop control, torque equation, speed torque characteristic, digital control of motor, comparison and applications of stepper motors. TEXT 1 and Reference Book 1 & 4	08	L1-L4
2	**Switched Reluctance Motor (SRM):** Construction, working principle, Inductance profile, pole arc and tooth arc constraints, torque equation, characteristics, power converter circuits, sensors- Hall and Optical, current regulators, sensor less and digital control, merits, demerits and applications. TEXT 1 and Reference Book 2	08	L1-L4
3	**Brushless Permanent Magnet DC (BLDC) Motor:** Introduction to PMDC motors. BLDC motors: Classification, construction, principle of operation, types of motor, electronic commutation, emf equation and waveforms, Torque equation, sensors, sensor less and digital control, comparison of brushed and brushless dc motors, merits, demerits and applications. TEXT 1 and Reference Book 2 & 3 Reference Book 2	08	L1-L5
4	**Permanent Magnet Synchronous Motor (PMSM):** Construction, principle of operation, emf equation, torque equation, sensor less and digital control, phasor and circle diagrams, comparison with conventional motors, applications. TEXT 1 and Reference Book 3	08	L1-L5
5	**Linear Induction Motor and Axial Flux Machines:** LIM: Construction, types, Principle of operation, thrust equation, and applications. **AFM:** Construction, types, Principle of operation, windings, torque and emf equations, applications. TEXT 1 and Reference Book 5	07	L1-L5

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.

Note 1: Unit 1 to 5 will have internal choice

Note 2:
c) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
d) Group activity for 5 marks has to be evaluated through PPT presentation/ Subject Quiz/ Project/ Seminar

Note:3 Out of 5 Units, Unit 3 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

Course Outcomes:

CO1 Able to describe the construction and operation of different special electrical machines

CO2 Compare merits, demerits of different special electrical machines and their applications.

CO3 Analyse different power converter topologies for operation of special electrical machines

CO4 Formulate the torque equation and analyze speed –torque characteristics of special electrical machines.

CO5 Develop digital control techniques for the operation and control of special electrical machines.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1.	CO1:	**2**	08	**3**	**3**	**2**	**1**	**2**	**2**			**1**	**1**		**2**
2.	CO2:	**3**	08	**3**	**3**	**2**	**1**	**2**	**2**			**1**			**2**
3.	CO3:	**4**	08	**3**	**3**	**2**	**1**	**2**		**2**			**1**		**2**
4.	CO4:	**5**	08	**3**	**3**	**2**	**1**	**2**							**2**
5.	CO5:	**5**	07	**3**	**3**	**2**	**1**	**2**	**1**	**1**					**2**
Average CO				3	3	3	2		1	1		2	1	1	2

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3		1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	
Average CO	3	2	1

Text Books.

1 E.G. Janardhanan, "Special Electrical Machines", First Edition, PHI, 2009

Reference Text Books.

1 K. Venkataratnam "Special Electrical Machines", First, University Press, 2009

2 R.Krishnan, "Switched Reluctance motor Drives Modeling, Simulation" Analysis, Design, and Applications, CRC Press, 2015.

3 Miller, T.J.E. "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989

4 Kenjo, T, "Stepping Motors and their Microprocessor control", Clarendon Press, Oxford, 1989.

5 Naser A and Boldea I, "Linear Electric Motors: Theory, Design and Practical Application", Prentice Hall Inc., New Jersey,1987

Web Links.

1 https://onlinecourses.nptel.ac.in/

2 https://www.academia.edu/9885014/SPECIAL_ELECTRICAL_MACHINES_NPTEL_NOTES

Subject Title : Artificial Intelligence Techniques for Electrical Engineering

Sub.Code: 18EE643	No. of Credits03=03:0:0 (L - T – P)	No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs	CIE+Assmt+GA +SEE=40+5+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1 To locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms.

2 To observe the concepts of feed forward neural networks and about feedback neural networks.

3 To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control.

4 To analyse genetic algorithm, genetic operations and genetic mutations.

5 To learn application of AI to power systems.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Artificial Neural Networks:** Introduction-Models of Neural Network – Architectures – Knowledge representation – Artificial Intelligence and Neural networks – Learning process – Error correction learning – Hebbian learning – Competitive learning – Boltzmann learning – Supervised learning – Unsupervised learning – Reinforcement learning – learning tasks. TEXT 1 and 2. Reference 1 - 4	07	L1 -L4
2	**ANN Paradigms:** Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map – Radial Basis Function Network – Functional link, network – Hopfield Network. TEXT 1 and 2. Reference 1 - 4	08	L1 -L4
3	**Fuzzy Logic:** Introduction – Fuzzy versus crisp – Fuzzy sets – Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets – Fuzzy Cartesian Product – Operations on Fuzzy relations – Fuzzy logic – Fuzzy Quantifiers – Fuzzy Inference – Fuzzy Rule based system – Defuzzification methods**.** TEXT 1 and 2. Reference 1 - 4	08	L1-L4
4	**Genetic Algorithms:** Introduction-Encoding – Fitness Function-Reproduction operators – Genetic Modeling – Genetic operators – Crossover – Single–site crossover – Two-point crossover – Multi point Crossover-Uniform crossover – Matrix crossover – Crossover Rate – Inversion & Deletion – Mutation operator – Mutation – Mutation Rate-Bit-wise operators – Generational cycle-convergence of Genetic Algorithm. TEXT 1 and 2. Reference 1 - 4	08	L1 -L4
5	**Applications of AI Techniques:** Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability	08	

	(Dynamic stability) Reactive power control – speed control of DC and AC Motors. TEXT 1 and 2. Reference 1 - 4		

Note 1: Unit 1 to 5 will have internal choice

Note 2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

CO1 Understand feed forward neural networks, feedback neural networks and learning techniques.

CO2 Analyze fuzziness involved in various systems and fuzzy set theory.

CO3 Develop fuzzy logic control for applications in electrical engineering

CO4 Develop genetic algorithm for applications in electrical engineering

CO5 Apply AI to study and analyse power system problems.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1	1 - 4	07	3	3	3	2	3							1
2.	CO2	1 - 4	08	3	3	3	2	3							1
3	CO3	1 - 4	08	3	3	3	2	3							1
4.	CO4	1 - 4	08	3	3	3	2	3							1
5.	CO5	1 - 4	08	3	3	3	2	3							1
Average COs				3	3	3	2	3							1

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3		1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	
Average CO	3	2	1

Text Books.

1 D.W.Patterson, “Introduction to Artificial Intelligence and Expert Systems”, PHI, **2009**

2 S. Rajasekaran and G. A. V. Pai, “Neural Networks, Fuzzy Logic & Genetic Algorithms”, 13th Edition, PHI, New Delhi, 2003

Reference Text Books.

1 P. D. Wasserman, Van Nostrand Reinhold, “Neural Computing Theory & Practice”, Newyork, 1989

2 Bart Kosko, “Neural Network & Fuzzy System”, , PHI, Pvt.Ltd, 1992

3 G. J. Klir and T. A. Folger, **"**Fuzzy sets, Uncertainty and Information**"**, 2 nd edition, PHI Private Limilted, 1994
4 D. E. Goldberg, **"**Genetic Algorithms**"**, Addison Wesley 1999

Web Links.

1 https://nptel.ac.in/

Subject Title : Electric Vehicle Technology

Sub.Code: 18EE644	No. of Credits:03=03:0:0 (L - T – P)	No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1 Understand and acquire knowledge of battery driven electric vehicle, characteristics and their applications.

2 Acquire knowledge about vehicle dynamics, Motors, Power Electronics, Batteries, and Charging

3 Study the performance of different types of electric drives.

4 Learn vehicle dynamics with constant and variable parameters

5 Analyse through Mat lab/ Simulink tool in real time applications.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Introduction to Electric Vehicle:** History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Introduction to: Motor Drive Technologies; Energy Source Technologies; EV Battery Charging Technologies, Comparison of energy diversification of different types of vehicles. TEXT 1 and TEXT 2. Reference Book 1	07	L1,L2,L3.
2	**Intro EV Subsystems and Configurations:** Basics of vehicle performance; HEV Subsystems and Configurations; Modes of Operation: Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis. TEXT 1 and TEXT 2. Reference Book 1	08	L1,L2,L3.
3	**Vehicle Dynamics 1:**Mathematical models to describe vehicle performance; system level design & component level design, force-speed characteristics; tractive effort- gravitational force, air friction, the resistance offered by tire, rolling resistance etc.; different types of EV motors used for electric vehicle. TEXT 1 and TEXT 2. Reference Book 2	08	L2,L3.
4	**Vehicle Dynamics 2:**Dynamic equation with constant Fte-constant Tractive effort, terminal velocity, average power; Dynamic equation variable Fte- derivation of different dynamic equations with variable FTE- variable tractive effort and different regions of vehicle speeds. TEXT 1 and TEXT 2. Reference Book 2	08	L3,L4.
5	**Vehicle Dynamics Modelling and simulation:** Simulation of Vehicle dynamic equation constant Fte; Simulation of Vehicle dynamic equation variable Fte. Vehicle Dynamics Modelling and Simulation in Mat Lab/Simulink with real time application.	08	L3,L4

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	TEXT 1 and TEXT 2. Reference Book 2		

Note 1: Unit 1 to 5will have internal choice

Note2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2.
a)Assignment -2 from Units 3, 4 and 5
b)Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/Project/Seminar.

Note:3 Out of 5 Units, Unit 5is a Webinar unit conducted through Google Classroom/ Zoom/Cisco-Webex.., and will be delivered by subject faculty.

Course Outcomes:

CO1 Summarize the fundamental concepts of Electric Vehicles.

CO2 Understand principles of operation of hybrid and electric vehicles.

CO3 Analyze the Electric Vehicle dynamics with constant and variable parameters.

CO4 Apply Electric Vehicle dynamics for real time applications

CO5 Create dynamic model of Electrical vehicle using simulation tools

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1	L1,L2,L3	09	3	2		1							1	
2.	CO2	L1,L2,L3	12	3		1	2	1							
3.	CO3	L2,L3	09				2						1	1	1
4.	CO4	L3,L4	9	3			1	1							1
5.	CO5	L3,L4	4	3		3				3					3
Average COs				3	2	2	2	1		3			1	1	2

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcomes	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	1	1	1
CO3	2	1	2
CO4	2	2	2
CO5	3	3	3
Average COs	2	2	2

Text Books.

1 Iqbal Husain,“ Electric and Hybrid Vehicles, Design Fundamentals”,CRC Press,2003

2 M. Ehsani, Y. Gao, S. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles” CRC Press,2005.

Reference Text Books.

1 Tom Denton. , “Electric And Hybrid Vehicles” Routledge / Taylor & Francis Group 2016.
2 Donald L Anglin & William H. Crouse, “Automotive Mechanics” ,McGraw-Hill,1985
3 Sira -Ramirez, R. Silva Ortigoza ,“Control Design Techniques in Power Electronics Devices”,Springer

Web Links.

1 https://swayam.gov.in/nd1_noc20_ee18

2 https://youtu.be/Ay-4AZTnTEQ

3. Electric Vehicle Part -1,Dr Amit Jain,IIT Delhi. https://nptel.ac.in/courses/108/102/108102121/

Subject Title : SMART GRID TECHNOLOGY

Sub.Code: 18EE645	No. of Credits:03=03:0:0 (L - T – P)	No. of Lecture Hours/Week : 3
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:39

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

1 Understand the features of smart grid
2 Study various smart transmission and distribution technologies
3 Appreciate distribution generation and smart consumption
4 Know the regulations and market models for smart grid..
5 Understand the distributed energy resources, home energy management systems

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Introduction to Smart Grids**: Definition, justification for smart grids, smart grid conceptual model, smart grid architectures, Interoperability, communication technologies, role of smart grids standards, intelligent grid initiative, national smart grid mission (NSGM) by Govt. of India .TEXT 1 and TEXT 2. Reference Book-1	07	L1,L2,L3.
2	**Smart Transmission Technologies**: Substation automation, Supervisory control and data acquisition (SCADA), energy management system (EMS), phasor measurement units (PMU), Wide area measurement systems (WAMS)TEXT 1 and TEXT 2. Reference Book-1	08	L1,L2,L3.
3	**Smart Distribution Technologies**: Distribution automation, outage management systems, automated meter reading (AMR), automated metering infrastructure (AMI), fault location isolation and service restoration (FLISR), Outage Management Systems (OMS), Energy Storage, Renewable Integration. TEXT 1 and TEXT 2. Reference Book-2	08	L1,L2,L3.
4	**Distributed Generation and Smart Consumption:** Distributed energy resources (DERs), smart appliances, low voltage DC (LVDC) distribution in homes / buildings, home energy management system (HEMS), Net Metering, building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Micro grid. TEXT 1 and TEXT 2. Reference Book-1	08	L1,L2,L3.
5	**Regulations and Market Models for Smart Grid:** Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc. Cost benefit analysis of smart grid projects. TEXT 1 and TEXT 2. Reference Book-2	08	L1,L2,L3.

Note 1: Unit 1 to 5 will have internal choice

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.

Note2:
c) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
d) Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/ Project/Seminar.

Note:3 Out of 5 Units, Unit 1 is a Webinar unit conducted through Google Classroom/Zoom/Cisco WebEx etc. and will be delivered by subject faculty.

Course Outcomes: At the end of the course students will be able to

CO1 Understand technologies for smart grid

CO2 Understand technologies for smart grid.

CO3 Realize the distribution generation and smart consumption.

CO4 Know the regulations and market models for smart grid..

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1	2	10	3	3	1	2				2		2		2
2.	CO2	2	10	1	3	1	2				2		2		2
3.	CO3	2	12	2	3	1	2				2		2		2
4.	CO4	4	12	3	3	1	2				2		2		2
5.	CO5	5	8	3	3	1	2				2		2		2
Average Course Outcomes				3	3	1	2				2		2		2

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3		
CO2		2	
CO3			
CO4			1
CO5	3	2	
Average CO	**3**	**2**	**1**

Text Books.

1 Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response", First Edition, CRC Press, 2009

2 Jean Claude Sabonnadière, NouredineHadjsaïd, "The Smart Grid, ", First Edition, Wiely ISTE IEEE Press, 2012

Reference Text Books.

1 JanakaEkanayake, KithsiriLiyanage, Jianzhong. Wu, Akihiko Yokoyama, Nick Jenkins, ". Smart Grid Technology and Applications", 4th edition, Wiely Publication, 2012

Web Links.

1 https://www.smartgrid.gov/the_smart_grid/smart_grid.html

Subject Title : OOPS using C++

Sub.Code:18EE646 No. of Credits:03=03:0:0 (L - T – P) No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs CIE+Asmt+GA+SEE=40+5+5+50=100 Total No.of Contact Hours:39

Course Learning Objectives:

1 To understand Object Oriented Programming concepts using the C++ language
2 Introduces the principles of function, classes and objects.
3 Introduces to Constructors, Destructors and Operator overloading.
4 Introduces the principles of inheritance, pointers, virtual functions and polymorphism.
5 Introduces the concept of streams and handling files.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Beginning with C++ and its features:** What is C++? Applications and structure of C++ program, Different Data types, Variables, Different Operators, expressions, operator overloading and control structures in C++ . Topics from Chap-2,3 of Text 1 and Reference Book	07	L1,l2
2	**Functions, classes and Objects:** Functions, Inline function, function overloading, friend and virtual functions, specifying a class, C++ program with a class, arrays within a class, memory allocation to objects, array of objects, members, pointers to members and member functions. Selected Topics from Chap-4,5 of Text1 and Reference Book	08	L1,L2,L3.
3	**Constructors, Destructors and Operator overloading:** Constructors, Multiple constructors in a class, Copy constructor, Dynamic constructor, Destructors, Defining operator overloading, Overloading Unary and binary operators, Manipulation of strings using operators. Selected topics from Chap-6, 7 of Text 1 and Reference Book	08	L1,L2,L3.
4	**Inheritance, Pointers, Virtual Functions, Polymorphism:** Derived Classes, Single, multilevel, multiple inheritance, Pointers to objects and derived classes, this pointer, Virtual and pure virtual functions. Selected topics from Chap-8,9 of Text 1 and Reference Book	08	L1,L2,L3.
5	**Streams and Working with files:** C++ streams and stream classes, formatted and unformatted I/O operations, Output with manipulators, Classes for file stream operations, opening and closing a file, EOF. Selected topics from Chap-10, 11 of Text 1 and Reference Book	08	L1,L2,L3.

Note 1: Unit 1 to 5 will have internal choice

Note2:
a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/Project/Seminar.

Note:3 Out of 5 Units, Unit 5 is a Webinar unit and will be delivered by subject faculty.

Course Outcomes:

CO1 Explain the basics of Object Oriented Programming concepts.

CO2 Apply the object initialization and destroy concept using constructors and destructors.

CO3 Apply the concept of run time polymorphism by using virtual functions, overriding functions and abstract class in programs and to implement compile time polymorphism in programs by using overloading methods and operators..

CO4 Use the concept of inheritance to reduce the length of code and evaluate the usefulness..

CO5 Use I/O operations and file streams in programs.

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1	**2**	**07**	**3**	**3**	**2**		**2**	**1**		**2**		**2**		**2**
2.	CO2	**3**	**08**	**3**	**3**	**2**		**3**	**1**	**2**	**2**		**2**		**2**
3.	CO3	**2**	**08**	**3**	**3**	**2**		**3**	**1**		**2**		**2**		**2**
4.	CO4	**4**	**08**	**3**	**3**	**2**		**3**	**1**	**2**	**2**		**2**		**2**
5.	CO5	**5**	**08**	**3**	**3**	**2**		**2**	**1**	**2**	**2**		**2**		**2**
Average CO				**3**	**3**	**3**		**3**	**1**	**2**	**2**		**2**		**2**

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcome	PSO1	PSO2	PSO3
CO1	3		
CO2		2	
CO3	3		
CO4		2	1
CO5	3	2	
Average CO	3	2	1

Text Books.

1 E. Balaguruswamy, "Object Oriented Programming with C++", 6th Edition, TMH,, 2013

Reference Text Books.

1 Robert Lafore, "Object Oriented Programming using C++", 2nd edition, Galgotia publication, 2010

Web Links.

1 www.nptel.com

Subject Title : Electric Vehicle Technology

Sub.Code: 18EEE02	No. of Credits:03=03:0:0 (L - T – P)	No. of Lecture Hours/Week : 03
Exam Duration:03 Hrs	CIE+Asmt+GA+SEE=40+5+5+50=100	Total No.of Contact Hours:39

Course Learning Objectives:

1 Understand and acquire knowledge of battery driven electric vehicle, characteristics and their applications.

2 Acquire knowledge about vehicle dynamics, Motors, Power Electronics, Batteries, and Charging

3 Study the performance of different types of electric drives.

4 Learn vehicle dynamics with constant and variable parameters

5 Analyse through Mat lab/ Simulink tool in real time applications.

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
1	**Introduction to Electric Vehicle:** History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Introduction to: Motor Drive Technologies; Energy Source Technologies; EV Battery Charging Technologies, Comparison of energy diversification of different types of vehicles. TEXT 1 and TEXT 2. Reference Book 1	07	L1,L2,L3.
2	**Intro EV Subsystems and Configurations:** Basics of vehicle performance; HEV Subsystems and Configurations; Modes of Operation: Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis. TEXT 1 and TEXT 2. Reference Book 1	08	L1,L2,L3.
3	**Vehicle Dynamics 1:** Mathematical models to describe vehicle performance; system level design & component level design, force-speed characteristics; tractive effort- gravitational force, air friction, the resistance offered by tire, rolling resistance etc.; different types of EV motors used for electric vehicle. TEXT 1 and TEXT 2. Reference Book 2	08	L2,L3.
4	**Vehicle Dynamics 2:** Dynamic equation with constant Fte-constant Tractive effort, terminal velocity, average power; Dynamic equation variable Fte- derivation of different dynamic equations with variable FTE- variable tractive effort and different regions of vehicle speeds. TEXT 1 and TEXT 2. Reference Book 2	08	L3,L4.
5	**Vehicle Dynamics Modelling and simulation:** Simulation of Vehicle dynamic equation constant Fte; Simulation of Vehicle dynamic equation variable Fte. Vehicle Dynamics Modelling and Simulation in Mat Lab/Simulink with real time application.	08	L3,L4

Unit No	Syllabus Contents	No.of Hours	Blooms Taxnomy level.
	TEXT 1 and TEXT 2. Reference Book 2		

Note 1: Unit 1 to 5will have internal choice

Note2: Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2.
a)Assignment -2 from Units 3, 4 and 5
b)Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/Project/Seminar.

Note:3 Out of 5 Units, Unit 5is a Webinar unit conducted through Google Classroom/ Zoom/Cisco-Webex.., and will be delivered by subject faculty.

Course Outcomes:

CO1 Summarize the fundamental concepts of Electric Vehicles.

CO2 Understand principles of operation of hybrid and electric vehicles.

CO3 Analyze the Electric Vehicle dynamics with constant and variable parameters.

CO4 Apply Electric Vehicle dynamics for real time applications

CO5 Create dynamic model of Electrical vehicle using simulation tools

Course Outcomes Mapping with Programme Outcomes.

Sl.No	Course Outcome	Level of Blooms Taxonomy	No. of hours of teaching	Programme Outcome											
				1	2	3	4	5	6	7	8	9	10	11	12
1.	CO1	L1,L2,L3	09	3	2		1							1	
2.	CO2	L1,L2,L3	12	3		1	2	1							
3.	CO3	L2,L3	09				2						1	1	1
4.	CO4	L3,L4	9	3			1	1							1
5.	CO5	L3,L4	4	3		3				3					3
Average COs				3	2	2	1.5	1		3			1	1	2

Course Outcomes Mapping with Programme Specific Outcomes.

Course Outcomes	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	1	1	1
CO3	2	1	2
CO4	2	2	2
CO5	3	3	3
Average COs	2	2	2

Text Books.

1 Iqbal Husain,“ Electric and Hybrid Vehicles, Design Fundamentals”,CRC Press,2003

2 M. Ehsani, Y. Gao, S. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles” CRC Press,2005.

Reference Text Books.

1 Tom Denton. , “Electric And Hybrid Vehicles” Routledge / Taylor & Francis Group 2016.
2 Donald L Anglin & William H. Crouse, “Automotive Mechanics” ,McGraw-Hill,1985
3 Sira -Ramirez, R. Silva Ortigoza ,“Control Design Techniques in Power Electronics Devices”,Springer

Web Links.

1 https://swayam.gov.in/nd1_noc20_ee18

2 https://youtu.be/Ay-4AZTnTEQ

3. Electric Vehicle Part -1,Dr Amit Jain,IIT Delhi. https://nptel.ac.in/courses/108/102/108102121/

Sub Title : MINI PROJECT WORK

Sub Code:ECMP67	**No. of Credits:02=0 :0 :02 (L-T-P)**	
Exam Duration :03 Hour	**CIE + SEE = 50+50 =100**	**Total No. of Contact Hours : 03**

A student is required to carry out elaborated project work. The project may be either design and fabrication work or a simulation of a problem on a computer. At the end of the semester student will be required to submit a detailed report of literature survey, design problem formulation, work plan and work done and will defend his/her work carried out before the examiners at the time of final evaluation.