NEW HORIZON
COLLEGE OF ENGINEERING

New Horizon Knowledge Park, Ring Road, Marathalli

Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC

Accredited by NAAC with 'A' Grade, Accredited by NBA

Department of Electrical and Electronics Engineering

Academic Year 2021-2022

Fifth and Sixth Semesters

B.E. Scheme and Syllabus

Department of Electrical & Electronics Engineering

Academic Year 2021-22

Fifth and Sixth Semesters B.E

Scheme and Syllabus

VISION

To evolve into a centre of excellence in Electrical and Electronics Engineering for bringing out contemporary Engineers, Innovators, Researchers and Entrepreneurs for serving nation and society.

MISSION

- To provide suitable forums to enhance the teaching-learning, research and development activities.
- Framing and continuously updating the curriculum to bridge the gap between industry and academia in the contemporary world and serve society.
- To inculcate awareness and responsibility towards the environment and ethical values.

.

PROGRAM EDUCATIONAL OBJECTIVES (PEO's):

PEO1: To provide good learning environment to develop entrepreneurship capabilities in various areas of Electrical and Electronics Engineering with enhanced efficiency, productivity, cost effectiveness and technological empowerment of human resource.

PEO2: To inculcate research capabilities in the areas of Electrical and Electronics Engineering to identify, comprehend and solve problems and adopt themselves to rapidly evolving technology.

PEO 3: To create high standards of moral and ethical values among the graduates to transform them as responsible citizens of the nation.

PROGRAM SPECIFIC OUTCOMES (PSO's):

PSO 1: Graduates will be able to solve real life problems of power system and power Electronics using MiPower, PSPICE and MATLAB software tools and hardware.

PSO 2: Graduates will be able to Develop & support systems based on Renewable and sustainable Energy sources.

PEOs to Mission statement mapping

PEO'S	MISSION OF THE DEPARTMENT		
	M1	M2	M3
PEO1	3	3	1
PEO2	2	3	2
PEO3	1	2	3

<u>Program Outcomes (PO) with Graduate Attributes</u>

.No	Graduate Attributes	Program Outcomes (POs)
1	Engineering Knowledge	PO1: Able to understand the fundamentals of mathematics, science, Electrical and Electronics Engineering and apply them to the solution of complex engineering problems.
2	Problem Analysis	PO2: Ability to identify, formulate and analyze real time problems in Electrical and Electronics Engineering.
3	Design and Development of Solutions	PO3: Design solutions for complex engineering problems, that meet the specified needs and to interpret the data.
4	Investigation of Problem	PO4: Use research-based knowledge and research methods to provide valid solutions for complex problems in Electrical and Electronics Engineering.
5	Modern Tool usage	PO5: Apply appropriate tools techniques for modeling, analyzing and solving Electrical and Electronics Engineering devices & systems.
6	Engineer and society	PO6: To give basic knowledge of social, economical, safety and cultural issues relevant to professional engineering.
7	Environment and sustainability	PO7: To impart knowledge related to the design and development of modern systems which are environmentally sensitive and to understand the importance of sustainable development.
8	Ethics	PO8: Apply ethical principles and professional responsibilities in engineering practice.
9	Individual & team work	PO9: Ability to visualize and function as an individual and as a member in a team of a multi-disciplinary environment.
10	Communication	PO10: Ability to communicate effectively complex engineering ideas to the engineering community & the society at large.
11	Lifelong learning	PO11: To impart education to learn and to engage in independent and life – long learning in the technological change.
12	Project management and finance	PO12: Ability to handle administrative responsibilities, manage projects & handle finance related issues in a multi-disciplinary environment.

New Horizon College of Engineering

Department of Electrical and Electronics Engineering

Scheme of Fifth Semester B.E Program

Sl. No	CourseCode	Course	BOS	Credit Distribution				Overall Credits	Contact Hours per Week	Marks		
				L	T	P	S			CIE	SEE	Total
1	20EEE51	Transmission and Distribution	EEE	3	0	0	0	3	3	50	50	100
2	20EEE52	Control Systems	EEE	3	0	0	0	3	3	50	50	100
3	20EEE53	Synchronous and Induction Machines	EEE	3	0	0	0	3	3	50	50	100
4	20EEE54	Signalsand Systems	EEE	3	0	0	0	3	3	50	50	100
5	20EEE55	Industrial Automation	EEE	3	0	0	0	3	3	50	50	100
6	20EEE56X/ 20EEE56XA	Professional Elective I	EEE	3	0	0	0	3	3	50	50	100
7	20EEL57	Control Systems Laboratory	EEE	0	0	1.5	0	1.5	3	25	25	50
8	20EEL58	Synchronous and Induction Machines Laboratory	EEE	0	0	1.5	0	1.5	3	25	25	50
9	20EEL59	Mini Project III	EEE	0	0	2	0	2	4	25	25	50
		TOTAL						**23**	**28**	**375**	**375**	**750**

Professional Elective I	
Course Code	Course
20EEE561A	Object Oriented programming using C++ and JAVA
20EEE562	Modern Communication Systems
20EEE563	Advanced Micro Controller and Applications
20EEE564	MEMS and Applications

New Horizon College of Engineering

Department of Electrical and Electronics Engineering

Scheme of Sixth Semester B.E Program

S. No	Course Code	Course	BOS	Credit Distribution				Overall Credits	Contact Hours per Week	Marks		
				L	T	P	S			CIE	SEE	Total
1	20EEE61	Power System Analysis	EEE	3	0	0	0	3	3	50	50	100
2	20EEE62	Power Electronics	EEE	3	0	0	0	3	3	50	50	100
3	20EEE63	Power System Protection	EEE	3	0	0	0	3	3	50	50	100
4	20EEE64X/20EEE64XA	Professional Elective II	EEE	3	0	0	0	3	3	50	50	100
5	20EEE65X	Professional Elective III	EEE	3	0	0	0	3	3	50	50	100
6	20NHOP6X X	Open Elective-I	EEE	3	0	0	0	3	3	50	50	100
7	20EEL66	Power System Analysis Laboratory	EEE	0	0	1.5	0	1.5	3	25	25	50
8	20EEL67	Power Electronics Laboratory	EEE	0	0	1.5	0	1.5	3	25	25	50
9	20EEL68	Mini Project IV	EEE	0	0	2	0	2	4	25	25	50
		TOTAL						23	28	375	375	750

Professional Elective II	
Course Code	**Course**
20EEE641A	Data structure and algorithms using python
20EEE642	Fiber Optic and Laser Instrumentation
20EEE643	Robotics and Automation
20EEE644	Virtual Instrumentation

Professional Elective III	
Course Code	**Course**
20EEE651	Operation Research
20EEE652	VLSI Design

20EEE653	Advanced Industrial and Building Automation
20EEE654	Advanced Control Systems

Fifth Semester

TRANSMISSION AND DISTRIBUTION

Course Code : 20EEE51 | **Credits : 03**
L:T:P:S : 3:0:0:0 | **CIE Marks : 50**
Exam Hours : 03 | **SEE Marks : 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Explore the different aspects of the power system
CO2	Evaluate the performance of transmission lines
CO3	Design the mechanical aspects of overhead lines and insulators
CO4	Investigate the various elements of underground cables and interpret cable faults
CO5	Examine the design consideration for substations
CO6	Choose the appropriate transmission and distribution systems for real time applications

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	1	-	1	-	-	-	-	-
CO2	3	3	3	3	1	-	-	-	-	-	-	-
CO3	3	3	3	3	1	2	2	-	-	-	-	-
CO4	3	3	1	2	1	-	-	-	-	-	-	-
CO5	3	3	3	2	1	-	-	-	-	-	-	-
CO6	3	3	3	2	1	-	-	-	-	-	-	-

Module No	Module Contents	Hours	Cos
1	**Structure of Power System** Structure of electric power system- Introduction to power generation-Different operating voltages of generation, transmission and distribution-Types of AC and DC distributors – Distributed and concentrated loads – Interconnection.	09	CO1, CO6
2	**Performance of power transmission lines** Short, medium (nominal T and π) and long transmission lines(only rigorous solution)- Regulation-Requirements of power distribution--AC and DC distribution- Radial & Ring main systems -Calculation for concentrated loads and uniform loading	09	CO2, CO6
3	**Mechanical design of OH lines** Line Supports –Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading- Insulators - Types, Voltage distribution - String Efficiency-Testing	09	CO3, CO6
4	**Underground cables** Construction of Three core cable – Insulating Materials - Insulation Resistance– Potential Gradient – Capacitance – Grading of Cable – Permissible Current Loading –Cable Faults–Loop Tests.	09	CO4, CO6
5	**Substations** Types-Bus bar arrangement schemes- Location of substation equipment-Reactors and capacitors- Interconnection of power stations-Corona- Disruptive and Visual critical voltages-Corona power loss-Merits and Demerits.	09	CO5, CO6

Text Books:

1. A Course of Electrical Power- Soni Gupta & Bhatnagar , Dhanpatrai and Sons, 2014.
2. Electrical Power System- C. L. Wadhwa, Wiley Eastern, 2016.
3. B.R.Gupta, 'Power System Analysis and Design', S. Chand, New Delhi, 2008
4. D.P.Kothari, I.J. Nagarath, 'Power System Engineering', Mc Graw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.

Reference Books:

1. Electrical Power Systems-W. D. Stevenson, Mc Graw Hill, 4th edition, 2012.
2. Electric Power Generation Transmission and Distribution-S. M. Singh, Prentice Hall of India Ltd, 2015.
3. Luces M.Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.

4. V.K Mehata, Rohit Mehta," Principles of Power system', S.Chand & Company Ltd, New Delhi,2013.

ssessment Pattern:

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	5	3	
Understand	5	3	2
Apply	5	3	4
Analyze	5	3	4
Evaluate	5	3	-
Create	-	-	-

SEE- Semester End Examination (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	-

CONTROL SYSTEMS

Course Code : 20EEE52 | **Credits : 03**
L:T:P:S : 3:0:0:0 | **CIE Marks : 50**
Exam Hours : 03 | **SEE Marks : 50**

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

CO1	Develop modeling of physical systems
CO2	Analyze the time response of systems and examine their stability
CO3	Deduce the closed loop response from open loop frequency response
CO4	Design a suitable controller/compensator to meet the required frequency response
CO5	Assess controllability and observability by state space approach
CO6	Implement a suitable closed loop system for a given practical application

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	2	-	-	-
CO2	3	3	2	2	-	-	-	-	2	-	-	-
CO3	3	3	3	3	-	-	-	-	2	-	-	-
CO4	3	3	3	3	-	-	-	-	2	-	-	-
CO5	3	3	3	3	-	-	-	-	2	-	-	-
CO6	3	3	2	2	-	-	-	-	2	-	-	-

Course Syllabus			
Module No.	**Contents of the Module**	**Hours**	**COs**
1	**Mathematical Modelling** Open loop and closed loop systems – Mathematical modelling – Mechanical, electrical and electromechanical systems – Transfer function – DC generator and motor – Servomotors – Block diagram reduction – Signal flow graph	9	**CO1, CO6**
2	**Time Response** Standard signals – Time response – First and second order systems – Time domain specifications – Steady state error – Static and dynamic error constants	9	**CO2, CO6**
3	**Stability and Root Locus** Stability – Location of closed loop poles – Classification of stability – Routh stability criterion – Root locus construction – Addition of open loop poles and zeros	9	**CO2, CO6**
4	**Frequency Response** Frequency domain specifications – Correlation between time and frequency domain specifications – Polar plot – Nyquist stability analysis – Assessment of relative stability – Bode plot – Determination of closed loop response from open loop frequency response.	9	**CO3, CO6**

5	**Compensator design** Performance criteria – Lag/Lead compensator design using bode plots – Effect of P-PD-PI-PID controllers **State Space Analysis** State space representation using physical, phase and canonical variables – Computation of state and output – Controllability and Observability – Introduction to State Feedback	9	**CO4, CO5,CO6**

Text Books

1. Control Systems Engineering, I.J.Nagrath and M.Gopal, New Age International Publishers, Sixth Edition, 2017
2. Control Systems, Principles and Design, M. Gopal, Fourth Edition, Tata McGraw Hill, 2015
3. Control System Engineering, Norman S. Nise, Sixth Edition, Wiley India, 2011
4. Modern Control Engineering, K. Ogata, Fifth edition, PHI, 2012.

Reference Books

1. Automatic Control systems, Benjamin C. Kuo, Ninth Edition, Wiley, 2014
2. Control System Engineering, S.K.Bhattacharya, Third Edition, Pearson, 2013
3. Control System, Dhanesh. N. Manik, Cengage Learning, 2012

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember			
Understand	5	4	
Apply	10	3	5
Analyze	10	3	5
Evaluate		5	
Create			

.

SEE- Semester End Examination (50 Marks)

Bloom's Category	**Marks Theory (50)**
Remember	-
Understand	10
Apply	20
Analyze	15
Evaluate	05
Create	-

SYNCHRONOUS AND INDUCTION MACHINES

Course Code	**: 20EEE53**	**Credits**	**: 03**
L:T:P:S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Investigate the performance of various three phase induction motors.
CO2	Select suitable starting and speed control technique(s) for three phase induction motors.
CO3	Analyze the types of single-phase induction motors.
CO4	Evaluate regulation of three phase Alternator.
CO5	Examine the effect of armature current, power factor and field current on a Synchronous motor.
CO6	Identify appropriate AC machines for real time applications.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	1	1	-	1	-	1	1
CO2	2	2	1	1	-	1	1	-	1	-	1	1
CO3	2	2	1	1	-	1	1	-	1	-	1	1
CO4	2	2	1	1	-	1	1	-	1	-	1	1
CO5	2	2	1	1	-	1	1	-	1	-	1	1
CO6	2	2	1	1	-	1	1	-	1	-	1	1

Module No	Contents of the Module	Hours	COs
1	**Three phase Induction Machines** Concept of Rotating Magnetic Field- Principle of Operation- Construction- Types of Rotors- Torque-Slip Characteristics- Losses- Efficiency.	09	CO1, CO6
2	**Starting and Testing of Three-phase Induction Motors** Necessity of starter- Types of starters- Speed control methods- No load and blocked rotor tests- brake test- Circle diagram - Cogging and Crawling.	09	CO2, CO6
3	**Single-phase Induction Motor** Double revolving field theory - Principle of operation - Types– Split phase induction motors- Capacitor start motor- Capacitor start and run motor- Shaded pole motor- AC series motor - Applications.	09	CO3, CO6
4	**Synchronous Generator** Principle of operation- Construction- Emf equation- Armature reaction- Phasor diagram - Voltage regulation - EMF, MMF and ZPF methods - Parallel operation.	09	CO4, CO6

5	**Synchronous Motor** Principle of operation - Phasor diagram- V and inverted V curves- Starting Methods-Applications	09	CO5, CO6

Text Books:

1. Electric Machines- I. J. Nagrath and D. P. Kothari- T.M.H-4th Edition-Reprint 2017.
2. Theory and Performance of Electrical Machines-Guptha J B-S K Kataria and sons-1st edition-2013
3. Electric machinery- B.S.Bhimbra- Khanna publications- 7th edition- 2015

Reference Books:

1. Electric machinery- Ashfaq hussain- dhanpat rai & co- 3rd edition- 2014
2. A text book of electrical Technology-Er.R.K.Rajput- Laxmi Publication-6th edition-2016

Assessment Pattern:

CIE-Continuous Internal Evaluation(50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	-	-	-
Understand	10	3	-
Apply	5	5	5
Analyze	10	5	5
Evaluate	-	2	-
Create	-	-	-

SEE- Semester End Examination (50 Marks)

Bloom's Category	**Marks Theory (50)**
Remember	
Understand	10
Apply	20
Analyze	15
Evaluate	05
Create	

SIGNALS AND SYSTEMS

Course Code : 20EEE54 **Credits : 03**

L:T:P:S : 3:0:0:0 **CIE Marks : 50**

Exam Hours : 03 **SEE Marks : 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Classify the continuous and discrete time signals and systems.
CO2	Examine the properties of LTI systems and evaluate the response.
CO3	Represent any periodic signal using Fourier series.
CO4	Estimate the frequency response of any time domain signal using Fourier Transform.
CO5	Evaluate the time response using Z Transform.
CO6	Realize Discrete Time systems.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	1	1	-	2	2	2	1
CO2	3	3	2	3	3	1	1	-	2	2	2	1
CO3	3	3	2	3	3	1	1	-	2	2	2	1
CO4	3	3	2	3	3	1	1	-	2	2	2	1
CO5	3	2	2	3	3	1	1	-	2	2	2	1
CO6	3	3	2	3	3	1	1	-	2	2	2	1

Module No	Module Contents	Hrs	COs
1	**Signals and Systems** Signals- Continuous / Discrete - Periodic / Aperiodic - Even / Odd - Energy and Power signals, Systems- Continuous / Discrete - Linear / Non-Linear – Time Variant / Invariant - Causal / Non-Causal – Stable / Unstable - Static / Dynamic systems.	09	**CO1**
2	**Time-domain representations for LTI systems** Convolution - Properties-ConvolutionSumandConvolutionIntegral for infinite duration sequences - Impulse response representation -Solutionsofdifferentialanddifferenceequations.	09	**CO1, CO2, CO3**
3	**Fourier Series** Representation - Properties - Dirichlet conditions -Trigonometricand ExponentialFourierseries -Complex Fourier spectrum.	09	**CO4, CO5**

4	**Fourier Transform** Deduction from Fourier series - Fourier transform of arbitrary and standard signals -Properties -Fouriertransformsinvolving impulse function and Signum function.	09	**CO4, CO5**
5	**Z-Transform and Realization of Systems** Computation of impulse response - Step response - Response of a discrete-time LTI system - Transfer function - Stability – Causality – Realization of Systems – Direct form I and II – Parallel and Cascade.	09	**CO4, CO5, CO6**

TEXT BOOKS:

1. Signals and Systems, Simon Haykin and Barry Van Veen, 2nd edition, 2007, John Wiley & sons.

REFERENCE BOOKS:

1. SignalsandSystems,AllenV.Oppenheim,AllenS.Willsiky,S.HamidNawab,2015,PHI.
2. PrinciplesofLinearSystemsandSignals,B.P.Lathi,2ndedition,2009,OxfordUniversity Press.
3. Signals and Systems,UdaykumarS,6thedition,2012,PrismbookHouse.

Assessment Pattern:

CIE- Continuous Internal **Evaluation (50 Marks)**

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	10	-	-
Understand	10	-	5
Apply	5	5	5
Analyze	-	5	-
Evaluate	-	5	-
Create	-	-	-

SEE- Semester End Examination (50 Marks)

Bloom's Taxonomy	**Tests**
Remember	10
Understand	15
Apply	10
Analyze	15
Evaluate	-
Create	-

INDUSTRIAL AUTOMATION

Course Code	**: 20EEE55**	**Credits**	**: 03**
L:T:P:S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Explore the various aspects of industrial automation.
CO2	Analyze the architecture of PLC.
CO3	Select an appropriate communication protocol to communicate with PLC using Open Systems Interconnection model.
CO4	Develop a suitable logic for various real time applications using specific programming language for PLC.
CO5	Deploy Schneider Electric PLC for various industrial applications using dedicated software tool Unity Pro.
CO6	Build a Human Machine Interface for various applications through Vijeo Designer software.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	3	1	1	2	2	3	3
CO2	3	2	3	2	3	3	1	1	2	2	3	3
CO3	3	2	3	2	3	3	1	1	2	2	3	3
CO4	3	2	3	2	3	3	1	1	2	2	3	3
CO5	3	2	3	2	3	3	1	1	2	2	3	3
CO6	3	2	3	2	3	3	1	1	2	2	3	3

Module	**Contents of the Module**	**Hours**	**COs**
1	**Basics of Automation:** Automation Strategy- Evolution of instrumentation and control, role of automation in industries, benefits,types. **Structure of PLC:** Evolution of PLC - Principle of operation- Elements of Power supply unit - PLC Scan –Memory organization – Input Types - Types and Selection of PLC- Application- Schneider M340 pedagogic bench for wiring of input and output elements.	09	CO1,CO2

2	**Standard Communication Protocols:** Definition- Open System Interconnection (OSI) model, Communication standards -RS232 and RS485, Modbus- ASCII and RTU, Introduction to third party interface, concept of OPC (Object linking and embedding for Process Control), Internet protocols. **Application-** Analysis of a PLC configuration and communication devices **Sensors in industrial automation:** Types and characteristics of most used sensors in industry. Application to sensors in PLC environment. Analysis of several sensors (technologies, performances) and connections to PLC	09	CO3
3	**PLC Programming** Types–Programming devices – Logical operations–Relay type instructions –Timer and Counter Instructions –Program Control Instructions – Data Manipulation Instructions – Data Compare Instructions – Arithmetic Instructions - Sequence Instructions - PID Instructions – PWM Function –Applications- PLC programming using ladder and FBD methods as per IEC61131.	09	CO1 CO2 CO4 CO5
4	**Sequential Functional Chart (SFC) Programming** SFC Structure- SFC programming as per IEC61131, Advances in SFC-Applications	09	CO1 CO3 CO5
5	**Human Machine Interfacing (HMI)** Evolution of HMI, Building HMI graphics, Communication with PLC, Overview of software(Vejio Designer)- Applications	09	CO1 CO6

Textbooks:

1. Programming Industrial Control Systems Using IEC 1131-3 (IEE CONTROL ENGINEERING SERIES) Revised Edition, by Robert W. Lewis
2. Programmable Logic Controllers and Industrial Automation: An Introduction 2nd Edition, by Madhuchhanda Mitra and SamarjtSemgupta.
3. Industrial Controls and Manufacturing (Engineering) 1st Editionby Edward W. Kamen

Reference books:

1. Industrial Instrumentation Paperback, by K Krishnaswamy, S. Vijyachitra.
2. Overview of Industrial Process Automation Paperback, by K.L.S. Sharma
3. Industrial Process Automation Systems 1st Edition, by B.R. Mehta Y. Jaganmohan Reddy

Assessment Pattern:

CIE- Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	-	-	-
Understand	5	5	-
Apply	10	5	5
Analyze	-	5	-
Evaluate	-	-	5
Create	10	-	-

SEE- Semester End Examination (50 Marks)

Bloom's Taxonomy	**Tests**
Remember	-
Understand	10
Apply	15
Analyze	-
Evaluate	-
Create	25

PROFESSIONAL ELECTIVE-I

OBJECT ORIENTED PROGRAMMING USING C++ AND JAVA

Course Code	**:20EEE561A**	**Credits :**	**03**
L: T:P:S	**: 3:0:0:0**	**CIE Marks :**	**50**
Exam Hours	**: 03**	**SEE Marks :**	**50**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Apply an object-oriented approach to programming and identify potential benefits of object-oriented programming over other approaches
CO2	Execute the concepts of classes and objects and their significance in real world
CO3	Implement overloading concepts of function and operators
CO4	Handle the inheritance, polymorphism and object relationship
CO5	Reuse the code and design applications which are easier to debug, maintain and extend
CO6	Analyze the probable error and develop a mechanism to handle it Real-time

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	-	-	-	-	-	3
CO2	3	3	3	3	3	-	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-
CO5	3	3	3	3	3	-	-	-	-	-	-	3
CO6	3	3	3	3	3	-	-	-	-	-	-	3

Module	Module Contents	Hours	Cos
1	**Object Oriented Programming and Basics of C++** Procedural Vs Object oriented programming, Principles of Object oriented programming, Tokens, Expressions, control structure, Functions in C++	**9**	**CO1**
2	**Classes and Objects** Class, Data members and Member functions, Creating Objects of Class, Access Specifiers, Friend Functions and Friend Classes, Static Members-Constructors and Destructors, Function overloading, Operator Overloading, Overloading unary operators, overloading binary operators, overloading special operators, type conversions	**9**	
3	**Inheritance, polymorphism, templates and Exception handling** Types of inheritance, virtual base class, virtual functions, class templates, function templates, exception handling, assertions	**9**	
4	**Introduction to Java**	**9**	

	Constants, variables and data types, operators, expressions, classes, objects, methods, arrays, strings and vectors, Interfaces, packages,		
5	**Java programming** Multithread programming, managing errors and exceptions, Applet programming, Managing files	**9**	

Text Books:

1. Object Oriented Programming Using C++ and Java E Balagurusamy, 7th edition, 2017, TMH

Reference Books:

1. C++ Primer Plus, Stephen Prata, 6th Edition, 2015, Pearson Education Limited
2. C++ PROGRAMMING Today, Barbara Johnston, 2nd Edition, 2015, Pearson Education
3. Herbert schildt (2010), The complete reference, 7th edition, Tata Mc graw Hill, New Delhi
4. Kathy Sierra and Bert Bates, Head First Java (Second Edition), O'Reilly, 2005

Assessment Pattern:

CIE-Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	4	-	-
Understand	4	7.5	5
Apply	9	7.5	5
Analyze	4	-	-
Evaluate	4	-	-
Create	-	--	-

SEE-Semester End Examination (50 Marks)

Blooms levels	**SEE - Theory**
	Examination = 50
Remember	10
Understand	10
Apply	15
Analyze	10
Evaluate	5
Create	--

MODERN COMMUNICATION SYSTEMS

Course Code : 20EEE562 **Credits : 03**
L:T:P:S : 3:0:0:0 **CIE Marks : 50**
Exam Hours : 03 **SEE Marks : 50**

Course Outcomes: At the end of the Course- the student will be able to:

CO1	Understand Modern Digital Modulation Techniques
CO2	Interpret Baseband Data Transmission: Signaling Schemes- Transmitting and Receiving Filters for Optimum Performance
CO3	Analyze the M-ary Signaling Schemes
CO4	Familiarize the Linear Block Channel Codes
CO5	Familiarize the Non-Linear Block Channel Codes- Convolutional Channel Codes
CO6	Interpret the Signals Emerging Modern Communication Technologies

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	1	2	1	2	1	1	1	1	1	1
CO2	2	2	2	1	1	2	1	1	1	1	1	1
CO3	2	2	1	1	1	1	1	1	1	1	1	1
CO4	2	2	1	1	1	1	1	1	1	1	1	1
CO5	2	2	1	1	1	1	1	1	1	1	1	1
CO6	2	2	1	1	1	2	1	1	1	1	1	1

Module No	**Contents of the Module**	**Hours**	**COs**
1	**Modern Digital Modulation Techniques:** Introduction- Information Capacity- Bits- Bit Rate- Baud rate & M-ary Encoding- ASK- FSK- PSK QAM Bandwidth Efficiency Carrier Recovery- Clock Recovery- DPSK- Trellis Code Modulation- Probability of Error and Bit Error Rate- Error Performance.	09	CO1
2	**Baseband Data Transmission:** Introduction – Baseband Binary PAM Systems – Baseband Pulse Shaping- Optimum Transmitting and Receiving Filters – Duo binary Baseband PAM System – Use of Controlled ISI in Duo binary Signaling Schemes- Transmitting and Receiving Filters for Optimum Performance.	09	CO2 CO3
3	**M-ary Signaling Schemes** – Analysis and Design of M-ary Signaling Schemes- Binary Versus M-ary Signaling Schemes - Shaping of the Transmitted Signal Spectrum – Effect of Pre coding on the	09	CO4

	Spectrum- Pulse Shaping by Digital Methods - Equalization - Transversal Equalizer- Automatic Equalizers B		
4	**Block and Convolutional Channel Codes:** Linear Block Codes - The Generator Matrix and Parity Check Matrix- Cyclic Codes- Bounds on Minimum Distance of Linear Block Codes- Non Binary Block Codes – Convolutional Codes – Transfer Function of a Convolutional Code- Optimum Decoding of Convolutional Code –Distance Properties of Binary Convolutional Codes	09	CO5
5	**Signals Emerging Modern Communication Technologies:** The North American Hierarchy- Digital Services- Broad band Digital Communication: SONET- Digital Switching Technologies- Broadband Services for Entertainment and Home office Applications- Video Compression- High Definition Television(HDTV)	09	

Text Books

1. Advanced Electronic Communications Systems- by Wayne Tomasi- 6 Edition Pearson Education.
2. K Sam Shanmugam- Digital and Analog Communication Systems- John Wiley and sons (Asia) Pvt Ltd.

Reference Books:

1. Simon Haykin- Digital communications- John Wiley and sons- 1998
2. Wayne Tomasi- Advanced electronic communication systems- 4th Edition Pearson Education Asia- 1998
3. B.P.Lathi Modern digital and analog communication systems- 3rd Edition- Oxford University press
4. Ravindranathan" Communication Systems Modeling Using Matlab & Simulink" Universities Press

Assessment Pattern :

CIE-Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	**Test**	**Assignment**	**Quiz**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	5	-	-
Understand	5	-	-
Apply	5	6	4
Analyze	5	6	4
Evaluate	5	3	2
Create	--	--	--

SEE – Semester End Examination (50 Marks)

Bloom's Taxonomy	**Test Marks (Out of 50)**
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	--

ADVANCED MICRO CONTROLLER AND APPLICATIONS

Course Code : 20EEE563 **Credits : 03**
L:T:P:S :3:0:0:0 **CIE Marks: 50**
Exam Hours : 03 **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Identify the features of ARM Processor
CO2	Develop ARM7 based assembly level programs.
CO3	Interface various coprocessors
CO4	Use the concepts of cache design, virtual memory and memory
CO5	Design AMBA bus architecture.
CO6	Design Embedded systems with HW peripherals in ARM

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	2	1	-	-	-	2	2	1	-
CO2	2	1	1	2	1	-	-	-	2	2	1	-
CO3	2	1	1	2	1	-	-	-	2	2	1	-
CO4	2	1	1	2	1	-	-	-	1	2	1	-
CO5	2	1	1	2	1	-	-	-	2	2	1	-
CO6	2	1	1	2	1	-	-	-	2	2	1	-

Module No	Module Contents	Hours	COs
1	**ARM Introduction:**Types of computer Architectures, ISA's and ARMHistory. Embedded System Software andHardware, stack implementation in ARM, Endianness, and condition codes. Processor core VSCPU core. **Interface and Pipeline structures:** ARM7TDMI Interface signals, MemoryInterface, Bus Cycle types, Register set,Operational Modes. Instruction Format, ARM CoreData Flow Model, ARM 3 stages Pipeline, ARMfamily attribute comparison. ARM 5 stage Pipeline,Pipeline Hazards, Data forwarding - a hardwaresolution	09	CO1
2	**ARM7TDMI assembly instructions and modes** ARM ISA and Processor Variants, Different Typesof Instructions, ARM Instruction set, dataprocessing instructions. Shift Operations, shiftOperations using RS lower byte, Immediate valueencoding. Dataprocessing Instructions.AddressingMode-1, Addressing Mode - 2.Addressing Mode -2, LDR/STR, and Addressing mode 3 with examples. Instruction Timing, AddressingMode - 4 with Examples. Swap Instructions, SwapRegister related Instructions, Loading Constants.Program Control Flow, Control Flow Instructions, B& BL instructions, BX instruction. **Interrupts and Exceptions:** Exception Handlers, Reset Handling.Aborts, software Interrupt Instruction, undefinedinstruction exception. Interrupt Latency, MultiplyInstructions, Instruction set examples. Thumb state,Thumb Programmers model, ThumbImplementation, Thumb Applications. ThumbInstructions, Interrupt processing. Interrupt Handling schemes, Examples of InterruptHandlers.	09	CO2
3	**ARM Coprocessor Interface** ARM coprocessor interface and Instructions,Coprocessor Instructions, data ProcessingInstruction, data transfers, register transfers. Number representations, floating pointrepresentation (IEEE754). **Vector Processors:**Flynn's Taxonomy, SIMDand Vector Processors, Vector Floating PointProcessor (VFP), VFP and ARM interactions, Anexample vector operation.	09	CO3
4	**Cache and Memory Management:** Memory Technologies, Need for memoryHierarchy, Hierarchical Memory Organization,Virtual Memory. Cache Memory, MappingFunctions. Cache Design, Unified or split cache,multiple level of caches, ARM cache features,coprocessor 15 for system control. Processes,Memory Map, **Memory Protection:** ARM systemswith MPU, memory Protection Unit (MPU). Physical Vs Virtual Memory, Paging, Segmentation. MMUAdvantage, virtual memory translation, Multitaskingwith MMU, MMU organization, Tightly coupledMemory (TCM).	09	CO4

5	**ARM tools:** ARM Development Environment, Arm ProcedureCall Standard (APCS), Example C program.Embedded software Development, Imagestructure, linker inputs and outputs, memory map, application start up. AMBA Overview, Typical AMAB Based Microcontroller. **ARM Peripherals:** AHB bus features, AHB Bustransfers, APB bus transfers, APB bridge. DMA Peripherals, Programming Peripherals in ARM.ARM ISAs, ARM v7 and, ARMv8.	09	CO5

Text Books:

1. ARM System Developers Guide, Designing and Optimizing System Software, Andrew N. SLOSS, Dominic SYMES and Chris WRIGHT,ELSEVIER
2. ARM System-on-Chip Architecture, Steve Furber, Fourth Edition, PEARSON, 2016
3. Operating Systems, William Stallings,SeventhEdition, PEARSON, 2016.

Reference:

1. The Definitive Guide to ARM® CORTEX®-M3 and CORTEX®-M4 Processors, Joseph Yiu, Newnes, Elsevier,Third Edition.
2. An Embedded Software Primer, David E. Simon, Pearson Education, 2016

Assessment Pattern:

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	**Test**	**Assignment**	**Quiz**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	4	-	-
Understand	4	3	4
Apply	9	6	6
Analyze	4	-	-
Evaluate	4	-	-
Create	-	6	-

.

SEE - Semester End Examination (50 Marks)

Bloom's Taxonomy	**Test Marks (Out of 50)**
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10

MEMS AND APPLICATIONS

Course Code	**: 20EEE564**	**Credits**	**: 03**
L:T:P:S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Gain the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
CO2	Learn various sensors and actuators.
CO3	Apply knowledge of Microfabrication techniques and applications to the design and manufacturing of a MEMS device or a microsystem.
CO4	Study different materials used for MEMS.
CO5	Understand the unique requirements, environments, and applications of MEMS.
CO6	Study various Polymer and Optical MEMS.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	1	1	2	1	1	-	-	1	1	2
CO2	3	3	1	1	2	1	1	-	-	1	1	2
CO3	3	3	1	1	2	1	1	-	-	1	1	2
CO4	3	3	1	1	2	1	1	-	-	1	1	2
CO5	3	3	1	1	2	1	1	-	-	1	1	2
CO6	3	3	1	1	2	1	1	-	-	1	1	2

Module No	**Module Contents**	**Hours**	**COs**
1	**Introduction :** Intrinsic Characteristics of MEMS, Energy Domains and Transducers, Sensors and Actuators, Introduction to Micro fabrication, Silicon based MEMS processes. New Materials, Review of Electrical and Mechanical concepts in MEMS, Semiconductor devices, Stress and strain analysis, Flexural beam bending, Torsional deflection.	09	CO1
2	**Sensors And Actuators I:** Electrostatic sensors, Parallel plate capacitor, Applications, Inter digitated Finger capacitor, Comb drive devices, Micro Grippers, Micro	09	CO2 CO5

	Motors, Thermal Sensing and Actuation, Thermal expansion, Thermal couples, Thermal resistors, Thermal Bimorph, Applications. Magnetic Actuators, Micro magnetic components, Case studies of MEMS in magnetic actuators, Actuation using Shape Memory Alloys.		
3	**Sensors And Actuators II :** Piezoresistive sensors, Piezoresistive sensor materials, Stress analysis of mechanical elements, Applications to Inertia, Pressure, Tactile and Flow sensors. Piezoelectric sensors and actuators, piezoelectric effects, piezoelectric materials, Applications to Inertia, Acoustic, Tactile and Flow sensors.	09	CO2
4	**Micromachining:** Silicon Anisotropic Etching, Anisotrophic Wet Etching, Dry Etching of Silicon, Plasma Etching, Deep Reaction Ion Etching (DRIE), Isotropic Wet Etching, Gas Phase Etchants, Case studies. Basic surface micro machining processes, Structural and Sacrificial Materials, Acceleration of sacrificial Etch, Striction and Antistriction methods, LIGA Process, Assembly of 3D MEMS, Foundry process.	09	CO3, CO4
5	**Polymer and optical MEMS:** Polymers in MEMS, Polimide, SU, Liquid Crystal Polymer (LCP), PDMS, PMMA, Parylene, Fluorocarbon, Application to Acceleration, Pressure, Flow and Tactile sensors. Optical MEMS, Lenses and Mirrors, Actuators for Active Optical MEMS.	09	CO5, CO6

Text Books:

1. Foundations of MEMS, Chang Liu, Pearson Education Inc., 2014
2. Microsystem Design, Stephen D Senturia, Springer Publication, 2013.
3. MEMS & Micro systems Design and Manufacture, Tai Ran Hsu,Tata McGraw Hill, New Delhi, 2002

Reference Books:

1. An Introduction to Micro Electromechanical System Design, NadimMaluf, Artech House, 2010.
2. The MEMS Handbook, Mohamed Gad- el- Hak, editor CRC press Baco Raton, 2013.
3. Micro Sensors MEMS and Smart Devices, Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, John Wiley & Son LTD, 2002.
4. Micro Electro Mechanical System Design, James J.Allen, CRC Press Publisher, 2010.
5. Introduction MEMS, Fabrication and Application, Thomas M.Adams and Richard A. Layton, Springer, 2012.

Assessment Pattern:

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	**Test**	**Assignment**	**Quiz**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	9	-	4
Understand	4	5	6
Apply	4	10	
Analyze	4	-	-
Evaluate	4	-	-
Create	-	-	-

SEE - Semester End Examination (50 Marks)

Bloom's Taxonomy	**Test Marks (Out of 50)**
Remember	15
Understand	10
Apply	15
Analyze	5
Evaluate	5
Create	--

CONTROL SYSTEMS LABORATORY

Course Code	**: 20EEL57**	**Credits**	**: 1.5**
L:T: P:S	**: 0:0:1.5:0**	**CIE Marks**	**: 25**
Exam Hours	**: 03**	**SEE Marks**	**: 25**

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

CO1	Evaluate the transfer functions of DC machines and a higher order system
CO2	Investigate the step response and the stability of systems
CO3	Design a suitable controller and compensator for the desired specification
CO4	Obtain state models from a mathematical model

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	2	1	-	-
CO2	3	3	2	2	3	-	-	-	2	1	-	-
CO3	3	3	3	3	3	-	-	-	2	1	-	-
CO4	3	3	3	3	3	-	-	-	2	1	-	-

Exp. No.	Experiments	COs
1	Determination of transfer function of armature controlled and field-controlled DC motor	CO1
2	Determination of transfer function of DC generator	
3	Determination of transfer function of a higher order system with two or more sub systems	
4	Digital Simulation of Step response of type-0 and type-1 unity feedback LTIV first order systems	CO2
5	Digital Simulation of Step response of type-0 and type-1 unity feedback LTIV second order systems	
6	Stability analysis of a third or higher order LTIV system	
7	Digital Simulation of Root locus plot for the desired time response of a higher order LTIV system	
8	Digital Simulation of Nyquist plot for stability analysis	
9	Digital Simulation of Bode plot for stability analysis	
10	Digital Simulation of PID controller design for a given system	CO3
11	Digital Simulation of Lead compensator design	
12	Digital Simulation of Lag compensator design	
13	Digital simulation of state space analysis	CO4

Assessment Pattern:

CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Category	Performance (day to day)	Internal Test
Marks (Out of 25)	**15**	**10**
Remember	02	02
Understand	03	03
Apply	05	02
Analyze	05	03
Evaluate	-	-
Create	-	-

SEE- Semester End Examination (25 Marks)

Bloom's Category	Lab (25)
Remember	3
Understand	5
Apply	9
Analyze	8
Evaluate	-
Create	-

SYNCHRONOUS AND INDUCTION MACHINES LABORATORY

Course Code : 20EEL58 **Credits : 1.5**
L:T:P:S : 0:0:1.5:0 **CIE Marks : 50**
Exam Hours : 03 **SEE Marks : 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Investigate various speed control techniques of induction motors
CO2	Evaluate the performance of induction and synchronous machines
CO3	Analyze load sharing among different alternators
CO4	Choose a suitable starter for various applications

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	1	1	-	1	1	1	1
CO2	3	3	2	2	-	1	1	-	1	1	1	1
CO3	3	3	2	2	-	1	1	-	1	1	1	1
CO4	3	3	2	2	-	1	1	-	1	1	1	1

S. No	LIST OF EXPERIMENTS	COs
1	Load test on single phase induction motor	CO2
2	No load and Blocked rotor tests on single phase Induction Motor	
3	Load test on three phase induction motor	
4	No load and Blocked rotor tests on three phase squirrel cage Induction Motor	
5	Speed control of three phase slip-ring induction motor	CO1
6	Regulation of three phase alternator by EMF Method	CO2
7	Regulation of three phase alternator by MMF Method	
8	Regulation of three phase alternator by ZPF Method	
9	Slip test and determination of regulation on Salient pole synchronous machine	
10	Parallel operation of alternators	CO3
11	V and Inverted V curves of a synchronous motor	
12	Study of starters	CO4

Assessment Pattern:

CIE-Continuous Internal Evaluation (25 Marks)

Bloom's Category	**Performance (day to day)**	**Internal Test**
Marks (Out of 25)	**15**	**10**
Remember	-	-
Understand	3	2
Apply	3	3
Analyze	3	3
Evaluate	6	2
Create	-	-

SEE- Semester End Examination (25 Marks)

Bloom's Category	**Lab (25)**
Remember	-
Understand	3
Apply	6
Analyze	6
Evaluate	10
Create	-

SIXTH SEMESTER

POWER SYSTEM ANALYSIS

Course Code : 20EEE61 | **Credits : 03**

L:T:P:S : 3:0:0:0 | **CIE Marks : 50**

Exam Hours : 03 | **SEE Marks : 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Develop per-unit reactance diagrams, bus incidence, Y_{bus} and Z_{bus} matrices for modelling theactual power system.
CO2	Determine steady state power flow analysis of power system using Gauss-Seidel, Newton-Raphson and fast decoupled iterative methods.
CO3	To analyze symmetrical and unsymmetrical faults in a power system.
CO4	To perform comparative study between various types of faults by solving numerical involving real time examples of a typical power system
CO5	Apply the methods to improve steady state and transient stability of power system.
CO6	Develop mathematical models for power system using dedicated software tools and thus analyze power system stability.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	3	2-	-	1	-	-	-	3
CO2	3	3	3	2	3	2	-	-	1	1	-	-
CO3	3	2	3	3	3	1	2	1	-	-	-	-
CO4	3	3	3	3	3	1	3	1	3	-	2	3
CO5	3	3	3	3	3	1	1	1	3	-	3	3
CO6	3	3	3	2	3	3	1	1	3	-	3	3

Module No	Contents of the Module	Hours	COs
1	**PER-UNIT SYSTEM MODELLING:** Introduction, Single line diagram, per unit system, per unit impedance and reactance diagram of power system **NETWORK MATRICES:**Bus Incidence matrix, Formation of Bus Admittance Matrix-Inspection method (Without half line charging admittance), Singular transformation method (with and without mutual coupling), Bus impedance matrix (Building algorithm without mutual coupling)	09	**CO1** **CO3**

2	**LOAD FLOW STUDIES:** Introduction, Power flow equations, Classification of buses, Operating constraints. **LOAD FLOW TECHNIQUES:** Gauss-Seidal Method, Acceleration of convergence; Newton Raphson's Method, Fast Decoupled load flow method, Comparison of Load Flow Methods. (Numerical problems for one iteration only)	09	**CO2** **CO6**
3	**SYMMETRICAL FAULT ANALYSIS:** Transients on a transmission line, Short circuit current and reactance of synchronous machines on no load and on load ,Selection of circuit breaker ratings. **SYMMETRICAL COMPONENTS:** Analysis ofUnbalanced load against balanced 3 phase supply, resolution of unbalanced phasors into their symmetrical components-Power in terms of symmetrical components	09	**CO3** **CO4**
4	**UNSYMMETRICAL FAULTS:** Sequence Networks, sequence impedances and sequence networks of power system elements (alternators, transformers and transmission lines) ,Positive sequence network, negative sequence network and zero sequence network of power system elements **UNSYMMETRICAL FAULTS:** Conceptual study of L-G,L-L,L-L-G,faults on an unbalanced alternator without and with fault impedance, Unsymmetrical faults on power system ,Numerical problems	09	**CO3** **CO4**
5	**STABILITY ANALYSIS:** Introduction, Dynamics of a synchronous machine-swing equation, power angle equation, steady state and transient stability. **ANALYSIS OF STABLITY OF POWER SYSTEM:** Equal area criterion for transient stability evaluation, Factors affecting transient stability, Methods of improving transient stability, Recent trends of improving transient stability.	09	**CO5** **CO6**

TEXT BOOKS:

1. G. W. Stagg, A. H. El-Abiad (2008), Computer Methods in power System Analysis, 2nd edition, Tata McGraw Hill Publications, New Delhi.
2. M. A. Pai (2008), Computer Techniques in Power System Analysis, 2nd edition, Tata McGraw Hill Publications, New Delhi, India.

REFERENCE BOOKS:

1. HadiSaadat (2010), Power System Analysis, Revised Edition, PSA Publishers, New Delhi.

2. I. J. Nagrath, D. P. Kothari (2005), Modern Power system Analysis, 3rd edition, Tata McGraw Hill Publications, New Delhi, India.

Assessment Pattern :

CIE-Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember		-	-
Understand	5	-	2
Apply	8	7.5	4
Analyze	7	7.5	4
Evaluate	5	-	
Create		-	

SEE-Semester End Examination (50 Marks)

Blooms levels	**SEE - Theory**
	Examination = 50
Remember	5
Understand	5
Apply	15
Analyze	15
Evaluate	10
Create	--

POWER ELECTRONICS

Course Code : 20EEE62 | **Credits : 03**
L:T:P:S : 3:0:0:0 | **CIE Marks : 50**
Exam Hours : 03 | **SEE Marks : 50**

Course Code	**: 20EEE62**	**Credits**	**: 03**
L:T:P:S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Analyze various power semiconductor devices
CO2	Investigate the protection, gating and commutation circuits
CO3	Assess different types of controlled rectifiers, choppers and inverters
CO4	Choose suitable harmonic reduction methods
CO5	Analyze the performance of power converters on a digital platform
CO6	Design power converters for industrial applications

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	1	-	-	-	-	-
CO2	3	2	2	2	1	-	1	-	-	-	-	-
CO3	3	3	2	2	2	-	1	-	1	-	-	-
CO4	3	3	2	2	2	-	1	-	1	-	-	-
CO5	3	3	2	2	2	-	1	-	1	-	-	-
CO6	3	3	2	2	3	-	1	-	1	-	-	-

SYLLABUS			
Module.	**Contents of Module**	**Hrs**	**Cos**
1	**Power Semiconductor Devices** Introduction, Construction, Principle of operation - Diode, BJT, IGBT, MOSFET, SCR, TRIAC, GTO-Static and dynamic characteristics - Two transistor model of SCR- Protection circuits - Commutation Techniques - Firing circuits.	9	C01, C02
2	**AC-DC Converter** Single phase and Three phase-controlled rectifiers (half and full converters) with R, RL and RLE load, Dual converters.	9	C02, C03
3	**DC-DC Converter** DC chopper - Time ratio control and current limit control – Buck, boost, buck-boost converter – Four Quadrant chopper. **AC-AC Converter** ON-OFF control and phase control, Single phase bi-directional controllers with R and RL loads-Multilevel converters.	9	C02 C03 CO5

4	**DC-AC Converter** Inverters – Single phase bridge inverters - Three phase bridge inverters (180^0 and 120^0 mode) – PWM schemes - Harmonic distortion analysis-Current Source Inverter.	9	C02 C03 CO4 CO5
5	**Industrial Applications** Drives, Heating, welding, SMPS, HVDC power transmission, static compensator, tap changers. Digital Simulation –Rectifier-Chopper-Inverter- Battery charger.	9	CO5 C06

Text books

1. Power Electronics - Circuits Devices and Applications, Rashid, M.H. Pearson, 4th edition, 2014.
2. Power Electronics, Bhimbra.P. S, Khanna publishers, 5th edition, 2014.

References

1. Thyristorised Power Controllers, Dubey.G.K, Doradia.S.R, Joshi, A. and Sinha.R.M, Wiley Eastern Limited 4th edition, 2010.
2. Power Electronics – Converters, Applications and Design", Ned Mohan, Tore M.Underland and William P.Robins, , John Wiley and Sons,4th Edition, 2012.
3. Power Electronics Essentials and Applications, LoganathanUmanand, Wiley India Pvt. Limited, 4th edition, 2010.
4. Marty Brown, Power Sources and Supplies, ELSEVIER, 2008

Assessment Pattern:

CIE-Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	3	1	2
Understand	6	5	2
Apply	7	3	2
Analyze	6	3	2
Evaluate	3	3	2
Create	-	-	

.

SEE-Semester End Examination (50 Marks)

Blooms levels	**SEE - Theory**
	Examination = 50
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	-

POWER SYSTEM PROTECTION

Course Code	**: 20EEE63**	**Credits**	**: 03**
L:T:P:S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the working of different types of switch, fuse and circuit breaker.
CO2	Analyze the causes and effects of over voltages in power system and protection against the overvoltage.
CO3	Analyze the effects of ungrounded neutral on system performance and the methods of neutral grounding.
CO4	Understand the schemes of protection for different power system elements and modern trends.
CO5	Evaluate the insulation coordination and choose the rating of the lightning arrester and insulation level for the substation equipment.
CO6	Understand the modern trends in power system protection.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	2	-	-	-	-	-	3
CO2	3	3	3	3	-	-	-	-	-	-	-	3
CO3	3	3	3	3	-	2	-	1	-	-	-	-
CO4	3	3	3	3	3	-	-	-	-	-	-	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-
CO6	3	3	3	3	3	-	-	-	-	-	-	3

Module No	Module Contents	Hours	COs
1	**Switches, Fuses and Circuit Breaker** Introduction- Energy management of power system- definition of switch gear , isolating, load breaking and earthing switches - fuse law- cut-off characteristics- Time current characteristics- fuse material- HRC fuse - Liquid fuse- Application of fuse Need of circuit breaker- Properties and Principle of arc quenching theories- Recovery and Restriking Voltages- Definitions in circuit breaker -symmetrical and asymmetrical breaking current- Rated making current- Rated Capacity - Duty Cycle - Voltage and frequency of circuit breaker- Derivation of RRRV- Maximum RRRV- Current Chopping -Resistance switching	09	CO1
2	**Circuit Breaker and Lightning Arrester** Types of circuit breaker: Air break, Air blast, Oil circuit breaker-Bulk oil circuit breaker and minimum oil circuit breaker,SF6 circuit breaker, Vaccum circuit breaker -Testing of circuit breaker. Causes of Over voltages -Internal and external lightning phenomena working principle of different lightning arrester	09	CO1, CO2 , CO5
3	**Protection against over voltages and Neutral Grounding** Generation of Over voltages in power system-Different lightning arresters-Valve type, Zinc oxide type- Insulation Coordination -BIL, Impulse ratio- Standard impulse test Grounded and Ungrounded Neutral Systems-Effects of ungrounded neutral on system performance- Methods of Neutral Grounding- Solid, Resistance, Reactance-Arcing grounds and grounding practices	09	CO1, CO2, CO3, CO5
4	**Protection of generator, bus bar protection,Transformers and Transmission Lines** Protection of generators against Stator faults, Rotor faults, and abnormal Conditions- Restricted Earth fault and Inter-turn fault Protection-Numerical Problems on % Winding Unprotected- Protection of Bus bars –Differential protection.Percentage Differential Protection, Numerical problem on design of CTs ratio,Buchholtz relay Protection- Over Current, Three-zone distance relay protection using Impedance relays- Translay Relay.	09	CO4
5	**Insulation Co-Ordination and Modern Trends in Power System Protection** Introduction-Basic approach to insulation Co-ordination in power system- Selection of arrester rating - Insulation Co-ordination between lines and substations- choice of insulation level for substation equipment; Gas insulated substation switch gear-Frequency Relays and Load Shedding- Field Programmable Gate Arrays based Relays- Adaptive protection	09	CO2, CO4 , CO5, CO6

Text Books:

1. Power system protection and switch gear ,B.Ravindranath.M.Chander ,New Age International limited ,Second edition , 2018.
2. Power system protection and switch gear, Badriram , D N Vishwakarma, Tata McGraw Hill Education Private Limited ,2011.
3. Switch gear protection and power systems , Sunil S.Rao,Khanna publishers, 13th edition,2008.

Reference Books:

1. Switchgear and Protection, J.B.Guptha ,S.K. Kataria& Sons , 2013.
2. Fundamentals of Power System Protection,Y.G.Paithankar, S.R.Bhide,Prentice hall India learning private limited second edition 2016.

Assessment Pattern:

CIE-Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	5	-	-
Understand	5	-	4
Apply	5	7.5	2
Analyze	5	7.5	2
Evaluate	5	-	2
Create	-	-	-

.

SEE-Semester End Examination (50 Marks)

Blooms levels	**SEE - Theory**
	Examination = 50
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	--

PROFESSIONAL ELECTIVE-II
DATA STRUCTURES AND ALGORITHMS USING PYTHON

Course Code	**: 20EEE641A**	**Credits**	**: 03**
L:T:P:S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Apply python concepts to primitive functions
CO2	Implement stacks, queues and linked lists for real time applications
CO3	Utilize various sorting techniques for mathematical primitives
CO4	Develop optimized programs using binary trees
CO5	Evaluate the performance of trees and graphs
CO6	Deploy searching, insertion, deletion, traversing mechanism operations on various data structures

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-
CO3	3	3	2	3	3	-	-	-	-	-	-	-
CO4	3	3	2	3	3	-	-	-	-	-	-	-
CO5	3	3	2	3	-	-	-	-	-	-	-	-
CO6	3	3	2	3	3	-	3	-	-	-	-	3

Module No	**Contents**	**No of hrs**	**COs**
1	**Introduction to Python** Python Overview, Objects in Python, Expressions, Operators, and Precedence, Control Flow, Functions, Simple Input and Output, Exception Handling, Iterators and Generators, Additional Python Conveniences, Scopes and Namespaces, Modules and the Import Statement	9	CO1
2	**Stacks and Queues** Types of data structures, Stack, stack implementation, simple balanced parentheses, converting decimal numbers to Binary numbers, Infix, Prefix and Postfix expressions, Queue, Queue implementation, simulation, Deques.	9	CO2 CO6
3	**Linked List and sorting techniques** The Unordered List Abstract Data Type, Implementing an Unordered List: Linked Lists, The Ordered List Abstract Data Type, Recursion,	9	CO2 CO3 CO6

	Sorting and Searching techniques		
4	**Trees** Introduction, Parse Tree, Tree Traversals, Binary Heap Operations, Binary Heap Implementations, Binary search Trees, AVL Trees.	9	CO4 CO6
5	**Graphs** Introduction, Adjancey Matrix, Adjaceny list, implementation, Breadth First Search , Depth First Search, Topological Sorting. Shortest Path Algorithms	9	CO5 CO6

Text Books:

1. Data Structures and Algorithms in Python. Michael T. Goodrich , Roberto Tamassia , Michael H. Goldwasser, Wiley, 2013
2. Problem Solving with Algorithms and Data Structures Using Python by Brad Miller, David Ranum. Publisher: Franklin, Beedle & Associates 2011

Reference Books:

1. Data Structures and Algorithms Using Python, Rance Necaise, Wiley 2011
2. `Think Python: How to Think Like a Computer Scientist'' Allen B. Downey, 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 http://greenteapress.com/wp/think- python/)
3. Grokking Algorithms. An illustrated guide for programmers and other curious people, Aditya Bhargava, Manning Publications, 2016

Assessment Pattern:

CIE-Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	**Test**	**Assignment**	**Quiz**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	5	-	-
Understand	10	7.5	-
Apply	10	7.5	10
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

SEE – Semester End Examination (50 Marks)

Bloom's Taxonomy	**Test Marks (Out of 50)**
Remember	5
Understand	20

Apply	25
Analyze	-
Evaluate	-
Create	-

FIBRE OPTIC AND LASER INSTRUMENTATION

Course Code	**: 20EEE642**	**Credits**	**: 03**
L:T:P:S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course- the student will be able to:

CO1	Explore the basic concepts of optical fibres and their properties
CO2	Interpret Fibre optic Sources, Detectors, Sensors and Instrumentation
CO3	Analyze the different Industrial Applications of Optical Fibres
CO4	Construe the Fundamental characteristics and types of LASER
CO5	investigate the different configurations of Industrial Applications Of LASER
CO6	Examine the Medical applications of LASER

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	1	2	1	1	1	1	1	1
CO2	2	2	2	1	1	2	1	1	1	1	1	1
CO3	2	2	1	1	1	1	1	1	1	1	1	1
CO4	2	2	1	1	1	1	1	1	1	1	1	1
CO5	2	2	1	1	1	1	1	1	1	1	1	1
CO6	2	2	1	1	1	2	1	1	1	1	1	1

Module No	Contents of the Module	Hours	COs
1	**OPTICAL FIBRES AND THEIR PROPERTIES** Principles of light propagation through a fibre - Different types of fibres and their properties- fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicer's – fibre termination – Optical sources – Optical detectors	09	CO1
2	**INDUSTRIAL APPLICATIONS OF OPTICAL FIBRES** Fibre optic sensors – Fibre optic instrumentation system – Different types of modulators – Inter ferometric method of measurement of length – Moire fringes – Measurement of pressure- temperature- current- voltage- liquid level and strain	09	CO2 CO3
3	**LASER FUNDAMENTALS** Fundamental characteristics of LASER – three levels and four levels LASER – properties of LASER – LASER modes – resonator configuration – q-switching and mode locking – cavity damping –	09	CO4

	types of LASER – gas LASER - solid LASER- liquid LASER- semiconductor LASER		
4	**INDUSTRIAL APPLICATIONS OF LASER** LASER for measurement of distance- length- velocity- acceleration- current- voltage and Atmospheric effect – Material processing – LASER heating- welding- melting and trimming of material – Removal and vaporization – Hologram	09	CO5
5	**MEDICAL APPLICATIONS** Medical applications of LASER- LASER and tissue interactive – LASER instruments for surgery- removal of tumours of vocal cards- Brain surgery- Plastic Surgery- Gynaecology and Oncology	09	CO6

Text Books:

1. J.M. Senior- ‘Optical fibre Communication – Principles and Practice’- Prentice Hall of India- 2010.
2. J. Wilson and J.F.B. Hawkes- ‘Introduction to Opto Electronics’- Prentice Hall of India- 2001.

Reference Books:

1. G. Keiser- ‘Optical Fibre Communication’- McGraw Hill- 2016.
2. M. Arumugam- ‘Optical Fibre Communication and Sensors’- Anuradha Agencies- 2002.
3. John F. Read- ‘Industrial Applications of LASERs’- Academic Press- 1997.

Assessment Pattern:

CIE-Continuous Internal Evaluation (50 Marks)

Bloom’sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	5	-	-
Understand	5	-	-
Apply	5	6	4
Analyze	5	6	4
Evaluate	5	3	2
Create	--	--	--

SEE-Semester End Examination (50 Marks)

Blooms levels	**SEE - Theory**
	Examination = 50
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	--

ROBOTICS AND AUTOMATION

Course Code : 20EEE643 **Credits : 03**
L:T:P:S : 3:0:0:0 **CIE Marks : 50**
Exam Hours : 03 **SEE Marks : 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the basic concepts of robotic Engineering
CO2	Identify performance of robots and their control strategies
CO3	Familiarize the image processing technologies and sensor technologies for automation applications.
CO4	Analyze the automation technologies by various inspection and testing methods
CO5	Analyze the economics of production in the industrial environment.
CO6	Predict the future technologies that may be applied in the industry.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	1	1	-	1	-	1	2
CO2	2	2	2	2	2	1	1	-	1	-	1	2
CO3	2	2	2	2	2	1	1	-	1	-	1	2
CO4	2	2	2	2	2	1	1	-	1	-	1	2
CO5	2	2	2	2	2	1	1	-	1	-	1	2
CO6	2	2	2	2	2	1	1	-	1	-	1	2

Module No	Contents of the Module	Hours	COs
1	**Introduction to Robots** Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom, Robot configurations and concept of workspace, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots	09	CO1 CO2
2	**Robotic control** Static force analysis of RP type and RR type planar robots, Dynamic analysis using Lagrangian and Newton-Euler formulations of RR and RP type planar robots, Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, Computed torque control, force control, hybrid control.	09	CO1 CO2
3	**Sensors and controllers** Internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser range finder.	09	CO1 CO3

	Robot vision Image processing fundamentals for robotic applications, image acquisition and preprocessing. Segmentation and region characterization object recognition by image matching and based on features		
4	**Automation technologies** Review of automation, Types of production, Functions of Manufacturing, Organization and Information Processing in Manufacturing, Production concepts and Mathematical Models, Automation Strategies **Production Economics**: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break-Even Analysis, Unit cost of production, Cost of Manufacturing Lead time and Work-in-process.	09	CO3 CO4
5	**Automated Inspection and Testing:** Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods. **The Future Automated Factory:** Trends in Manufacturing, The Future Automated Factory, Human Workers in the Future Automated Factory, The social impact.	09	CO5 CO6

Text Books:

1. Robotics, control, sensing, Vision and Intelligence, Fu. K.S, Gonzalez, R.C., Lee, C.S.G, McGraw Hill International, 2014
2. Robots and manufacturing Automation, C.RayAsfahl, John Wiley and Sons New York,2018
3. Automation, Production Systems and Computer Integrated Manufacturing, Mikell P.Grover, Pearson Education,2016

Reference Books:

1. Robot Analysis& Control, Harry Asada &Slottine, Wiley Publications, 2014
2. Introduction to Robotics S K Saha, , 2nd edition, TMH, 2015

Assessment Pattern:
CIE-Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	2	-	-
Understand	5	-	-
Apply	8	6	4
Analyze	7	6	4
Evaluate	3	3	2
Create	--	--	--

SEE-Semester End Examination (50 Marks)

Blooms levels	**SEE - Theory**
	Examination = 50
Remember	6
Understand	13
Apply	14
Analyze	10
Evaluate	7
Create	--

VIRTUAL INSTRUMENTATION

Course Code : 20EEE644 **Credits : 03**
L:T:P:S : 3:0:0:0 **CIE Marks : 50**
Exam Hours : 03 **SEE Marks : 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the evolution and applications of virtual instrumentation.
CO2	Acquire knowledge on VI programming techniques.
CO3	Explore various data acquisition techniques.
CO4	Understand the concept of common instrument interfaces with industrial applications.
CO5	Study about the use of tools for the analysis of various applications.
CO6	Apply the concept VI in various engineering applications.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	1	1	-	1	-	1	2
CO2	2	2	2	2	2	1	1	-	1	-	1	2
CO3	2	2	2	2	2	1	1	-	1	-	1	2
CO4	2	2	2	2	2	1	1	-	1	-	1	2
CO5	2	2	2	2	2	1	1	-	1	-	1	2
CO6	2	2	2	2	2	1	1	-	1	-	1	2

Module No	Contents of the Module	Hours	COs
1	**INTRODUCTION** Virtual Instrumentation: Historical perspective - advantages - block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in the data flow, comparison with conventional programming.	09	CO1 CO2

2	**VI PROGRAMMING TECHNIQUES** VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O, Instrument Drivers, Publishing measurement data in the web.	09	CO1 CO2
3	**DATA ACQUISITION** Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques, and buses. Latest ADCs, DACs, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements – Issues involved in the selection of Data acquisition cards – Data acquisition cards with serial communication - VI Chassis requirements. SCSI, PCI, PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA, and IVI	09	CO1 CO3
4	**VI TOOLSETS** Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, windowing, and filtering. Application of VI in process control designing of equipment like oscilloscope, Digital multimeter, Design of digital Voltmeters with transducer input Virtual Laboratory, Web-based Laboratory	09	CO3 CO4
5	**APPLICATIONS** Distributed I/O modules- Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition, and processing,Motion control. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.	09	CO5 CO6

TEXTBOOKS:

1. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
2. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, Prentice-Hall, New Jersey, 1997.

REFERENCES:

1. Kevin James, PC Interfacing, and Data Acquisition: Techniques for Measurement, Instrumentation, and Control, Newnes, 2000.

Assessment Pattern:

CIE-Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	Tests	Assignments	Quizzes
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	2	-	-
Understand	5	-	-
Apply	8	6	4
Analyze	7	6	4
Evaluate	3	3	2
Create	--	--	--

SEE-Semester End Examination (50 Marks)

Blooms levels	SEE - Theory Examination = 50
Remember	6
Understand	13
Apply	14
Analyze	10
Evaluate	7

PROFESSIONAL ELECTIVE-III

OPERATION RESEARCH

Course Code : 20EEE651 | **Credits : 03**
L:T:P:S : 3:0:0:0 | **CIE Marks : 50**
Exam Hours : 03 | **SEE Marks : 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Describe characteristics and scope of operation research and formulate mathematical problems.
CO2	Select optimal problems solving techniques for a given problem using LP.
CO3	Formulate and solve transportation, travelling salesman and transshipment problems.
CO4	Formulate and solve optimization problems related to job/ work assignments, demonstrate, and solve simple models of Game theory.
CO5	Solve different problems related to Network
CO6	Investigate elements of scheduling by CPM and PERT, importance and limitations of simulation.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	-	2	2	1	1	2	2	1
CO2	3	1	2	1	-	2	2	1	1	2	2	1
CO3	3	1	2	1	-	2	2	1	1	2	2	1
CO4	3	1	2	1	-	2	2	1	1	2	2	1
CO5	3	1	2	1	-	2	2	1	1	2	2	1
CO6	3	1	2	1	-	2	2	1	1	2	2	1

Module No	Module Contents	Hours	Cos
1	**Introduction to Operations Research:** Basics definition, scope, objectives, phases, models and limitations of Operations Research. **Linear Programming Problem** Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, big-M method, two-phase method, sensitivity analysis.	09	CO1, CO2
2	**Linear Programming: II:** Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. **Optimality test:** The steppingstone method and MODI method.	09	CO3
3	**Linear Programming: III:** Formulation, Hungarian method for optimal solution. Solving unbalanced problem. Traveling salesman problem and assignment problem. **Game Theory:** Introduction, Competitive Situations, Characteristics of Competitive Games, Maximin – Minimax Principle, Dominance	09	CO4
4	**Network Optimization Models:** The Terminology of Networks, the Shortest-Path Problem, the Minimum Spanning Tree Problem, the Maximum Flow Problem, the Minimum Cost Flow Problem & the Network Simplex Method.	09	CO5
5	**Project Scheduling and PERT-CPM**: Introduction, Basic Difference between PERT and CPM, PERT/CPM Network Components and Precedence Relationship, Project Management – PERT **Simulation:** Definition, classification of simulation models, advantages of simulation, limitations of simulation technique, monte-carlo simulation.	09	CO5

Text Books:

1. Operation Research, TAHA, PHI, New Delhi, 8th edition, 2007.
2. Principle of Operations Research, Ackoff, Churchaman, arnoff, Oxford IBH, Delhi, 2nd edition.
3. Advance praise for introduction to operations research, Hillier/ Lieberman, McGraw-Hill, Seventh edition, 2001.

Reference Books:

1. Electrical Properties of Materials, L.Solymar, D.Walsh, OUP oxford, 9th Indian Edition, 2014.
2. MEMS and MOEMS Technology and Applications**,** P.Rai-Choudhury (Editor), PHI, 2009.
3. Electrical Engineering materials, A.J.Dekkar, Prentice Hall of India private limited, 2007.

Assessment Pattern:

CIE-Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	9	-	4
Understand	4	-	6
Apply	4	10	-
Analyze	4	5	-
Evaluate	4	-	-
Create	-	-	-

SEE-Semester End Examination (50 Marks)

Blooms levels	**SEE - Theory** Examination = 50
Remember	15
Understand	10
Apply	15
Analyze	5
Evaluate	5
Create	--

VLSI DESIGN

Course	**: 20EEE652**	**Credits**	**: 3**
L:T:P:S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the basic concepts of VLSI and CMOS design
CO2	Analyze the different inverters and design rules and electrical properties of MOS devices
CO3	Analyze the switching Characteristics of MOS transistor
CO4	Design NMOS, CMOS and Bi-CMOS based logic circuits
CO5	Understand the low power VLSI Designing
CO6	Develop programmable device using Hardware description Language

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2	1	1	1	-	-	1	1	1
CO2	3	1	2	2	1	1	1	-	-	1	1	1
CO3	3	1	2	2	1	1	1	-	-	1	1	1
CO4	3	1	2	2	1	1	1	-	-	1	1	1
CO5	3	1	2	2	1	1	1	-	-	1	1	1
CO6	3	1	2	2	1	1	1	-	-	1	1	1

Module no.	Module contents	Hrs	COs
1.	**Basic MOS transistor** Enhancement mode & Depletion mode – Fabrication (NMOS, PMOS, CMOS, BiCMOS) Technology, NMOS transistor current equation, second order effects, MOS Transistor Model, MOS I/V Characteristics, **VLSI technology** Introduction to VLSI technologies, MOS transistors, fabrication, thermal aspects, production of E-beam masks.	9	CO1
2.	**NMOS & CMOS inverter and gates** NMOS & CMOS inverter, Determination of pull up / pull down ratios, stick diagram, lambda based rules, super buffers, BiCMOS& steering logic. **Basic electrical properties of MOS, CMOS & BICOMS circuits:** Ids -V_{ds} Relationships, Threshold Voltage V_t, G_m, G_{ds} and W_o, Pass Transistor, MOS,CMOS& Bi-CMOS Inverters, Z_{pu}/Z_{pd}, MOS Transistor Circuit Model, Latch-Up in CMOS Circuits.	9	CO2,CO3
3.	**Sub system design & layout** Structured design of combinational circuits, Dynamic CMOS & clocking, Tally circuits (NAND-NAND, NOR-NOR and AOI logic), EXOR structure, Barrel shifter. **Design of combinational elements & regular array logic** Programmable Logic Devices- PLA,PAL,GAL, CPLD, FPGA– Implementation of Finite State Machine with PLDs	9	CO4
4.	**Low power vlsi designing basics** Need for low power VLSI chips, Sources of power dissipation on DigitalIntegrated circuits. Emerging Low power approaches. Physics of power dissipation in CMOS devices. **Device & technology impact on low power:** Dynamic dissipation in CMOS, Transistor sizing & gateoxide thickness, Impact of technology Scaling, Technology & Device innovation.	9	CO5
5.	**Introduction to hardware design** Digital System Design Process, Hardware Description Languages, Hardware Simulation, Hardware Synthesis, Levels of Abstraction. **VHDL programming** VHDL Background: VHDL History, Existing Languages, VHDL	9	CO6

	Requirements, The VHDL Language. RTL Design ,Structural level Design- combinational logic, Types, Operators, Packages, Test benches (Examples: adder, Multiplexers / Demultiplexers).		

Text Books:

1. Basic VLSI Design, D.A.Pucknell, K.Eshraghian, Prentice Hall of India, New Delhi4th Edition,2014.
2. VLSI Design, Debprasad Das, Oxford University Press 4th Edition, 2012.
3. Introduction to VLSI Design, Eugene D.Fabricius, Tata McGraw Hill5th Edition, 2014.
4. Practical Low Power Digital VLSI Design, Gary K. Yeap, KAP, 4th Edition, 2014.

Reference Books:

1. Principles of CMOS VLSI Design, N.H.Weste, Pearson Education, India5th Edition, 2015.
2. Fundamentals of Logic Design, Charles H.Roth, Jaico Publishing House3rd Edition, 2013.
3. VHDL Analysis and Modelling of Digital Systems, ZainalatsedinNavabi, Tata McGraw Hill 4th Edition,2012.
4. VHDL Programming By Example, Douglas Perry, Tata McGraw Hill, 4th Edition, 2012.
5. Digital System Design using PLD, Parag K.Lala, BS Publication, 4th Edition, 2012.

Assessment Pattern:

CIE-Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	3	2	2
Understand	7	2	2
Apply	8	3	2
Analyze	5	3	2
Evaluate	2	5	2
Create	-	-	-

.

SEE-Semester End Examination (50 Marks)

Blooms levels	**SEE - Theory**
	Examination = 50
Remember	6
Understand	13
Apply	14
Analyze	10
Evaluate	7
Create	--

ADVANCED INDUSTRIAL AND BUILDING AUTOMATION

Course Code : 20EEE653 **Credits : 03**
L:T:P:S : 3:0:0:0 **CIE Marks : 50**
Exam Hours : 03 **SEE Marks : 50**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the architecture of an advanced industrial automation system and SCADA
CO2	Analyze and configure connections between elements of an advanced or a building automation system.
CO3	Analyze and configure the fire alarm system the components
CO4	Analyze and configure connections of CCTV and access control system
CO5	Understand the various security system for home automation
CO6	Design and Develop a basic CBUS application for building application management.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	3	2	1	-	2	2	2	3
CO2	3	3	3	3	3	2	2	1	1	3	3	3
CO3	3	3	3	3	3	2	2	1	2	3	3	3
CO4	3	3	3	3	3	2	2	1	2	3	3	3
CO5	3	2	2	3	3	2	1	-	1	3	2	3
CO6	3	3	3	3	3	3	2	1	2	2	3	3

Module	**Contents of the Module**	**Hours**	**COs**
1	**Introduction to Advanced PLC and SCADA:** Need of SCADA systems, features of SCADA, Block diagram of SCADA, Function of SCADA,Network Protocols, Protocol standards, Serial Communication – Device Net – Control Net – EthernetRS232, RS48, Modbus – Fieldbus – Probus - Subnetting – Subnet mask - File transfer protocol. • **Practical activities:** o PLC interface to SCADA using communication links RS232, RS48s and protocols (Modbus ASCII RTU), o Advanced PLC applications, o SCADA Applications using energy management system (drives, …), o Application with Citect SCADA.	9	CO1

2	**Introduction to Building management system and energy management systems:** Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.-Functions of EMS and Block diagram of EMS • **Practical activities:** o Design of a EMS and BMS, o Configuration of a EMS and BMS, o Applications with Schneider Software.	9	CO2 , CO6
3	**Fire alarm systems:** Applications, FASarchitecture: Types of Architecture and Examples.Fire Alarm SystemDevices and Standards **Practical activities:** Fire- Fire Alarm System-The History, Need for Fire Alarm System, Basic Fire Alarm System, Classification of Fire Alarm System, Conventional Fire Alarm System, Addressable Fire Alarm System, Principles of Operations, Panel Components, Its o Design of a fire alarm system, o Configuration of a fire alarm system, o Applications with Schneider control panel and software tools.	9	CO3
4	**CCTVand access control systems:** Access Components, Access control system Design and Standards. CCTV: Camera: Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical types of cables, controlling systemStandards. • **Practical activities:** o Design of a basic CCTV and access control system, o Configuration of a basic CCTV and access control system, o Applications with Schneider control panel and software tools.	9	CO4

5	**Home automationsystems:** Home automation system necessity-block diagram of home automation system-Introduction to Security Systems, Concepts-Components, Technology,Advanced Applications. Security Design-Concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components -Standards for communication: CBUS – KNX, • **Practical activities:** o Design of a basic CCTV and access control system, o Configuration of a basic CCTV and access control system, o Applications with Schneider software tools.	9	CO5, CO4

Text Books:

1. Intelligent Building Systems by Albert Ting-Pat So, WaiLok Chan, Kluwer Academic publisher,3rd ed., 2012
2. PLCs & SCADA: Theory and Practice by Rajesh Mehra, edition2018
3. Design of Special Hazards and Fire Alarm Systems by Robert Gagnon, Thomson Delmar Learning; 2nd edition, 2007.
4. Turner, W. C, " Energy Management Handbook", 5 th Edition, 2004
5. Handschin, E. "Energy Management Systems", Springer Verlag, 2090.

Reference books:

1. The High Performance HMI Handbook 1st Edition , by Bill Hollifield (Author), DanaOliver (Author), Ian Nimmo (Author), Eddie Habibi (Author)
2. Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs) by Reinhold A. Carlson, Robert A. Di Giandomenico, pub. by R.S. Means Company, 2091

Assessment Pattern:

CIE-Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	5	2	2
Understand	6	4	2
Apply	5	6	2
Analyze	-	3	2
Evaluate	-		2
Create	9	-	

SEE-Semester End Examination (50 Marks)

Blooms levels	SEE - Theory Examination = 50
Remember	5
Understand	10
Apply	10
Analyze	10
Evaluate	5
Create	10

ADVANCED CONTROL SYSTEMS

Course Code : 20EEE654 **Credits : 03**
L:T:P:S : 3:0:0:0 **CIE Marks : 50**
Exam Hours : 03 **SEE Marks : 50**

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

CO1	Obtain state models by various techniques
CO2	Analyze time response of states and outputs of LTIV systems
CO3	Assess controllability and observability from the state models
CO4	Design a state feedback controller that meets the desired specifications
CO5	Design full order and reduced order state observers for state measurement
CO6	Analyze and evaluate the behaviour and stability of nonlinear systems

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	2	-	-	-
CO2	3	3	2	2	-	-	-	-	2	-	-	-
CO3	3	3	3	3	-	-	-	-	2	-	-	-
CO4	3	3	3	3	-	-	-	-	2	-	-	-
CO5	3	3	3	3	-	-	-	-	2	-	-	-
CO6	3	3	2	2	-	-	-	-	2	-	-	-

Course Syllabus			
Module No.	**Contents of the Module**	**Hours**	**COs**
1	**State space representation** Advantages of state space analysis - Introduction – State, state variable, state trajectory, state space, state model - State space representation using physical, phase and canonical variables – Non uniqueness of state model	**9**	**CO1**
2	**Time Response** Existence and uniqueness of solutions to Continuous-time state equations – Solution of Linear Time Invariant State equations – Evaluation of matrix exponential	**9**	**CO2**
3	**Controllability and Observability** Controllability - Observability – Canonical forms - Stabilizability and Detectability – Output Controllability – Reducibility	**9**	**CO3**
4	**State Feedback** Introduction – Necessary and Sufficient Condition for Arbitrary Pole-placement – pole placement design – design of full order and reduced order state observers – State Feedback with integral control	**9**	**CO4**
5	**Analysis of Non-linearities** Types of non-linearity – Typical examples – Equivalent linearization – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations	**9**	**CO5, CO6**

Text Books

1. Digital control and state variable methods: Conventional and Intelligent Control Systems, M Gopal, McGraw Hill Education, Fourth Edition 2012
2. Control Systems, Principles and Design, M. Gopal, Fourth Edition, Tata McGraw Hill, 2015
3. Modern Control Engineering, K. Ogata, Fifth edition, PHI, 2012.

Reference Books

1. Control System Engineering, Norman S. Nise, Sixth Edition, Wiley India, 2011
2. The Control Handbook: Control System Fundamentals, William S Levine, Second edition, CRC Press, Tayler and Francis Group, 2010
3. Modern Control Systems, D. Roy Choudhury, New Age International, 2005.

Assessment Pattern:

CIE-Continuous Internal Evaluation (50 Marks)

Bloom'sTaxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (Out of 50)	**25 Marks**	**15 Marks**	**10 Marks**
Remember	-	-	-
Understand	5	5	2
Apply	10	6	4
Analyze	10	4	4
Evaluate	-		-
Create	-	-	

SEE-Semester End Examination (50 Marks)

Blooms levels	**SEE - Theory**
	Examination = 50
Remember	-
Understand	10
Apply	20
Analyze	20
Evaluate	-
Create	-

INDUSTRIAL OPEN ELECTIVES

Open Elective - II		
Course Code	**Course**	**BOS**
20NHOP601	Big Data Analytics using HP Vertica-1	CSE
20NHOP602	VM Ware Virtualization Essentials-1	ISE
20NHOP604	Big Data Analytics using HP Vertica-2	CSE
20NHOP605	VM Ware Virtualization Essentials-2	ISE
20NHOP607	SAP	MEE
20NHOP608	Schneider-Industry Automation	EEE
20NHOP609	Cisco-Routing and Switching-1	ECE
20NHOP610	Data Analytics	CSE
20NHOP611	Machine learning	MEE
20NHOP612	CISCO-Routing and switching - 2	ECE
20NHOP613	IIOT Embedded System	MEE
20NHOP614	Block Chain	CSE
20NHOP615	Product Life cycle management	MEE
20NHOP617A	Network Security and Cryptography	ECE
20NHOP618A	Physical Design	ECE
20NHOP619A	AI Data Analysis with Python	AI & ML

POWER SYSTEM ANALYSIS LABORATORY

Course Code : 20EEL66 **Credits : 1.5**

L:T:P:S : 0:0:1.5:0 **CIE Marks : 25**

Exam Hours : 03 **SEE Marks : 25**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Develop per-unit reactance diagrams, bus incidence, Y_{bus} and Z_{bus}matrices for modelling the actual power system.
CO2	Determine power flow analysis of power system using Gauss-Seidel, Newton-Raphson and fast decoupled iterative methods.
CO3	Examine steady state and transient stability of power system.
CO4	Develop mathematical models for power system using dedicated software tools and thus, analyze power system stability

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	1	3	2	1	-	1	1	1	3
CO2	3	3	-	3	-	1	1	-	1	1	1	3
CO3	3	3	1	3	-	3	3	-	1	1	1	1
CO4	3	3	1	3	-	3	1	-	1	3	3	1

S. No	**LIST OF EXPERIMENTS**	**COs**
1	Computation of Parameters and Modelling of Transmission Lines	CO1
2	Formation of Bus Admittance Matrices and Solution of Networks. i. By Inspection method ii. By Singular Transformation Method (without Mutual coupling) iii. By Singular Transformation Method (with Mutual coupling)	CO2
3	Determination of bus currents, bus power, line flows and line losses for a specified system profile.	CO2
4	Determination of power angle plot for a) Salient pole synchronous machine. b) Non salient pole synchronous machine	CO4
5	Formation of Bus impedance matrix using Building algorithm.	CO4 CO1

6	Formation of Jacobian for a system not exceeding 4 buses (without PV buses) in polar coordinates.	CO3
7	Transient stability analysis of SMIB system using swing equation	CO4
8	Short circuit analysis for power system-Using Mi-Power	CO3
8	Transient stability analysis of SMIB system using swing equation	CO4
9	Load Flow Analysis – I : Solution of load flow and related problems using Gauss-Seidel Method	CO3
10	Load Flow Analysis – II: Solution of load flow and related problems using Newton Raphson.	CO3
11	Load Flow Analysis – III: Solution of load flow and related problems using Fast Decoupled Method.	CO3
12	Economic Dispatch in Power system-Using Mi-Power	CO3

Assessment Pattern:

CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Category	**Performance (day to day)**	**Internal Test**
Marks (Out of 25)	**15**	**10**
Remember	-	-
Understand	2	2
Apply	3	3
Analyze	5	2
Evaluate	5	3
Create	-	-

SEE- Semester End Examination (25 Marks)

Bloom's Category	**Lab (25)**
Remember	-
Understand	3
Apply	6
Analyze	6
Evaluate	10
Create	-

POWER ELECTRONICS LABORATORY

Course Code : 20EEL67 **Credits : 1.5**
L:T:P:S : 0:0:1.5:0 **CIE Marks : 25**
Exam Hours : 03 **SEE Marks : 25**

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Analyze various power semiconductor devices
CO2	Investigate the protection, gating and commutation circuits
CO3	Analyze the performance of power converters on a digital platform
CO4	Design power converters for industrial applications

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	-	1	-	1	-	-	-
CO2	3	2	2	2	2	-	1	-	1	-	-	-
CO3	3	3	2	2	3	-	1	-	1	-	-	-
CO4	-	2	2	2	2	1	1	-	3	-	-	-

S. No	LIST OF EXPERIMENTS	COs
1	Static characteristics of SCR.	CO1
2	Static characteristics of MOSFET and IGBT	CO1
3	SCR turn-on circuit using synchronized UJT relaxation oscillator	CO2
4	SCR Digital triggering circuit for a single-phase controlled rectifier and A.C. voltage controller	CO2
5	Single-phase full-wave rectifier with R and RL loads	CO4
6	Speed control of D.C. motor using single semi converter	CO4
7	A.C. voltage controller using TRIAC and DIAC combination connected to R and R-L loads	CO3
8	Speed control of a separately excited D.C. motor using an IGBT or MOSFET chopper	CO4
9	MOSFET OR IGBT based single-phase full-bridge inverter connected to R load	CO4
10	Series Inverter	CO3
11	Speed control of universal motor using A.C. voltage controller	CO4
12	Speed control of stepper motor	CO4
13	Simulation of Converter Circuits	CO4

Assessment Pattern:

CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Category	**Performance (day to day)**	**Internal Test**
Marks (Out of 25)	**15**	**10**
Remember	02	02
Understand	03	03
Apply	05	03
Analyze	05	02
Evaluate	-	-
Create	-	-

SEE- Semester End Examination (25 Marks)

Bloom's Category	**Lab (25)**
Remember	3
Understand	5
Apply	9
Analyze	8
Evaluate	-
Create	-

APPENDIX A

Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

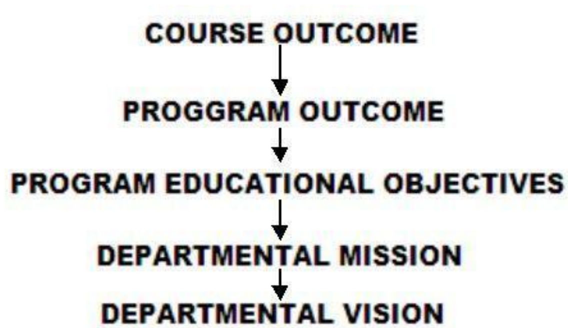
There are three educational Outcomes as defined by the National Board of Accredition:

Program Educational Objectives: The Educational objectives of an engineering degree program arethe statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes



APPENDIX B

The Graduate Attributes of NBA

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Conduct investigations of complex problems: The problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline. * That may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions. Hat require consideration of appropriate constraints/requirements not explicitly given in the problem statement. (like: cost, power requirement, durability, product life, etc.). which need to be defined (modeled) within appropriate mathematical framework. that often require use of modern computational concepts and tools.#

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering

activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX C

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. **[eduglosarry.org]**