NARAYANA ENGINEERING COLLEGE::NELLORE

AUTONOMOUS

B.Tech-Electrical and Electronics Engineering(E.E.E)

Course Structure

&

SYLLABUS

(2020-21 academic year)

(NECR B.Tech 20)

(w.e.f AY: 2020-21)

NARAYANA

ENGINEERING COLLEGE

(AUTONOMOUS)

NARAYANA ENGINEERING COLLEGE::NELLORE

AUTONOMOUS

INSTITUTE VISION & MISSION

VISION

- To be one of the nation's premier Institutions for Technical and Management Education and a key contributor for Technological and Socio-economic Development of the Nation.

MISSION

- To produce technically competent Engineers and Managers by maintaining high academic standards, world class infrastructure and core instructions.
- To enhance innovative skills and multi disciplinary approach of students through well experienced faculty and industry interactions.
- To inculcate global perspective and attitude of students to face real world challenges by developing leadership qualities, lifelong learning abilities and ethical values.

Department of E.E.E –

(Electrical and Electronics Engineering)

DEPARTMENT VISION & MISSION

VISION OF THE DEPARTMENT

To impart knowledge in the field of Electrical and Electronics Engineering to meet the technical challenges of industry and society with strong innovative skills, leadership qualities and ethics.

MISSION OF THE DEPARTMENT

M1. To provide standard training and effective teaching learning process to the students by using the state-of-the-art laboratories, core instruction and efficient faculty.

M2. To enhance competent, innovative and technical skills amongst the students through training programs by industry and external participation.

M3. To inculcate leadership qualities, ethical values and lifelong learning skills in learners to serve the society and nation for overall development through value based education**.**

PEOs, POs, PSOs

POs

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

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

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

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

professional engineering practice.

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

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

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

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

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

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

PEOs

PEO 1: To solve composite problems using mathematics, basic sciences and engineering principles in the domains of testing, design and manufacturing.

PEO 2: To achieve higher positions in their profession by demonstrating leadership qualities, research and innovative abilities.

PEO 3: To contribute in the field of Electrical and Electronics Engineering to find solutions for societal problems through their lifelong learning skills and ethical values.

PSOs

PSO_1: Provide alternate solutions to address the problems with specific requirements in the field of Electrical and Electronics Engineering.

PSO_2: Be ready to work professionally in relevant industries like power systems, control systems and software industries

NARAYANA ENGINEERING COLLEGE::NELLORE

AUTONOMOUS

DEPARTMENT OF ELECTRICAL & ELETRONICS ENGINEERING

Course Structure for B.Tech E.E.E w.e.f AY: 2020-21

SEMESTER I

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20MA1001	BS	Algebra and Calculus	**3**	**1**	**0**	**4**	**4**	**40**	**60**	**100**
20PH1001	BS	Applied Physics	**3**	**0**	**0**	**3**	**3**	**40**	**60**	**100**
20ES1001	ES	Problem Solving and Programming	**3**	**0**	**0**	**3**	**3**	**40**	**60**	**100**
20EN1001	HS	English	**2**	**0**	**0**	**2**	**2**	**40**	**60**	**100**
20PH1501	BS	Applied Physics Lab	**0**	**0**	**3**	**3**	**1.5**	40	60	100
20ES1501	ES	Electrical Engineering Workshop	0	0	2	2	**1**	40	60	100
20ES1505	ES	Engineering & IT Workshop	0	0	4	4	**2**	40	60	100
20ES1506	ES	Problem Solving and Programming Lab	**0**	**0**	**3**	**3**	**1.5**	40	60	100
20EN1501	HS	English Language Lab	**0**	**0**	**3**	**3**	**1.5**	40	60	100
20MC8001	**MC**	Mandatory course I :Induction Program	Induction Program							
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	**11**	**1**	**18**	**30**	**19.5**	**360**	**540**	**900**

SEMESTER II

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20MA1003	BS	Vector Calculus Complex Variables and Transforms	3	1	0	4	**4**	**40**	**60**	**100**
20CH1001	BS	Chemistry	3	0	0	3	**3**	**40**	**60**	**100**
20ES1002	ES	Basic Electrical Circuits	3	0	0	3	**3**	**40**	**60**	**100**
20ES1007	ES	Introduction to Python Programming	2	0	0	2	**2**	**40**	**60**	**100**
20CH1501	BS	Chemistry Lab	0	0	3	3	**1.5**	40	60	100
20ES1507	ES	Basic Electrical Circuits Lab	**0**	**0**	**2**	**2**	**1**	40	60	100
20ES1504	ES	Engineering Graphics Lab	**0**	**1**	**4**	**5**	**3**	40	60	100
20ES1510	ES	Introduction to Python Programming Lab	**0**	**0**	**2**	**2**	**1**	40	60	100
20EN1502	**HS**	Oral Communication skills lab	0	0	2	2	1	40	60	100
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	**11**	**2**	**16**	**29**	**19.5**	**360**	**540**	**900**

SEMESTER III

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20MA1006	BS	Probability Statistics and Numerical Methods	3	0	0	3	3	40	60	100
20ES1011	ES	Data Structures	2	0	2	4	3	40	60	100
20ES1013	ES	Electronic Devices and Circuits	3	0	0	3	3	40	60	100
20EE2001	PC	Electrical Circuit Analysis	3	0	0	3	3	40	60	100
20EE2002	PC	DC Machines and Transformers	3	0	0	3	3	40	60	100
20ES1516	ES	Electronic Devices and Circuits Lab	0	0	3	3	1.5	40	60	100
20EE2501	PC	DC Machines and Transformers Lab	0	0	3	3	1.5	40	60	100
20EE2502	PC	Electrical Circuits and Simulation Lab	0	0	3	3	1.5	40	60	100
20CD6001	SC	Career competency Development I	0	0	2	2	1	40	60	100
20CC6001	SC	Value added course/Certificate course I	0	1	0	1	1	40	60	100
20MC8002 -12	MC	Mandatory course II	2	0	0	2	0			
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	16	1	16	33	21.5	400	600	1000

SEMESTER IV

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EE2003	PC	Analog Electronic Circuits	2	0	0	2	2	40	60	100
20EE2004	PC	Electro Magnetic Fields	3	0	0	3	3	40	60	100
20EE2005	PC	Induction Motors and Synchronous Machines	3	0	0	3	3	40	60	100
20EE2006	PC	Linear Control Systems	3	0	0	3	3	40	60	100
20EE2007	PC	Power Generation & Transmission	3	0	0	3	3	40	60	100
-	OE	Open elective I	3	0	0	3	3	40	60	100
20EE2503	PC	Analog Electronics and Simulation Lab	0	0	2	2	1	40	60	100
20EE2504	PC	Induction Motors and Synchronous Machines Lab	0	0	3	3	1.5	40	60	100
20CD6002	SC	Career competency Development II	0	0	2	2	1	40	60	100
20CC6002	SC	Value added course/Certificate course II	0	1	0	1	1	40	60	100
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	17	1	10	28	21.5	400	600	1000

SEMESTER V

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EE2008	PC	Digital Electronics and logic design	3	0	0	3	3	40	60	100
20EE2009	PC	Power Distribution & Distributed Generation	3	0	0	3	3	40	60	100
20EE2010	PC	Power Electronics	3	0	0	3	3	40	60	100
-	OE	Open elective II	3	0	0	3	3	40	60	100
20EE4001 -05	PE	Professional Elective I	3	0	0	3	3	40	60	100
20EE2505	PC	Control Systems and Simulation Lab	0	0	3	3	1.5	40	60	100
20EE2506	PC	Power Electronics & Simulation Lab	0	0	3	3	1.5	40	60	100
20CD6003	SC	Career competency Development III	0	0	2	2	1	40	60	100
20CC6003	SC	Value added course/Certificate Course III	0	1	0	1	1	40	60	100
20EE7501	PR	Internship/skill development Training I	0	0	0	0	1.5	00	100	100
20MC8002-12	MC	Mandatory course III	2	0	0	2	0	00	00	00
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	17	1	11	29	21.5	360	640	1000

SEMESTER VI

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EE2011	PC	Electrical Measurements & Instrumentation	2	0	0	2	2	40	60	100
20EE2012	PC	Modern Power System Analysis	3	0	0	3	3	40	60	100
20EE2013	PC	Switch Gear and Protection	3	0	0	3	3	40	60	100
-	OE	Open Elective III	3	0	3	3	3	40	60	100
20EE4006 -10	PE	Professional Elective II	3	0	0	3	3	40	60	100
20EE4011 -15	PE	Professional elective III	3	0	0	3	3	40	60	100
20EE2507	PC	Measurements & Instrumentation Lab	0	0	2	2	1	40	60	100
20EE2508	PC	Power Systems Lab	0	0	3	3	1.5	40	60	100
20CD6004	SC	Career competency Development IV	0	0	2	2	1	40	60	100
20CC6004	SC	Value added course/Certificate course IV	0	1	0	1	1	40	60	100
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	17	1	13	28	21.5	400	600	1000

SEMESTER VII

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20HS5001-8	HE	Humanities and Social Science Elective	2	0	0	2	2	40	60	100
20EE2014	PC	Solid State Electric Drives	3	0	0	3	3	40	60	100
20EE2015	PC	Power System Operation and Control	3	0	0	3	3	40	60	100
-	OE	Open Elective IV	2	0	2	4	3	40	60	100
20EE4016-20	PE	Professional elective IV	3	0	0	3	3	40	60	100
20EE4021-25	PE	Professional elective V	3	0	0	3	3	40	60	100
20EE2509	PC	Electronic systems design lab	0	0	2	2	1	40	60	100
20EE2510	PC	Power Systems Simulation Lab	0	0	3	3	1.5	40	60	100
20CD6005	SC	Career competency Development V	0	0	2	2	1	40	60	100
20CC6501	SC	Skill development Training	0	0	2	2	1	40	60	100
20EE7502	PR	Internship II/on job training/Com Ser	0	0	3	3	1.5	00	100	100
20MC8002-12	MC	Mandatory course IV	2	0	0	2	0	00	00	00
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	18	0	17	35	23	400	700	1100

SEMESTER VIII

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EE7503	**PR**	Project work, seminar and internship	0	0	0	0	12	60	140	200
		Activity Point Programme	During the Semester					20 points		
			0	**0**	**0**	**0**	**12**	**60**	**140**	**200**

OPEN ELECTIVES (OE) Offered by EEE Department

Department	Course Code	Open Elective
Electrical & Electronics Engineering	20EE3001	Artificial Neural Networks and Fuzzy Logic
	20EE3002	Energy Auditing and Conservation
	20EE3003	Electrical Measurements and Instrumentation
	20EE3004	Energy Storage Technologies
	20EE3005	Electrical Technology
	20EE3006	Industrial Automation Engineering
	20EE3007	Industrial Electrical Systems
	20EE3008	Renewable Energy Sources
	20EE3009	Research Methodology

PROFESSIONAL ELECTIVES (PE)

Elective Track/Group	Professional Elective-1	Professional Elective-2	Professional Elective-3	Professional Elective-4	Professional Elective-5
Advanced Power systems	Industrial Electrical Systems (20EE4001)	Power System Planning (20EE4006)	Reactive Power Compensation and Management (20EE4011)	Power Quality (20EE4016)	Smart Grid Technologies (20EE4021)
Control Systems	System Modeling and Identification (20EE4002)	Advanced Control systems (20EE4007)	Digital Signal Processing (20EE4012)	Multivariable Control System (20EE4017)	Real Time Control System (20EE4022)
Electromechanical Systems	Machine Modeling and Analysis (20EE4003)	Electrical Machine Design (20EE4008)	Programmable Control Devices and Applications (20EE4013)	Hybrid Electrical Vehicles (20EE4018)	Automotive Electrical Engineering (20EE4023)
Energy Systems	Renewable Energy Conversion Systems (20EE4004)	Solar and Fuel Cell Energy Systems (20EE4009)	Wind and Biomass Energy Systems (20EE4014)	Utilization of Electrical Energy (20EE4019)	Energy Audit &Demand side Management (20EE4024)
Power Electronics	Advanced Power Electronics (20EE4005)	Advanced Electrical Drives (20EE4010)	HVDC & FACTS (20EE4015)	Advanced Power Converters (20EE4020)	Advanced Power Semiconductor Devices and Protection (20EE4025)

LIST OF HONOR SUBJECTS

S.NO	Course Name	Course Code	L-T-P	Credits
POOL-1 (Power Systems)				
1	Advanced power system	20EEH001	3-1-0	4
2	Advanced Power system protection	20EEH002	3-1-0	4
3	Power system dynamics and control	20EEH003	3-1-0	4
4	Restructed power system	20EEH004	3-1-0	4
POOL-2 (Power Electronics)				
1	Analysis of Power Electronic Converters	20EEH005	3-1-0	4
2	Application of Power Converters	20EEH006	3-1-0	4
3	Power Electronic Applications to Renewable Energy	20EEH007	3-1-0	4
4	Switched Mode Power Conversion	20EEH008	3-1-0	4
POOL-3 (Renewable Energy Sources)				
1	Advanced Electrical Vehicles	20EEH009	3-1-0	4
2	Grid Integration of Renewable Energy systems	20EEH010	3-1-0	4
3	High Power Battery Technologies	20EEH011	3-1-0	4
4	Renewable Energy Technologies	20EEH012	3-1-0	4
POOL-4 (Integrated Circuits)				
1	CAD for VLSI	20EEH013	3-1-0	4
2	CMOS Analog and digital VLSI design	20EEH014	3-1-0	4
3	Digital Design through Verilog HDL	20EEH015	3-1-0	4
4	VLSI design	20EEH016	3-1-0	4

LIST OF MINOR SUBJECTS

S.NO.	Course Name	Course Code	L-T-P	Credits
1	Electrical Measurements	20EEM001	3-1-0	4
2	Electrical Technology	20EEM002	3-1-0	4
3	Instrumentation	20EEM003	3-1-0	4
4	Network Analysis	20EEM004	3-1-0	4
5	Power Distribution system	20EEM005	3-1-0	4
6	Power system Generation	20EEM006	3-1-0	4
7	Power Transmission system	20EEM007	3-1-0	4
8	Renewable Energy Resources	20EEM008	3-1-0	4

PROFESSIONAL ELECTIVES (PE)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
V Sem	Professional Elective I	20EE4001-05	3
VI Sem	Professional Elective II	20EE4006-10	3
	Professional Elective III	20EE4011-15	3
VII Sem	Professional Elective IV	20EE4016-20	3
	Professional Elective V	20EE4020-25	3
	TOTAL		**15**

OPEN ELECTIVES (OE)

SEMESTER	SUBJECT	CREDITS
IV Sem	Open Elective I	3
V Sem	Open Elective II	3
VI Sem	Open Elective III	3
VII Sem	Open Elective IV	3
	TOTAL	**12**

SKILL ORIENTED COURSE (SC)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
III Sem	Career Competency Development I	20CD6001	1
	Value Added Course/Certificate Course I	20CC6001	1
IV Sem	Career Competency Development II	20CD6002	1
	Value Added Course/Certificate Course II	20CC6002	1
V Sem	Career Competency Development III	20CD6003	1
	Value Added Course/Certificate Course III	20CC6003	1
VI Sem	Career Competency Development IV	20CD6004	1
	Value Added Course/Certificate Course IV	20CC6004	1
VII Sem	Career Competency Development V	20CD6005	1
	Skill Development Training	20CC6501	1
	TOTAL		10

PROJECT (PR)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
V Sem	Internship I/on job training/Com Ser Project	20EE7501	1.5
VII Sem	Internship II/on job training/Com Ser Project	20EE7502	1.5
VIII Sem	Project work, seminar and internship	20EE7503	12
	TOTAL		**15**

HUMANITIES AND SOCIAL SCIENCES (HS)

SEMESTER	Course Code	SUBJECT	CREDITS
I	20EN1001	English	2
	20EN1501	English Language Lab	1.5
II	20EN1502	Oral Communication skills lab	1
VII	20HS5001-8	Humanities and social Science Elective	2
		TOTAL	6.5

BASIC SCIENCES (BS)

SEMESTER	Course Code	SUBJECT	CREDITS
I	20MA1001	Algebra and Calculus	4
	20PH1001	Applied Physics	3
	20PH1501	Applied Physics Lab	1.5
II	20CH1001	Chemistry	3
	20MA1003	Vector Calculus, Complex Variables and Transforms	4
	20CH1501	Chemistry lab	1.5
III	20MA1006	Probability Statistics and Numerical Methods	3
		TOTAL	20

ENGINEERING SCIENCES (ES)

SEMESTER	Course Code	SUBJECT	CREDITS
I	20ES1001	Problem Solving and Programming	3
	20ES1501	Electrical Engineering Workshop	1
	20ES1505	Electrical Engineering &IT Workshop	2
	20ES1506	Problem Solving and Programming Lab	1.5
II	20ES1002	Basic Electrical Circuits	3
	20ES1007	Introduction to Python Programming	2
	20ES1507	Basic Electrical Circuits Lab	1
	20ES1504	Engineering Graphics Lab	3
	20ES1510	Introduction to Python Programming Lab	1
III	20ES1011	Data Structures	3
	20ES1013	Electronics Devices and Circuits	3
	20ES1516	Electronics Devices & Electrical Circuits lab	1.5
		Total	25

PROFESSIONAL CORE (PC)

SEMESTER	Course Code	SUBJECT		CREDITS
III	20EE2002	DC Machines and Transformers		3
	20EE2001	Electrical Circuit Analysis		3
	20EE2501	DC Machines and Transformers Lab		1.5
	20EE2502	Electrical Circuits and Simulation Lab		1.5
			9	
IV	20EE2003	Analog Electronic Circuits		2
	20EE2004	Electro Magnetic Fields		3
	20EE2005	Induction Motors and Synchronous Machines		3
	20EE2006	Linear Control Systems		3
	20EE2007	Power Generation & Transmission		3
	20EE2503	Analog Electronics and Simulation Lab		1
	20EE2504	Induction Motors and Synchronous Machines Lab		1.5
			16.5	
V	20EE2008	Digital Electronics and logic design		3
	20EE2009	Power Distribution & Distributed Generation		3
	20EE2010	Power Electronics		3
	20EE2505	Control Systems and Simulation Lab		1.5
	20EE2506	Power Electronics & Simulation Lab		1.5
			12	
VI	20EE2011	Electrical Measurements & Instrumentation		2
	20EE2012	Modern Power System Analysis		3
	20EE2013	Switch Gear & Protection		3
	20EE2507	Measurements & Instrumentation Lab		1
	20EE2508	Power Systems Lab		1.5
			10.5	
VII	20EE2014	Solid State Electric Drives		3
	20EE2015	Power System Operation & Control		3
	20EE2509	Electronic systems design lab		1
	20EE2510	Power Systems Simulation Lab		1.5
			8.5	
		TOTAL		56.5

S NO	SUBJECT AREA	CREDITS PER SEMESTER								Credits NECN
		I	II	III	IV	V	VI	VII	VIII	
1	HS	3.5	1					2		6.5
2	BS	8.5	8.5	3						20
3	ES	7.5	10	7.5						25
4	PC			9	16.5	12	10.5	8.5		56.5
5	PE					3	6	6		15
6	OE				3	3	3	3		12
7	SC			2	2	2	2	2		10
8	PR					1.5		1.5	12	15
9	MC									No credit
	TOTAL	**19.5**	**19.5**	**21.5**	**21.5**	**21.5**	**21.5**	**23**	**12**	**160**

NARAYANA ENGINEERING COLLEGE::NELLORE

AUTONOMOUS

DEPARTMENT OF ELECTRICAL & ELETRONICS ENGINEERING

SEMESTER I

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20MA1001	BS	Algebra and Calculus	3	1	0	4	4	40	60	100
20PH1001	BS	Applied Physics	3	0	0	3	3	40	60	100
20ES1001	ES	Problem Solving and Programming	3	0	0	3	3	40	60	100
20EN1001	HS	English	2	0	0	2	2	40	60	100
20PH1501	BS	Applied Physics Lab	0	0	3	3	1.5	40	60	100
20ES1501	ES	Electrical Engineering Workshop	0	0	2	2	1	40	60	100
20ES1505	ES	Engineering & IT Workshop	0	0	4	4	2	40	60	100
20ES1506	ES	Problem Solving and Programming Lab	0	0	3	3	1.5	40	60	100
20EN1501	HS	English Language Lab	0	0	3	3	1.5	40	60	100
20MC8001	MC	Mandatory course I :Induction Program	Induction Program							
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	11	1	18	30	19.5	360	540	900

NARAYANA ENGINEERING COLLEGE: NELLORE								
20MA1001	**Algebra &Calculus (CSE, ECE, EEE, CE, ME)**							R-2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	3	1	0	64	4	40	60	100

Pre-requisite: Intermediate Mathematics

Course Objectives:

1. To familiarize the students with the theory of matrices and quadratic forms
2. To analyze first order ordinary differential equations.
3. To enlighten the learners in the concepts of higher order differential equation an its applications
4. To explain the series expansions using mean value theorems and the concepts of multivariable differential calculus.
5. To summarize the procedure to solve the partial differential equations.
6. To explain the student with mathematical tools needed in evaluating multiple integrals and its applications.

Course Outcomes: After successful completion of the course, the student will be able to		**Blooms taxonomy Level**
CO 1	**Solve** the system of Linear Equations	**BL-3**
CO 2	**Solve** first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases.	**BL-3**
CO 3	**Obtain** the complete solution of a higher order differential equations	**BL-2**
CO 4	**Make use of** the Taylor's and Maclaurin's Series and Maxima, Minima for the given function	**BL-3**
CO 5	**Apply** a range of techniques for solutions of first order Linear and non linear Partial Differential Equations (PDE)	**BL-3**
CO 6	**Apply** the techniques of Multiple integrals for the Area of the region bounded by curves and volume	**BL-3**

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2												
CO2	3	3	1											
CO3	3	3	1											
CO4	3	2												
CO5	3	3	1											
CO6	3	2												

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**Matrices**	**14 H**

Introduction to matrices, Definition of Rank ,Definition of Echelon form , Problems, Solving System of Non-Homogeneous equations- Definition, Conditions for Consistency, Problems,

Solving System of Homogeneous equations- Definition, Problems, Eigen values & Eigen Vectors- Definition, Problems ,properties of Eigen values & Eigen Vectors(Without proof), Cayley – Hamilton Theorem -Statement(Without proof),finding inverse and power of a matrix by Cayley-Hamilton Theorem, Diagonalization of a Matrix-Definition, similarity of a matrix ,modal matrix, spectral matrix, powers of a matrix, problems on Diagonalization of a matrix, Quadratic Forms- Definition, Finding Matrix from Q.F, Index, signature, rank and nature of the quadratic forms, Reduction of Q.F. into a canonical form by linear transformation , Reduction of Q.F. into a canonical form by orthogonal transformation.

At the end of the Module 1, students will be able to:

1. Solve the system of homogenous and non-homogenous linear equations.BL-3
2. Obtain the Eigen values and Eigen vectors of a matrix.BL-2
3. Identify special properties of matrix and for using this information to study the nature of the linear equations. BL-3
4. Find the inverse and powers of a square matrix.BL-1
5. Obtain the diagonalization form of the matrix.BL-2
6. Apply the techniques of matrices in various engineering problems. BL-3

MODULE -2	**First Order Ordinary Differential Equations**	**9 H**

Exact Differential equation - Definition, condition for exactness, problems, Non - Exact Differential equations- Integrating factor , Method1:Integrating factor by inspection, problems, Method2:Finding Integrating factor , problems, Method3:Finding Integrating factor , problems, Method4:Finding Integrating factor , problems, Method5:Finding Integrating factor , problems, Linear differential Equation- Definition, Working rule to find general solution, problems, Bernoulli's differential Equation- Definition, Working rule to find general solution, problems, Applications of Differential equation of First order: Newton's law of Cooling-Explanation of the concept, problems, Law of natural growth and Decay- Explanation of the concept, problems and Simple Electric Circuits-Explanation of the concept, problems.

At the end of the Module 2, students will be able to:

1. Identify the first order ordinary differential equations. BL-3
2. Solve the first order ordinary differential equations. BL-3
3. Apply the techniques of first order ordinary differential equations in Newton's law of cooling, Natural growth & Decay problems. BL-3
4. Make Use of the first order ordinary differential equation techniques in simple electric circuits.
   BL-3

MODULE-3	**Higher Order Ordinary Differential Equations**	**10 H**

Non-Homogenous Linear Differential equation of second and higher order with constant coefficients-Definition, complete solution, operator D, rules for finding Complimentary function, problems, inverse operator, General method for finding Particular Integral**.**

Non-homogeneous Linear Differential Equations of Second & Higher order with Constant coefficients with RHS term of the typee^{ax},sinax ,cosax, Polynomial in X,$e^{ax}v(x)$, X.V(x)-Explanation of the concept& problems, Method of variation of parameters- Explanation of the concept& problems, Euler- Cauchy equation- Definition, problems ,Legendre's Linear equation-Definition, problems. Applications to Higher order Differential Equations - L-C-R circuits, problems.

At the end of the Module 3, students will be able to:

1. Identify the higher order ordinary differential equations. BL-3
2. Solve the linear differential equations with constant coefficients by appropriate methods BL-3
3. Solve the linear differential equations with variable coefficients by appropriate methods BL-3
4. Make Use of the higher order ordinary differential equations techniques in electrical circuits. and in various engineering problems. BL-3

MODULE-4	Mean value theorems & Multivariable Calculus	9 H

Taylor's and Maclaurin's theorems with remainders-Statements (without proof), problems on Taylor's series , problems on Maclaurin's series, Jacobean-Definition, Properties , problems ,Functional dependence-Definition , problems ,Maxima & Minima of function of two variables - Rules , Maxima & Minima of function of two variables without constraint- problems ,Maxima & Minima of function of two variables with constraint- problems, Lagrange's Method of Undetermined multipliers, problems.

At the end of the Module 4, students will be able to:

1. Demonstrate the given function as a series of Taylor's and maclurin's with remainders.BL-2
2. Illustrate series expansions of functions using mean value theorems. BL-2
3. Apply Jacobean concept to deal with problems in change of variables.BL-3
4. Obtain the maxima and minimum values of the function for two variables.BL-2
5. Apply the mean value theorems to check the continuity of the function in the given interval BL-3

MODULE-5	Partial Differential Equations	11 H

Definition ,Formation of PDE by the Method of Elimination of arbitrary constants, problems ,Method of Elimination of arbitrary functions, problems, Method of Separation of Variables-Explanation of the concept& problems, First order linear partial differential equations-Definition, Solutions of first order linear PDE-Working rule of Lagrange's Method, problems ,First order non-linear partial differential equations- Definition, Solutions of first order non-linear partial differential equations-Standard form-I, problems , Standard form-II, problems ,Standard form-III, problems, Standard form-IV, problems.

At the end of the Module 5, students will be able to:

1. Identify the basic properties of partial differential equations. BL-3
2. Outline partial differential equations. BL-2
3. Solve the applications of PDE by using the method of separation of variablesBL-3
4. Apply the PDE techniques in various engineering fields. BL-3

MODULE-6	Multiple Integrals	11 H

Double Integrals- Introduction, Evaluation in Cartesian coordinates, problems, Evaluation in Polar coordinates, change of variables – Problems on Cartesian to Polar, Change of Order of Integration- Problems , Area enclosed by plane curves - Problems, Triple integrals- Introduction, Evaluation of Triple Integrals, Volume by Triple Integrals – Problems, Change of variables

between Cartesian, cylindrical and spherical polar coordinates- Problems.

At the end of the Module 6, students will be able to:

1. Obtain double integrals in Cartesian and polar co-ordinates. BL-2
2. Obtain the area bounded by a region using double integration techniques.BL-2
3. Solve triple integrals.BL-3
4. Obtain volumes by using triple integrals.BL-2
4. Make Use of multiple integral techniques in engineering problems.BL-3

Total hours:	**64 H**

Content beyond syllabus:

1. Orthogonal Trajectories.
2. Deflection of Beams .
3. Simultaneous Linear equations with constant coefficients
4. Taylor's series for function of two variables.
5. Homogeneous Linear Partial differential equations with constant coefficients.
6. Calculation of mass, centre of gravity, moment of inertia

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	**Matrices**	CO1	https://youtu.be/P2pL5VThrzQ
2	**First Order Ordinary Differential Equations**	CO2	https://youtu.be/P7gVp333B6M
3	**Higher Order Ordinary Differential Equations**	CO3	https://youtu.be/btOCUmJkrrg
4	**Mean value theorems & Multivariable Calculus:**	CO4	https://youtu.be/bJPuy0QZ-tE https://youtu.be/0apMXhWG_W8 https://youtu.be/aqfSOOiO2kI
5	**Partial DifferentialEquations**	CO5	https://youtu.be/kZ7Oa7iMiCs
6	**Multiple Integrals**	CO6	https://youtu.be/mIeeVrv447s

Text Book(s):

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017
3. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

Reference Book(s):

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.

3.B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education
4.H. k Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.

Online Resources/ Web Resources:

1 http://www.macs.hw.ac.uk/~simonm/linalg.pdf

2.http://www.e-booksdirectory.com/details.php?ebook=7400re

3 http://www.efunda.com/math/math_home/math.cfm

4.http://www.ocw.mit.edu/resources/#Mathematics

5 .http://www.sosmath.com/

6.http://www.mathworld.wolfram.com/

NARAYANA ENGINEERING COLLEGE:NELLORE								
20PH1001	APPLIED PHYSICS							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Fundamental concepts of Physics

Course Objectives:

1. To identify the importance of the optical phenomenon i.e. interference and diffraction related to its Engineering applications
2. To enable the students in understanding the importance of quantum physics
3. To learn the dynamics of free electrons in metals by applying Free electron theories on metals.
4. To explain and provide the knowledge about semiconductors
5. To teach the concepts related to superconductivity & nano materials which leads to their fascinating applications.
6. To impart knowledge in basic concepts of LASERs along with its Engineering applications

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

CO 1	Explain optical phenomenon i.e. interference, diffraction using Huygen's wave theory.
CO 2	Comprehend and explain the concepts of matter waves, wave functions and its interpretation to understand the matter at atomic scale.
CO 3	Comprehend Free electron theories on metals and apply them to learn the dynamics of free electrons in metals
CO 4	Compute carrier concentration in semiconductors and to understand carrier transport mechanism in semiconductors
CO 5	Understand the concepts of superconductors and nano materials to familiarize their applications in relevant fields.
CO 6	Realize importance of LASERs in Engineering and Medical applications.

CO-PO Mapping

CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	1									2		
CO2	3	2										2		
CO3	2	2										1		
CO4	3	2										2		
CO5	3	2				1						2		
CO6	3	2				1						2		

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

WAVE OPTICS **9 H**

Interference-Principle of Superposition, Interference of light, Conditions for sustained Interference ,derivation of conditions for constructive and destructive interference of reflected light from a thin film, Newton's Rings-experimental arrangement, Determination of Wavelength; Engineering applications of Interference

Diffraction-distinction between interference and diffraction, differences between Fresnel & Fraunhoffer diffractions, Fraunhoffer Diffraction at single slit(derivation, energy distribution curve) , Fraunhoffer Diffraction at a Double slit (derivation, energy distribution curve),Theory of Diffraction Grating -Determination of Wavelength; Engineering applications of diffraction

At the end of the Module 1, students will be able to:

1. explain the need of coherent sources and the conditions for sustained interference BL-2
2. describe the theory of interference of reflected light from a thin film BL-2
3. explain the theory of Fraunhoffer Diffraction of light at single and multiple slits BL-2
4. identify engineering applications of interference and diffraction BL-3
5. analyze the differences between interference and diffraction (L4)

MODULE -2

INTRODUCTION TO QUANTUM MECHANICS **8 H**

Matter waves -de-Broglie hypothesis - properties, G.P.Thomson experiment, Phase and group velocities—Expression for group velocity; Heisenberg's uncertainty principle; Schrodinger's time dependent and independent wave equations – Physical significance of wave function-important characteristics of wave function, free particle energy, wave function, momentum; operators and expectation values, Eigen values and Eigen functions of a particle confined to one dimensional infinite square well (potential well).

At the end of the Module 2, students will be able to:

1. understand the concept of matter waves BL-2
2. Recognize the difference between phase velocity and group velocity BL-2.
3. understand Physical significance of wave function BL-2
4. Identify the importance of Schrodinger's wave equation in describing the motion of elementary particles BL-3 **.**

MODULE-3

FREE ELECTRON THEORY OF METALS **8 H**

Classical free electron theory-assumptions, expression for electrical conductivity, merits and demerits; Quantum free electron theory of metals-expression for electrical conductivity; Fermi-Dirac distribution, Mathiesson rule, causes of electrical resistance in metals, Bloch's theorem (Qualitative), Kronig - Penny Model (Qualitative), effective mass and Brillouin zones, Classification of solids into conductors, semiconductors and insulators based on energy band gap.

At the end of the Module 3, students will be able to:

1. explain Classical, Quantum free electron theory of metals BL-2.
2. apply these theories to explain electrical conductivity in metals BL-3

3. explain formation of energy bands in solidsBL-2 .
4. Understand the band structure of a solid and Classify materials as metals, insulators, or semiconductors, and sketch a schematic band diagram for each one BL-2.

MODULE-4

INTRODUCTION TO SEMICONDUCTORS **8 H**

Origin of energy bands , Intrinsic semiconductors - density of charge carriers(derivation),Fermi energy , Electrical conductivity; extrinsic semiconductors - P-type & N-type , Density of charge carriers , Dependence of Fermi energy on carrier concentration and temperature; Direct and Indirect band gap semiconductors, Hall effect- Hall coefficient (derivation), Applications of Hall effect ; Drift and Diffusion currents , Einstein coefficients, Continuity equation(derivation) , Applications of Semiconductors.

At the end of the Module 4, students will be able to:

1. outline the properties of n-type and p-type semiconductors BL-2.
2. interpret the direct and indirect band gap semiconductors BL-2.
3. identify the type of semiconductor using Hall effect BL-3 .
4. identify applications of semiconductors in electronic devices BL-3

MODULE-5

SUPERCONDUCTORS AND NANOMATERIALS **8 H**

Superconductors- Properties, Meissner's effect, BCS Theory, Josephson effect (AC &DC), Types of Super conductors, Applications of superconductors. Nano materials – Significance of nanoscale , Properties of nanomaterials: Physical, mechanical, Magnetic, Optical ; Synthesis of nanomaterials: Top-down-Ball Milling, Bottom-up –Chemical vapour deposition ; Applications of Nano materials.

At the end of the Module 5, students will be able to:

1. explain how electrical resistivity of solids changes with temperatureBL-2
2. classify superconductors based on Meissner's effect BL-2
3. explain Meissner's effect, BCS theory & Josephson effect in superconductors BL-2
4. identify the nano size dependent properties of nanomaterials BL-3
5. illustrate the methods for the synthesis and characterization of nanomaterials BL-2
6. Apply the basic properties of nanomaterials in various Engineering branches BL-3

MODULE-6

LASERS & OPTICAL FIBERS **7 H**

Lasers: Spontaneous & stimulated emission of radiation, Population inversion, Pumping methods, Properties of lasers- monochromaticity, coherence, directionality, brightness, Types of lasers: Nd-YAG Laser, He–Ne Laser, Semiconductor laser; Applications.

Introduction to Optical Fibers-Total Internal Reflection-Critical angle of propagation-Acceptance angle-Numerical Aperture-Classification of fibers based on Refractive index profile-advantages of optical fibres.

At the end of the Module 6, students will be able to:

1. describe Spontaneous & stimulated emission of radiation BL-2
2. Understand the basic concepts of LASER light Sources BL-2

3. describe the construction and working of different types of Lasers BL-2
4. identify the applications of lasers in various fields BL-3

Content beyond syllabus:Polarization of light.

Self-Study:

Contents to promote self-Learning:

S.NO	Topic	CO	Reference
1	Wave Optics	CO1	**https://youtu.be/n65gZGwiZtk**
2	Introduction To Quantum Mechanics	CO2	**https://youtu.be/w7Wf3Wr0guA?list=PL1955A15B7F282A7F** **https://youtu.be/NfkJKIoExYo?list=PL1955A1B7F282A7F**
3	Free Electron Theory Of Metals	CO3	**https://youtu.be/L-eOdZFt9BY** **https://youtu.be/G2zgAs5O7I8**
4	Introduction To Semiconductors	CO4	**https://youtu.be/BQijtvYxgIM** **https://youtu.be/rzxCRJcFaIw**
5	Superconductors And Nanomaterials	CO5	https://youtu.be/GglT1RoBPzg https://youtu.be/iiT_KJJ1Uhs
6	Lasers	CO6	**https://youtu.be/eoOM0Gx6GJc** **https://youtu.be/RyY4PEpV2RO**

Total hours:	**48 hours**

Text Book(s):

1. M. N. Avadhanulu, P.G. Kshirsagar & TVS Arun Murthy" AText book of Engineering Physics"- S. Chand Publications, 11th Edition 2019.
2. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning, 2012.
3. S.O.Pillai, "Solid State Physics", 8th edition, New Age International Publishers, 2018..

Reference Book(s):

1. Shatendra Sharma, Jyotsna Sharma, " Engineering Physics", Pearson Education,2018
2. N. Subrahmanyam, BrijLal, *A Textbook of Optics*, S. Chand, New Delhi, 2015
3. Kittel, C. ―Introduction to Solid State Physics‖. Wiley, 2005.
4. K. Thyagarajan, *Engineering Physics*, McGraw-Hill Education (India) Pvt. Ltd, 2016.
5. Ajoy Ghatak, *Optics*, 5th Edition, McGraw Hill, 2012
6. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
7. William T. Silfvast, "Laser Fundamentals" 2nd edition, Cambridge University Press, 2004.
8. T. Pradeep, "A Text Book of Nanoscience and Nanotechnology", Tata Mc Graw Hill, 2003

Online Resources:

1. http://www.peaceone.net/basic/Feynman/
2. http://physicsdatabase.com/free-physics-books/
3. http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf
4. http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html

Web Resources:

1. http://link.springer.com/book
2. http://www.thphys.physics.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1001	**PROBLEM SOLVING AND PROGRAMMING**							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Mathematics Knowledge, Analytical and Logical skills

Course Objectives:

1. To understand various steps in Program development.
2. To understand the basic concepts in C Programming Language.
3. To learn how to write modular and readable C Programs.
4. To learn the syntax and semantics of a C Programming language.
5. To learn structured programming approach for problem solving.

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

CO 1	Identify methods to solve a problem through computer programming. BL-3
CO 2	Understand the use of basic elements of C language. BL-2
CO 3	Understand the difference and the usage of various control statement. BL-2
CO 4	Apply the modular approach for solving the problems. BL-3
CO 5	Apply the Arrays and Pointers for solving problems. BL-3
CO 6	Explain User-Defined Data Types and Files. BL-2

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3											1	
CO2	1	2	1										1	
CO3	1	2	1		2								2	2
CO4	2	2	3	2	1							2	3	2
CO5	3	3	2	2								1	2	
CO6	2	2	2	2								1	2	

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**Fundamentals of Computers and Programming**	**8H**

Fundamentals of computers: History of Computers, Generations of Computer, The Computer System - The Input-Process-Output Concept, Components of Computer System, Operating System - Introduction, Objectives, Functions.

Introduction to Programming, Algorithms and Flowcharts: Programs and Programming, Programming languages, Compiler, Interpreter, Structured Programming Concept, Algorithms, Flowcharts, How to Develop a Program.

Fundamental Algorithms: Exchanging the values of Two Variables, Counting, Summation of a set of numbers, Factorial computation, Generation of the Fibonacci Sequence, Reversing the digits of an integer.

At the end of the Module 1, students will be able to:

1. Illustrate the working of a Computer. BL-2
2. Solve problems using language independent notations. BL-3
3. Understand the compilers and interpreters. BL-2
4. Understand Structured Programming. BL-2
5. Develop algorithms and flowcharts for problems.BL-3

MODULE -2	**Basic Elements of C**	**7 H**

Basics of C: Introduction**,** Character Set, Structure of a C Program, A Simple C Program, Variables, Data Types and Sizes, Declaration, How does The Computer Store Data in

Memory, Identifiers, Keywords, Constants, Assignment, and Initialization.
Operators and Expressions: Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Conditional Operator, Comma operator, size of operator, Expressions, L values and R values, Expression Evaluation- Precedence and Associativity, Type Conversion.

At the end of the Module 2, students will be able to:
1. Understand the basic structure of a program in C. BL-2
2. Understand tokens in C language.BL-2
3. Illustrate the working of expressions.BL-2
4. Understand the precedence and Associativity rules of operators. BL-2
5. Understand the rules of type conversion. BL-2

MODULE-3	Data Input / Output and Control Statements	8 H

Input and Output: Basic Screen and Keyboard I/O in C, Formatted Input and Output, Unformatted Input and Output Functions
Control Statements: Selection Statements - if, Nested if, if-else, Nested if-else, else-if ladder,switch Looping Statements - while, do-while, for, Nested loops, Unconditional Statements -go to, break, continue, return.

At the end of the Module 3, students will be able to:
1. Explain the Formatted and Unformatted I/O functions. BL-2
2. Understand Selection Statements. BL-2
3. Understand Looping Statements. BL-2
4. Explain Unconditional Statements. BL-2

MODULE-4	Functions and Program Structure	8 H

Functions: Introduction, Using Functions, Passing Arguments to a Function, Working with Function, Scope and Extent, Recursion, The C Preprocessor.
Program Structure: Storage classes, Automatic variables, External variables, Static variables, Register variables, Multi file programs.

At the end of the Module 4, students will be able to:
1. Understand the basic concept of functions. BL-2
2. Understand concept of Recursion and Preprocessor. BL-2
3. Explain storage specifiers. BL-2

MODULE-5	Arrays and Pointers	9 H

Arrays and Strings: Introduction, One-Dimensional Array, Multidimensional Arrays, Passing Arrays to Function, Strings - Declaration, Initialization, Printing Strings, String Input, Character Manipulation, String Manipulation, Arrays of Strings.
Pointers: Fundamentals, Pointer Declarations, Operations on pointers, Passing Pointers to a Function, Pointers and Arrays, Arrays of Pointers, Pointer to Pointer, Pointer to Functions, Command line arguments, Dynamic Memory Management.

At the end of the Module 5, students will be able to:
1. Understand the concept of Arrays. BL-2
2. Understand the concept of pointers. BL-2
3. Explain Dynamic Memory Management. BL-2

MODULE-6	User-Defined Data Types and Files	8 H

Structures and Unions: Basics of Structures, Nesting of Structures, Arrays of Structures, Structures and Pointers, Structures and Functions, Self-Referential Structures, Unions, Bit-fields, Enumerations, type def.
Files: Introduction, Using Files in C, Working with Text Files, Random Accesses to Files of Records.

At the end of the Module 6, students will be able to:
1. Explain user defined data types. BL-2
2. Understand the concept of Self-Referential Structures. BL-2
3. Understand the working of files. BL-2

Total hours:	**48 HOURS**

Content Beyond Syllabus:
1. Analysis of Algorithms

2. Binary Files
3. Variable Length Argument Lists

Self-Study:

Contents to promote self-Learning:

SNo	Module	Reference
1	Fundamentals of Computers and Programming	https://nptel.ac.in/courses/106/106/106106127/ [Lec1] https://nptel.ac.in/courses/106/105/106105214/ [Week 1 - Lec 1 To 2] https://nptel.ac.in/courses/106/105/106105171/ [Week 1 - Lec 1 To 4]
2	Basic Elements of C	https://nptel.ac.in/courses/106/105/106105171/ [Week 1 - Lec5] https://nptel.ac.in/courses/106/105/106105171/ [Week 2 - Lecture 7 To 10] https://nptel.ac.in/courses/106/105/106105171/ [Week 3 - Lec 11 To 14] https://nptel.ac.in/courses/106/106/106106127/ [Lec2] https://nptel.ac.in/courses/106/106/106106127/ [Lec3] https://nptel.ac.in/courses/106/106/106106127/ [Lec4]
3	Data Input / Output and Control Statements	https://nptel.ac.in/courses/106/106/106106127/ [Lec5] https://nptel.ac.in/courses/106/105/106105171/ [Week 3 - Lec15] https://nptel.ac.in/courses/106/105/106105171/ Week 4 - Lec 16 To 20] [Week 5 - Lec 21 To 25] https://nptel.ac.in/courses/106/106/106106127/ [Lec 6 &7]
4	Functions and Program Structure	https://nptel.ac.in/courses/106/105/106105171/ [Week 7 - Lec35] [Week 8 - Lecture 36 To 40] https://nptel.ac.in/courses/106/105/106105171/ [Week 11 - Lec 53 To 54] https://nptel.ac.in/courses/106/106/106106127/ [Lec 20 To 27]
5	Arrays and Pointers	https://nptel.ac.in/courses/106/105/106105171/ [Week 6 - Lec 26 To 30][Week 7 - Lec 32 To 34,48] [Week 12 - Lec 58, 59, 61] https://nptel.ac.in/courses/106/106/106106127/ [Lec 9 To 19]
6	User-Defined Data Types and Files	https://nptel.ac.in/courses/106/105/106105171/ [Week 11 - Lec 55, 56, 57, 60] https://nptel.ac.in/courses/106/106/106106127/ [Lec 36, 37, 38] https://nptel.ac.in/courses/106/106/106106127/ [Lec60]

Text Book(s):

1. Pradip Dey, and Manas Ghosh, "Programming in C", 2018, Oxford University Press.
2. Byron Gottfried, Schaum's Outline of Programming with C, 4th Edition, 2018, McGraw-Hill

Reference Books :

1. Brian W. Kernighan, and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson.
2. Ajay Mittal, Programming in C: A Practical Approach , 3/e, Pearson Publication
3. SCHILDT and HERBERT, C: The Complete Reference,4th Edition, McGraw Hill, 2020
4. SOMASHEKARA, M. T., GURU, D. S., MANJUNATHA, K. S., Problem Solving with C,2nd Edition, PHI Learning, 2018
5. Paul Deitel, Deitel& Harvey Deitel, C How to Program,6th Edition, Pearson Education
6. Jeri R. Hanly, Elliot B. Koffman, Ashok Kamthane and A.Ananda Rao, Programming in C and Data Structures, 1st Edition, Pearson Education, 2010.
7. H.Cheng, C for Engineers and Scientists, Mc.Graw-Hill International Edition Education / PHI, 2009
8. Yashavant P. Kanetkar, Let us C, 16th Edition, BBP Publications, Delhi, 2017.
9. R.G. Dromey, "How to Solve it by Computer". Pearson,2014.
10. Anita Goel, Computer Fundamentals, Pearson Publication,2010.

Online Resources / Web Resources:

1. https://nptel.ac.in/courses/106/105/106105171/
2. https://nptel.ac.in/courses/106/106/106106127/
3. https://www.youtube.com/playlist?list=PLVlQHNRLflP8IGz6OXwlV_lgHgc72aXlh
4. https://www.youtube.com/watch?v=8PopR3x-VMY
5. https://www.youtube.com/watch?v=vl794HKeXug
6. https://books.goalkicker.com/CBook/
7. https://www.tutorialspoint.com/cprogramming/index.htm
8. https://www.programiz.com/c-programming
9. https://www.javatpoint.com/c-programming-language-tutorial
10. https://www.edureka.co/blog/c-programming-tutorial/
11. https://data-flair.training/blogs/c-tutorial/
12. https://www.programmingsimplified.com/c-program-examples
13. https://www.w3schools.in/category/c-tutorial/
14. C Programming Notes for Professionals book : https://books.goalkicker.com/CBook/

NARAYANA ENGINEERING COLLEGE :: NELLORE								
20EN1001	ENGLISH							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	2	0	0	32	2	40	60	100

Pre-requisite: Knowledge of fundamentals of English Language & Grammar

Course Objectives:

1. To enhance the linguistic and communicative competence.
2. To improve the Language proficiency of students in English with an emphasis on Vocabulary, Reading and Writing skills.
3. To provide knowledge of grammatical structures & rules and encourage their appropriate use.
4. To expose the students to Reading skills and apply the skill & strategies of a successful reader
5. To acquaint the students with effective strategies of paragraphs, note making, text editing, review writing and formal correspondence such as letter writing, e mail, and memos.
6. To aid the students acquire appropriate and adequate knowledge on writing Technical Reports.

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

CO 1	Acquire in depth knowledge on formulating appropriate sentences with grammatical accuracy and vocabulary building. **BL-2**
CO 2	Understand the factors that influence in use of grammar and learn to use sentences unambiguously. **BL-2**
CO 3	Impart effective strategies for professional written communication using devices of coherence & cohesion with adequate support & detail. **BL-3**
CO 4	Provide knowledge of use of phrases & clauses and improve effective writing Note making & Paraphrasing. **BL-2**
CO 5	Understanding the grammar rules for synthesis of sentences and use prewriting strategies to plan to write dialogues, reviews and edit the text effectively. **BL-2**
CO 6	Master the skills and sub skills of reading and use strategies for reading effectively and provide knowledge on the structure and format of technical writing. **BL-3**

CO-PO Mapping

CO	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1									2		2		
CO2	1									2		2		
CO3	1									3		2		
CO4	1									2		3		

CO5	**1**									**3**		**3**		
CO6	**1**									**3**		**3**		
1: Low, 2-Medium, 3-High														

COURSE CONTENT		
Module – I		**6 H**
Grammar : Parts of speech: Noun (Countables & Uncountables, Singulars & Plurals, Kinds of Nouns), Pronoun, Verb, Adverb, Adjective - Kinds of Sentences & Sentence Structures – Question forms – Word order in Sentence **Vocabulary Building** : Concept of word formation – Synonyms & Antonyms – Homonyms & Homophones – Prefixes & suffixes – Commonly confused Words – One word substitutes – Idioms & Phrasal Verbs **At the end of the Module 1, students will be able to:** • Acquire in depth knowledge on basic grammar concepts. • Understand the meaning of suffixes & Prefixes, idioms and phrasal verbs. • Learn meaning and usage of Vocabulary.		
Module – II		**8 H**
Grammar : Subject Verb agreement – Pronoun-antecedent agreement – Verbs: auxiliary verbs (Primary & Modal)- Tenses **Writing** : Principles of writing: clarity, simplicity, brevity, single focus, organization of thoughts - Sentence Structure – Joining the sentences - sequencing the ideas - introduction and conclusion – Punctuation. **At the end of the Module II, students will be able to:** • Learn to use sentences clearly. • Understand the usage of grammar. • Learn the importance of use of Auxiliary verbs.		
Module – III		**10 H**
Grammar : Direct & Indirect Speech – Active and Passive Voice – Comparison of Adjectives – Articles – Prepositions **Writing** : Paragraph Writing - Phrases & Clauses – Conditionals - Business letters and Emails and Memos - Structure/ template of common business letters and emails: inquiry/ complaint/ placing an order		
At the end of the Module III, students will be able to: • Understand and learn the nuance of writing business letters, e-mails, memos and effective paragraphs • Learn to use devices of coherence & cohesion with adequate support & detail • Learn the use of prepositions and active & passive voice in engineering and scientific contexts.		

Module – IV		10 H

Grammar : Phrasal Verb – Cause and effect – Verb noun Collocations & adjective-noun collocations – correcting common errors in grammar and usage - Misplaced modifiers, idiomatic expressions

Writing : Note Making- organizing techniques: providing a suitable title, headings and sub headings; methods of sequencing - Paraphrasing -techniques of paraphrasing: Replacement of words and phrases, change of sentence structures.

At the end of the Module IV, students will be able to:

- Understand the usage of phrases and clauses in sentences
- Learn grammatical rules to encourage their appropriate use in writing
- Learn to write effective note making and paraphrase

Module – V		8 H

Grammar : Question formation (Wh- questions, Yes or No questions, Tag questions)-If Clauses—Simple, Compound, Complex Sentences - Correcting common errors in grammar and usage

Writing : Editing short texts - Dialogue writing - Writing Definitions (short and long) – compare and contrast paragraphs- Writing of Reviews : Book / Play / Movie - focus on appropriate vocabulary and structure - language items like special vocabulary and idioms used

At the end of the Module V, students will be able to:

- Acquire the knowledge of applying the grammatical rules for synthesis of sentences
- Learn to write dialogues for various contexts
- Learn to edit the text and writing reviews

Module – VI		6 H

Reading Skills : Types of reading: Skimming, Scanning, Intensive & Extensive Reading - Effective Reading-Tips
Reading Comprehension
Scramble Sentences
Complete the passage using contextual clues
Identifying Main Ideas using Scanning Technique
Identifying Specific Ideas using Skimming Technique

Writing : Describing – Report Writing: definition - purpose – types – structure - formal and informal reports - stages in developing report- proposal, progress and final reports –examples

At the end of the Module VI, students will be able to:

- Master the skills and sub skills of reading
- Learn the structure and format of technical reports
- Learn to write description of things, process, places and persons

Content beyond syllabus:

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Vocabulary for Aptitude &	CO1	https://youtu.be/uzvZa2qEuWo

	Recruitment Tests | Campus Jobs		
2	Tips to Improve Verbal and Written Communication Skills	CO2	**https://youtu.be/6Y3NY0ERBxY**
3	How to write professional emails in English	CO3	**https://youtu.be/3Tu1jN65slw**
4	Introduction to Collocation	CO4	**https://youtu.be/-ouWOpo2Uh8**
5	**Error Spotting Questions in Campus Recruitment Tests**	CO5	https://youtu.be/Rz6-qjNrzCU
6	Reading Skills: How To Skim, Scan and Read for Detail Effectively	CO6	https://youtu.be/SRHNKzXxu6o

Text Books:

- *Green, David Contemporary English Grammar –Structures and Composition, MacMillan India, 2014*
- *Raymond Murphy's English Grammar with CD, Murphy, Cambridge University Press,2012*
- *Michael Swan, (2017) Practical English Usage (Practical English Usage), 4th edition, UK:Oxford University Press.*
- *Ashraf, M Rizvi. Effective Technical Communication. Tata McGraw-Hill, 2006.*

Reference Books

- *English Conversation Practice –Grant Taylor, Tata McGrawHill, 2009.*
- *Hewings, Martin. Cambridge Academic English (B2). CUP, 2012*
- *Meenakshi Raman and Sangeeta Sharma, Professional Communication, Second Edition, Oxford University Press, India, 2017*
- *Michael McCarthy, Felicity O'Dell, (2015) English Vocabulary in Use Advanced (South Asian Edition), UK: Cambridge University Press*
- *Spoken English, R.K. Bansal &JB Harrison, Orient Longman,2013, 4Th edition***.**

WEB RESOURCES:

- *Grammar/Listening/Writing 1-language.com*
- *http://www.5minuteenglish.com/*
- *https://www.englishpractice.com/*

Grammar/Vocabulary

- *English Language Learning Online*
- *http://www.bbc.co.uk/learningenglish/*
- *http://www.better-english.com/*
- *http://www.nonstopenglish.com/*
- *https://www.vocabulary.com/*
- *BBC Vocabulary Games*
- *Free Rice Vocabulary Game*

Reading

- *https://www.usingenglish.com/comprehension/*
- *https://www.englishclub.com/reading/short-stories.htm*
- *https://www.english-online.at/*

Listening

- *https://learningenglish.voanews.com/z/3613*
- *http://www.englishmedialab.com/listening.html*

Speaking

- *https://www.talkenglish.com/*
- *BBC Learning English – Pronunciation tips*
- *Merriam-Webster – Perfect pronunciation Exercises*

All Skills

- *https://www.englishclub.com/*
- *http://www.world-english.org/*
- *http://learnenglish.britishcouncil.org/*

Online Dictionaries

- *Cambridge dictionary online : https://dictionary.cambridge.org/*
- *MacMillan dictionary : https://www.macmillandictionary.com/*
- *Oxford learner's dictionaries : https://www.oxfordlearnersdictionaries.com/*

NARAYANA ENGINEERING COLLEGE:NELLORE								
20PH1501	**Applied Physics lab**							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	0	0	3	48	1.5	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To provide student to learn about some important experimental techniques in physics with knowledge in theoretical aspects so that they can excel in that particular field. To prepare students for performing requirement analysis and design of variety of applications.
2. To enable the students to understand the concepts of interference and diffraction and their applications.
3. To educate students to recognize the applications of laser in finding the wavelength, slit width and its role in diffraction studies
4. To make the students to understand the important parameters of optical fibres and metals

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

CO 1	learn important concepts of physics through involvement in the experiments by applying theoretical knowledge.
CO 2	understand the concepts of interference and diffraction and their applications.
CO 3	recognize the applications of laser in finding the wavelength, slit width and its role in diffraction studies
CO 4	understand the important parameters of optical fibres and metals

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1										2		
CO2	2	1				1						2		
CO3	2	1				1						2		
CO4	2	1										2		

1: Low, 2-Medium, 3- High

COURSE CONTENT	CO
Task -1 Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.	
The objective :To determine a) sign of the charge carriers, b) charge carrier concentration, c) mobility of the charge carriers of a given semiconductor	CO 1
Task - 2 To determine the resistivity of semiconductor by Four probe method	
Objective: To determine the resistivity of semiconductor by Four probe method	CO 1
Task -3 Determine the energy gap of a given semiconductor diode.	

Objective: To plot characteristics between reverse saturation current and 103 /T and find out the approximate value of Energy Band Gap in PN junction diode	CO 1
TASK -4 Measurement of radius of curvature of a lens by Newton's rings method.	
Objective: To determine the wavelength of sodium light by Newton's Ring method The key idea behind Newtons ring experiment is the thin film formation between a plane-convex lens and a glass plate. Due to this thin film of air a path difference occurs in the waves which reflect from the lower surface of the lens and the top surface of the glass plate. As a result of it, they superimpose and develop the interference pattern.	CO 2
TASK -5. Determine the thickness of the wire using wedge shape method	
Objective: To calculate the thickness of a thin wire by forming interference fringes using an air wedge arrangement. The key idea behind this experiment is the formation of thin wedge shaped film between two plane glass plates. Due to this thin film of air, a path difference occurs between waves reflected from top and bottom surface of the film. On superimposition of these waves an interference pattern containing a number of straight line fringes will be produced	CO 2
TASK-6 Determination of wavelength by plane diffraction grating normal incidence method	
Objectives: 1.To understand the types of diffraction 2.To familiarize with the principle of diffraction in plane transmission grating 3.To know the procedure for standardization of the grating 4.To determine the wavelengths of prominent spectral lines of mercury spectrum. An arrangement, which is equivalents in its action to a large number of parallel slits of same width separated by equal opaque spaces is called diffraction grating. It is constructed by ruling fine equidistant parallel lines on an optically plane glass plate with the help of a sharp diamond point.	CO 2
TASK -7 Dispersive power of a diffraction grating	
objective: To determine Dispersive power of a diffraction grating When white light passes through a grating, different wavelengths undergo different angles of diffraction. Hence white light split up into different colours and diffraction spectra of different orders will be produced. The angular dispersion or dispersive power of a grating is defined as the rate of change of angle of diffraction with the change of wavelength in a particular order of the spectrum.	CO 2
TASK -8 Determination of wavelength of LASER light using diffraction grating	
Objectives :1. To determine the concept of diffraction 2. To determine the wavelength of the given Laser source.	CO 3
TASK -9 . Laser: Diffraction at a single slit	
Objective: Determination of width of a given single slit using laser diffraction method Laser beam has high monochromaticity,coherence and directionality. Hence it forms a clear diffraction pattern and we can measure width of a single slit accurately.	CO 3
TASK -10 Laser: Diffraction at a double slit	

Objective: Determination of width of a given double slit using laser diffraction method. With this experiment we can demonstrate diffraction nature of lasers and measure width of a double slit accurately.	CO3
Additional Experiments:	
TASK -11 To determine the numerical aperture and acceptance angle of a given optical fibre	
Objective: To determine the numerical aperture and acceptance angle of a given optical fiber. In optical fibres light travel by multiple total internal reflections. Numerical aperture represents light gathering powerof optical fibre. Acceptance angle represents maximum limiting angle at one end of optical fibre for the liglht ray to travel by multiple total internal reflections through the core region of thefibre. 1. Optical fibers may be used for accurate sensing of physical parameters and fields like pressure, temperature and liquid level. 2. For military applications like fiber optic hydrophones for submarine and underwater sea application and gyroscopes for applications in ships, missiles and aircrafts.	CO 4
TASK -12: Determination of Fermi energy of a metal.	
Objective: To determine Fermi energy of a metal. Fermi energy represents highest energy level occupied by the electron at 0 K in a metal.	CO4
Virtual lab: 1) Laser beam divergence and spot size https://vlab.amrita.edu/?sub=1&brch=189&sim=342&cnt=1 2. Michelson's Interferometer- Wavelength of laser beam https://vlab.amrita.edu/?sub=1&brch=189&sim=1106&cnt=1 3. Anderson's Bridge https://vlab.amrita.edu/?sub=1&brch=192&sim=859&cnt=1	

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Newton rings		**https://youtu.be/PU-SeNfIRcs**
2	Diffraction grating experiment - Wavelength of mercury spectrum		**https://youtu.be/N0lxwqANsd4**
3	Experiment - Laser Grating-Determination of Wavelength of Given Laser Source		**https://youtu.be/764Fr0mnOrQ**

Text Book(s):

1. C. L. Arora, “Practical Physics”, S. Chand & Co., New Delhi, 3rd Edition, 2012.
2. Vijay Kumar, Dr. T. Radhakrishna, “Practical Physics for Engineering Students”, S M Enterprises, 2nd Edition, 2014.

Reference Book(s):

1. S. Balasubramanian, M.N. Srinivasan “A Text book of Practical Physics”- S Chand Publishers, 2017.
2. C.H. Bernard and C.D. Epp, John Wiley and Sons, "Laboratory Experiments in College Physics" Inc., New York, 1995.
3. Dr.Ruby Das, C.S.Robinson, Rajesh Kumar and Prasanth Kumar “A text book of Engineering Physics Practical”, 1st edition, Sahu University Science Press, 2010.
4. Jayaraman, “Engineering Physics Laboratory Manual”, 1st edition, Pearson Education, 2014.

Web Resources:

1. https://www.scribd.com/doc/143091652/ENGINEERING-PHYSICS-LAB.
2. https://www3.nd.edu/~wzech/LabManual_0907c.pdf.
3. https://www.morebooks.de/store/gb/book/engineering-physics-lab-manual/isbn/978-3-330-34402.

NARAYANA ENGINEERING COLLEGE: NELLORE								
20ES1501	ELECTRICAL ENGINEERING WORKSHOP							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	0	0	2	32	1	40	60	100
Pre-requisite: Nil								

Course Objectives:

1. To know about different tools, abbreviations and symbols in Electrical Engineering
2. To learn about types of measuring instruments to measure electrical quantities
3. To gain knowledge on different types of earthing and earth resistance
4. To study different types of wiring

Course Outcomes: After successful completion of the course, the student will be able to:	
CO 1	Demonstrate knowledge on different tools, abbreviations and symbols used in Electrical Engineering
CO 2	Measure different electrical quantities using measuring instruments
CO 3	Explain how to trouble shoot the electrical equipments (like fan, grinder, motor, etc.)
CO 4	Understand about wiring and earthing for residential houses

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	2	1	1	1						1	2	3
CO2	2	2	2	1	1	1						1	2	3
CO3	2	2	2	1	1	1						1	2	3
CO4	2	2	2	1	1	1						1	2	3
1: Low, 2-Medium, 3- High														

COURSE CONTENT	**CO**
Task - 1 - STUDY OF INTRODUCTION TO ELECTRICAL TOOLS, SYMBOLS AND ABBREVIATIONS	**CO1**
Objective: To Study the electrical tools, symbols and abbreviations in electrical engineering.	
Task - 2 - MAKING "T" JOINT AND STRAIGHT JOINT OF WIRES	**CO 4**
Objective: To make "T" joint and straight joint of wires for domestic wiring..	
Task -3 - MEASUREMENTS OF ELECTRICAL QUANTITIES (VOLTAGE, CURRENT, POWER, POWER FACTOR IN RLC CIRCUITS)	**CO 2**
Objective: To measure voltage, current, power, power factor for a given RLC circuit.	
TASK -4 - STUDY OF MEASUREMENTS OF ENERGY (USING SINGLE PHASE METER) BY CONNECTING DIFFERENT LOADS	**CO 2**
Objective: To study the testing a single phase energy meter for measuring the power.	

TASK -5 - MEASUREMENT OF EARTH RESISTANCE	**CO 4**
Objective: To measure the earth resistance.	
TASK-6 - RESIDENTIAL WIRING (USING ENERGY METER, FUSES, SWITCHES, INDICATOR, LAMPS, etc.)	**CO 4**
Objective: To design different types of residential wirings and know the performance of residential wiring	
TASK -7 - FLUORESCENT LAMP WIRING	**CO 4**
Objective: To prepare wiring for a fluorescent tube light with switch control	
TASK -8 - SOLDERING & DESOLDERING PRACTICE	**CO 3**
Objective: To understand and know the Introduction to Soldering and disordering practice.	
TASK -9 - MEASUREMENT OF WIRE GUAGES USING GUAGE METER	**CO 3**
Objective: To Measure the of wire gauges using gauge meter.	
TASK -10 - DEMONSTRATION OF TRANSFORMER AND INDUCTION MOTOR	**CO 3**
Objective: To verify different components of transformer and induction motor and their applications.	
TASK -11 - LT SWITCHGEAR'S & MCB'S	**CO 3**
Objective: To understand different types of low tension switchgear equipments and MCB's	
TASK -12 - TROUBLE SHOOTING OF ELECTRICAL EQUIPMENTS (FAN, IRON BOX, MIXER,GRINDER, etc.)	**CO 3**
Objective: To understand and know the trouble shooting of electrical equipment's.	

Additional Experiments:	
TASK -13 - STUDY OF VARIOUS ELECTRICAL GADGETS (CFL AND LED)	**CO 1**
Objective:- To study about CFL (Compact Fluorescent Lamp) and LED (Light Emitting Diode) used for lighting purposes.	
TASK - 14- STUDY OF PHOTO VOLTAIC (PV) CELL	**CO 4**
Objective: To study about Photo Voltaic Cell and its applications.	
TASK - 15 - IDENTIFICATION OF COLOR CODE, RESISTORS, ICS, TRANSISTORS, CAPACITORS, DIODES, SCRS, IGBTS ETC.	**CO 1**
Objective:- To study about the Identification of color code, resistors, ICs, Transistors, capacitors, diodes, SCRs, IGBTs etc.	

Self-Study:

Contents to promote self-Learning:

SNO	CO	Reference

1	**CO 1**	Lab manual of Electrical Engineering by TTTI, Chennai.	
2	**CO 2**	Lab manual of Electrical Engineering by TTTI, Chennai.	
3	**CO 3**	Lab manual of Electrical Engineering by TTTI, Chennai.	
4	**CO 4**	Lab manual of Electrical Engineering by TTTI, Chennai.	

Text Book(s)/ Reference Book(s):

1. Lab manual of Electrical Engineering by TTTI, Chennai.

Online/Web Resources:

https://www.roboversity.com/workshops

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1505	ENGINEERING & ITWORK SHOP							R2020
PART – A ENGINEERING WORK SHOP								
I-B.Tech	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	0	0	4	64	2	40	60	100

Pre-requisite: Basic mathematics.

Course Objectives:

1. To know basic workshop processes and adopt safety practices while working with various tools and equipments
2. To identify, select and use various marking, measuring, holding, striking and cutting tools & equipments.
3. Toknowabouttheinternalpartsofacomputer,assemblingacomputerfromtheparts,preparing a computer for use by installing the operating system
4. To gain knowledge about the usage of tools like Word processors, Spreadsheets, Presentations
5. To learn about Networking of computers and use Internet facility for Browsing and Searching

CourseOutcomes:Aftersuccessfulcompletionofthecourse,thestudentwillbeableto:

CO1	Understand the safety aspects in using the tools and equipments.BL-2
CO2	Applytoolsformakingmodelsinrespectivetradesofengineeringworkshop.BL-3
CO3	Applybasicelectricalengineeringknowledgetomakesimplehousewiringcircuits andchecktheirfunctionality.BL-3
CO4	Understand to disassemble and assemble a Personal Computer and prepare the computer ready to use. BL-2
CO5	Apply knowledge to Interconnect two or more computers for information sharing. BL-3

COURSE CONTENT (TRADES FOR PRACTICE)

Trade -1 Carpentry (6 H)

Familiaritywithdifferenttypesofwoodsandtoolsusedinwoodworkingandmakefollowingjointsfromoutof 300x40x25mmsoftwoodstock.

a) Half–Lapjoint.
b) Mortiseand Tenon joint

Trade-2 Fitting (6 H)

i.]Familiarity with different types of tools used in fitting and do the fitting exercises out of 80 x 50 x 5 mm M.S. stock

a) V-fit b) Dovetail fit

Trade - 3 Sheet Metal Work (6 H)

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from out of 22 or 20 guage G.I. sheet

a) Tapered tray b) Conical funnel

Trade - 4 Electrical House Wiring (6 H)

Familiarities with different types of basic electrical circuits and make thefollowing Electrical connections

a) Two lamps in series
b) Two way switch
c) Tube light
d) Two lamps in parallel with 3 pin plug and switches

Trade 5 - Welding
Familiarity with different types of tools used in welding and do the following welding exercises 1. Single V butt joint 2. Lap joint
Text Book(s): 1. Hajra Choudhury S.K., Hajra Choudhury A.K., Nirjar Roy S.K. "Elements of WorkshopTechnology"Vol-I2008&Vol-II2010MediaPromoters&Publishers Pvt.Limited,Mumbai. 2. KalpakjianS.andStevenS.Schmid,"ManufacturingEngineeringand Technology" 4th Edition, Pearson Education IndiaEdition,2002. 3. P. Kannaiah&K. L. Narayana "Workshop manual" 2nd Ed., ScitechpublicationsPvt.Ltd.,Hyderabad,2008.
Reference Book(s): 1. Gowri P., Hariharan and Suresh Babu A., "Manufacturing Technology-I", Pearson Education2008. **WebResources:** 1. https://www.muet.edu.pk/sites/default/files/images/users/41/Workshop%20Intro.pdf 2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=98826

PART-B IT WORKSHOP LAB	
Course Objectives: 1. To provide Technical training on Productivity tools like Word processors, Spreadsheets, Presentations. 2. To make the students know about the internal parts of a computer, assembling, installing the operating system. 3. To teach connecting two or more computers.	
Course Outcomes: After successful completion of the course, the student will be able to:	
CO 1	Understand functionalities of a computer and operating system. BL-2
CO 2	Practice Word processors, Presentation and Spreadsheet tool. BL-2
CO 3	Connect computer using wired and wireless connections. BL-2

CO-PO Mapping														
	PO												PSO	
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1													
CO2	1													
CO3	1													
1: Low, 2-Medium, 3- High														

COURSE CONTENT	CO
Task-1 Learn about Computer (4H)	
Identify the internal parts of a computer and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.	CO 1
Task -2 Assembling a Computer (4H)	
Disassemble and assemble the PC back to working condition. Troubleshoot the computer and identify working and non-working parts. Identify the problem correctly by various methods available (eg: beeps). Record the process of assembling and trouble-shooting a computer.	CO 1
Task-3 Install Operating system (2H)	CO 1
Install Linux, any other operating system (including proprietary software) and make the system dual boot or multi boot. Record the entire installation process.	
TASK-4 Operating system features (2H)	CO 1
Record various features that are supported by the operating system(s) installed. Submit a report on it. Access CD/DVD drives, write CD/DVDs, access pen drives, print files, etc. Install new application software and record the installation process.	
TASK-5 Word Processor (6H)	CO 2
Create documents using the word processor tool. Tasks to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the colour, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Prepare project cover pages, content sheet and chapter pages at the end of the task using the	

features studied. Submit a report of the word processor considered. Create documents using the word processor tool. Mail Merge in word processor for creating appointment orders for 10 employee records in excel.	
TASK-6 Spreadsheet (4H)	CO 2
To create, open, save the spreadsheet and format them as per the requirement. Some of the tasks to be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells, working with pivot tables and charts. Submit a report of the Spreadsheet application considered.	
TASK-7 Presentations (6H)	CO 2
To create, open, save and run the presentations, Select the style for slides, format the slides with different fonts, colors, create charts and tables, insert and delete text, graphics and animations, bulleting and numbering, hyperlink, set the time for slide show, Record slide show. Submit a report of the Presentation tool considered.	
TASK-8 Wired network & Wireless network (4H)	CO 3
Select a LAN cable, Identify the wires in the cable, Define the purpose of each wire, Study the RJ45 connecter, Use crimping tool to fix the cable to the connecter, Test the cable using LAN tester, Connect two or more computers using cross and straight cables, Configure the computers, share the data between the computers.	

Additional Experiments:	
TASK -1 IoT	CO 3
Raspberry Pi Study the architecture of Raspberry pi, configure software, Install SD card, Connect the cables, Install Raspbian (or any other) operating system, Configure Wi-Fi, Remotely connect to your Raspberry Pi.	
TASK -2 OUTLOOK, MACROS	CO 3
Practice the following tasks and submit report A. Configure outlook and access mails. B. Create Macros in word and spreadsheet tools	

Text Book(s):

1. B.Govindarajulu, "IBM PC and Clones Hardware Trouble shooting and Maintenance",2nd edition, Tata McGraw-Hill, 2002
2. "MOS study guide for word, Excel, Powerpoint& Outlook Exams", Joan Lambert, Joyce Cox, PHI.
3. "Introduction to Information Technology", ITL Education Solutions limited, Pearson Education.

Reference Book(s):

1. Rusen, "Networking your computers and devices", PHI
2. Bigelows, "Trouble shooting, Maintaining & Repairing PCs", TMH.

On-line/Web Resources:

https://turbofuture.com/computers/Dissassembling-and-Assembling-the-computer-system
https://www.instructables.com/id/Disassemble-a-Computer/
https://www.windowscentral.com/how-do-clean-installation-windows-10
https://www.tutorialspoint.com/ms_excel_online_training/index.asp
https://www.raspberrypi.org

NARAYANA ENGINEERING COLLEGE::NELLORE								
20ES1506	**Problem Solving and Programming Lab**							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	0	0	3	48	1.5	40	60	100

Pre-requisite: Mathematics Knowledge, Analytical & Logical Skills

Course Objectives:

1. To work with the compound data types
2. To explore dynamic memory allocation concepts
3. To able to design the flowchart and algorithm for real world problems
4. To able to write C programs for real world problems using simple and compound data types
5. To employee good programming style, standards and practices during program development

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

CO 1	Translate algorithms into programs (In C language) (BL - 2)
CO 2	Code and debug programs in C program language using various constructs.(BL-3)
CO 3	Solve the problems and implement algorithms in C. (BL - 3)
CO 4	Make use of different data types to handle the real time data (BL - 3)

CO-PO Mapping

	PO												PSO	
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1	2											1	
CO2	2	2	2										2	1
CO3	2	2	3	1	2								2	2
CO4	2	2	3	1	1								2	2

1: Low, 2-Medium, 3- High

COURSE CONTENT	**CO**
TASK-1 (3H)	
1. Practice DOS and LINUX Commands necessary for execution of C Programs. 2. Study of the Editors, Integrated development environments, and Compilers in chosen platform. 3. Write, Edit, Debug, Compile and Execute Sample C programs to understand the programming environment.	CO 1
TASK-2 (6H)	
1. Practice programs: Finding the sum of three numbers, exchange of two numbers, largest of two numbers, to find the size of data types, Programs on precedence and associativity ofoperators, sample programs on various library functions.	CO 1
TASK-3 (6H)	
1. Write a C program to calculate the factorial of a given number 2. Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 & 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a Cprogram to generate the first n terms of the sequence. 3. Write a program to find the roots of a Quadratic equation.	CO1
TASK-4 (6H)	
1. Write a program to generate the series of prime numbers in the given range. 2. Write a program to reverse the digits of a number.	CO 2

3. Write a C program to find the sum of individual digits of a positive integer.	
TASK-5 (3H)	
1. Write a program to check for number palindrome. 2. Write a program to find the maximum of a set of numbers. 3. Write a C program to find the GCD (greatest common divisor) of two given integers	CO 2
TASK-6 (3H)	
1. Write a program to find the sum of positive and negative numbers in a given set of numbers. 2. Write C code to reverse the elements of the array. For example, [1,2,3,4,5] should become [5,4,3,2,1] 3. Write a C program to find factorial of a given integer number using recursion	CO 3
TASK-7 (6H)	
1. Write a C program that use pointers to find Addition of Two Matrices 2. Write a C program that use functions to find Multiplication of Two Matrices	CO 3
TASK-8 (3H)	
1. Write a program to accept a line of characters and print the number of Vowels, Consonants, blank spaces, digits and special characters. 2. Write a C program to check whether a given string is a palindrome or not, without using anybuilt-in functions.	CO 3
TASK-9 (6H)	
1. Illustrate the use of auto, static, register and external variables. 2. Write a program to read and print student information using structures 3. Write a C program to define a union and structure both having exactly the same numbers using the sizeof operators print the sizeof structure variables as well as union variable	CO 4
TASK-10 (6H)	
1. Write a program to split a "file" into two files, say file1 and file2. Write lines into the 'file' from standard input. Read the contents from 'file' and write odd numbered lines into file1 and even numbered lines into file2. 2. Write a program to merge two files.	CO 4

Additional Experiments:	
TASK-1	
1. Programs on bitwise operators. 2. Programs on bit fields.	CO4
TASK-2	
1. Write a program to read a set of strings and sort them in alphabetical order. 2. Programs on implementation of structures using files.	CO 4

Virtual Labs:
1. Problem Solving Lab (IIIT HYDERABAD) : http://ps-iiith.vlabs.ac.in/
List of Experiments

1. Numerical Representation 2. Beauty of Numbers 3. More on Numbers 4. Factorials 5. String Operations	6. Recursion 7. Advanced Arithmetic 8. Searching and Sorting 9. Permutation 10. Sequences
2. Computer Programming Lab (IIIT HYDERABAD) : http://cse02-iiith.vlabs.ac.in/	
List of Experiments	
1. Numerical Approximation 2. Functions 3. Advanced Control Flow 4. Arrays 5. Structures	6. Basic Control Flow 7. Pointers 8. Recursion 9. Expression Evaluation

Text Book(s):

1. "How to Solve it by Computer", R.G. Dromey, 2014, Pearson.
2. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A.Ananda Rao, Pearson Education, 1st Edition, 2010.

Reference Book(s):

1. "The C Programming Language", Brian W. Kernighan, Dennis M. Ritchie, 2nd Edition, Pearson.
2. "Let us C", Yeswant Kanetkar, BPB publications
3. "Pointers in C", Yeswant Kanetkar, BPB publications, 16th Edition, 2017
4. Computer Science, A Structured Programming Approach Using C by Behrouz A. Forouzan& Richard F. Gilberg, 3rd Edition, Cengage Learning
5. C Programming A Problem-Solving Approach, Behrouz A. Forouzan & E.V. Prasad, F. Gilberg, 3rd Edition, Cengage Learning
6. Programming with C RemaTheraja, Oxford, 2018
7. Programming in C, 3rd Edition, 2015, Ashok N. Kamthane, Pearson Education
8. Programming in C, 3/e : A Practical Approach by Ajay Mittal, Pearson Publication
9. Problem Solving with C by SOMASHEKARA, M. T., GURU, D. S., MANJUNATHA, K. S., PHI Learning, 2nd Edition, 2018
10. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press, 2001
11. Byron Gottfried, Schaum's Outline of Programming with C, 4th Edition, 2018, McGraw-Hill

Web Resources:

1. https://www.includehelp.com/c-programs/advacnce-c-examples.aspx
2. https://www.programiz.com/c-programming/examples
3. https://www.javatpoint.com/c-programs
4. https://www.w3resource.com/c-programming-exercises/
5. https://www.sanfoundry.com/simple-c-programs/
6. https://www.includehelp.com/c-programming-examples-solved-c-programs.aspx
7. http://www.c4learn.com/c-programs/tag/c-programs-typical-programs

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EN1501	**ENGLISH LANGUAGE LAB**							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	0	0	3	48	1.5	40	60	100

Pre-requisite: Basic English Grammar

Course Objectives:

1. To expose the students to develop knowledge and awareness of English phonetics be able to read and produce phonemic transcriptions
2. To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm
3. To develop strategies appropriately to improve one's ability to listen and Use listening skills to create more effective, less confrontational, more productive professional and personal communication
4. To demonstrate his/her ability to write error free written communication
5. To distinguish main ideas from specific details and make use of contextual clues to infer meanings of unfamiliar words from context
6. To provide a structured methodology for participants to prepare and deliver an effective, high impact presentation that meets the objectives and brings results

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

CO 1	Understand how speech sounds are used to create meaning. Apply their knowledge of English phonetics and phonology to improve their own pronunciation.
CO 2	Recognize and use pitch patterns to signal complete and incomplete thought groups and Speak confidently and intelligibly within groups and before an audience.
CO 3	Discuss and respond to content of a lecture or listening passage orally and/or in writing and make inferences and predictions about spoken discourse
CO 4	Produce coherent and unified paragraphs with adequate support and detail and can write a paragraph with a topic sentence, support, and concluding sentence
CO 5	To help the students to cultivate the habit of reading passages for competitive exams such as GRE, TOEFL, GMAT etc.
CO 6	Learn, practice and acquire the skills necessary to deliver effective, presentation with clarity and enable them to prepare resume with cover letter.

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1									3		2		
CO2	1									2		3		
CO3	1									3		3		
CO4	1									2		3		
CO5	1									3		3		
CO6	1									3		3		
1: Low, 2-Medium, 3- High														

COURSE CONTENT	
Module - 1	8 hrs
Introduction to Phonetics : Introduction to Sounds of Speech – Vowels – Consonants - Listening with a focus on pronunciation Reading Newspaper – Highlighting Vowels and Consonants	**CO1**
Module – 2	8 hrs
Syllabification: Word Stress, Rules of word stress Practice on Intonation and Stress	**CO2**
Module – 3	8 hrs
Listening Skills : Types of Listening Skills Active listening and anticipating the speaker Listening for Specific & General Details Listening Comprehension	**CO3**
Module – 4	8 hrs
Defining & Describing: Objects, Places and Events Video Speech Writing Review Writing (Books / Movies / Products..etc.,)	**CO4**
Module – 5	8 hrs
Reading Comprehension Everyday English – Grammar, Vocabulary, LSRW Skills, Summarizing and Note making Vocabulary Building	**CO5**
Module – 6	8 hrs
JAM Role Play Giving and Asking Directions Information Transfer	**CO6**

Reference Books:

- *A Textbook of English Phonetics for Indian Students 2nd Ed T. Balasubramanian.(Macmillian),2012*
- *Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.*
- *English Pronunciation in Use. Intermediate & Advanced, Hancock, M. 2009. CUP*
- *Rizvi, Ashraf. M., Effective Technical Communication, Mc Graw Hill, New Delhi. 2005*
- *Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi. 2011.*

Web Resources:

- *Grammar/Listening/Writing 1-language.com*
- *http://www.5minuteenglish.com/*
- *https://www.englishpractice.com/*

Grammar/Vocabulary

- *English Language Learning Online*
- *http://www.bbc.co.uk/learningenglish/*
- *http://www.better-english.com/*
- *http://www.nonstopenglish.com/*
- *https://www.vocabulary.com/*
- *BBC Vocabulary Games*
- *Free Rice Vocabulary Game*

Reading

- *https://www.usingenglish.com/comprehension/*
- *https://www.englishclub.com/reading/short-stories.htm*
- *https://www.english-online.at/*

Listening

- *https://learningenglish.voanews.com/z/3613*
- *http://www.englishmedialab.com/listening.html*

Speaking

- *https://www.talkenglish.com/*
- *BBC Learning English – Pronunciation tips*
- *Merriam-Webster – Perfect pronunciation Exercises*

All Skills

- *https://www.englishclub.com/*
- *http://www.world-english.org/*
- *http://learnenglish.britishcouncil.org/*

Online Dictionaries

- *Cambridge dictionary online : https://dictionary.cambridge.org/*
- *MacMillan dictionary : https://www.macmillandictionary.com/*
- *Oxford learner's dictionaries : https://www.oxfordlearnersdictionaries.com/*

NARAYANA ENGINEERING COLLEGE::NELLORE

AUTONOMOUS

DEPARTMENT OF ELECTRICAL & ELETRONICS ENGINEERING

SEMESTER II

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20MA1003	BS	Vector Calculus Complex Variables and Transforms	3	1	0	4	**4**	**40**	**60**	**100**
20CH1001	BS	Chemistry	3	0	0	3	**3**	**40**	**60**	**100**
20ES1002	ES	Basic Electrical Circuits	3	0	0	3	**3**	**40**	**60**	**100**
20ES1007	ES	Introduction to Python Programming	2	0	0	2	**2**	**40**	**60**	**100**
20CH1501	BS	Chemistry Lab	0	0	3	3	**1.5**	40	60	100
20ES1507	ES	Basic Electrical Circuits Lab	**0**	**0**	**2**	**2**	**1**	40	60	100
20ES1504	ES	Engineering Graphics Lab	**0**	**1**	**4**	**5**	**3**	40	60	100
20ES1510	ES	Introduction to Python Programming Lab	**0**	**0**	**2**	**2**	**1**	40	60	100
20EN1502	**HS**	Oral Communication skills lab	0	0	2	2	1	40	60	100
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	**11**	**2**	**16**	**29**	**19.5**	**360**	**540**	**900**

NARAYANA ENGINEERING COLLEGE: NELLORE								
20MA1003	VECTOR CALCULUS, COMPLEX VARIABLES & TRANSFORMS (VC-CV&TS)							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	3	1	0	64	4	40	60	100

Pre-requisite: Intermediate Mathematics

Course Objectives:

1. To illustrate the physical interpretation of gradient, divergence and curl.
2. To apply the basic concepts of vector integration and their applications.
3. To acquire the knowledge on the calculus of functions of complex variables.
4. To understand the concepts of Laplace transforms and its properties.
5. To apply the concepts of Laplace, transform to solve the ordinary differential equations.
6. To understand the concepts of Fourier series and Fourier transforms and its properties.

Course Outcomes: After successful completion of the course, the student will able to:

CO 1	Utilize different operators such as gradient, curl and divergence find the function BL-3
CO 2	Evaluate area and volumes by fundamental theorems of vector integrationBL-5
CO 3	Apply the complex functions, Cauchy's integral Theorem to find the integral values BL-3
CO 4	Solve the differential equation by using Laplace transforms and its techniques BL-3
CO 5	Apply the Inverse Laplace transforms techniques to covert into time Domaine BL-3
CO 6	Find the Fourier Series and Fourier Transform for the given functionsBL-2

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**3**	**2**	**2**										**PSO1**	**PSO 2**
CO2	**3**	**2**	**2**										3	
CO3	**3**	**3**	**1**										3	
CO4	**3**	**3**	**2**										2	
CO5	**3**	**3**	**2**										3	2
CO6	**3**	**3**	**2**										2	2

1- Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	**Vector Differentiation**	**8 H**
Introduction to vector differentiation, Definition of Scalar and Vector point functions, Definition of Vector differential operator, Gradient of a Scalar point function- Definition of Gradient of a scalar point function and properties (without proof), Definition of Directional Derivative, Definition of level surface, Different Problems, Divergence of a Vector point function- Definition, Definition of Solenoidal vector and problems, Curl of a vector point function- Definition of Curl, definition of Irrotational vector, Problems, Laplacian operator- Definition and related problems, Vector Identities- Statements(without proof)		
At the end of the Module 1, students will be able to: 1. Apply del to scalar and vector point function BL-3 2. Understand the concepts of Vector Differentiation BL-2 3. Illustrate the physical interpretation of gradient, divergence and curl. BL-2 4. Calculate directional derivatives and gradients BL-1 5. Apply Vector Differentiation concepts in fluid mechanics problems BL-3		
MODULE -2	**Vector Integration**	**8 H**
Introduction to vector integration, Line Integrals-Explanation, Work done by a Force-Explanation, problems, Surface Integral-Explanation and formula for surface integrals (without proof), Problems, Volume integral- Explanation and formula for volume integral (without proof), Problems, Green's Theorem-Statement (without proof), Problems, Gauss divergence Theorem- Statement (without proof), Problems, Stake's-Theorem-Statement (without proof), Problems.		
At the end of the Module 2, students will be able to: 1. Find the work done in moving a particle along the path over a force field BL-1 2. Evaluate the rate of fluid flow along and across curves BL-5 3. Apply Green's, Stokes and Divergence theorem in evaluation of double and triple integrals BL-3 4. Use the Gauss divergence theorem to give a physical interpretation of the divergence of a Vector field. BL-3 5. Evaluate the line integrals along simple closed curves on the Plane by Green's Theorem BL-5 6. Apply Stokes' theorem to give a physical interpretation of the curl of a vector field. BL-3		
MODULE-3	**Complex Variable**	**Hours: (11L+4T)**
complex variables- differentiation: introduction to complex variables, functions of complex variable-definition, limit and continuity of a complex function, derivative of f(z)-definition, problems, analytic function & harmonic functions- definitions, problems, cauchy-riemann equations in cartesian coordinates-statement (without proof), problems ,cauchy-riemann equations in polar coordinates-statement (without proof), problems , conjugate harmonic functions- definition, problems, milne thomson method- working rule, problems, applications to flow problem- problems. complex variables- integration: introduction to complex integration, line integration-definition, problems, cauchy's integral theorem-statement(without proof), problems, cauchy's integral formula- statement (without proof), problems, zeros of analytic functions, singularities, poles. residues-definition, explanation. cauchy's residue theorem- statement (without proof), problems. evaluation of integrals of $\int_0^{2\pi}$ $\int_{-\infty}^{\infty}$		

the type: (a) improper real integrals $\int f(x)dx$ (b) $\int f(\cos\theta,\sin\theta)d\theta$.

At the end of the Module 3, students w$^{-\infty}$ill be able to: ^{0}

1. Understand the functions of complex variable and its properties. BL-2
2. Find derivatives of complex functions. BL-1
3. Understand the analyticity of complex functions. BL-2
4. Understand the concept of differentiability, limit, continuity of complex functions and be able to calculate limits of standard complex functions BL-2
5. Apply Cauchy's integral theorem and Cauchy's integral formula in engineering problems. BL-3
6. Understand singularities of complex functions. BL-2

MODULE-4	**Laplace Transforms**	**8 H**

Introduction to Laplace Transforms, Definition of Laplace Transforms, Sufficient conditions for the existence of the L.T of a function, Laplace Transforms of standard Functions. First Translation (or) First Shifting theorem, Problems. Second Translation (or)Second Shifting theorem, Problems. Change of scale property, Problems. L.T. of derivatives, Problems. L.T. of integrals, Problems. Multiplication by 't', Problems. L.T. of Division by 't', Problems. Evaluation of integrals by L.T. L.T. of some special functions- Unit Step Function or Heaviside's Unit Function- Definition, problems. Unit Impulse Function or Dirac Delta function- Definition, problems. Laplace Transform of Periodic Functions- Statement (without proof), Problems.

At the end of the Module 4, students will be able to:

1. Understand the concepts of Laplace transforms and convert into time to frequency demine BL-2
2. Apply Laplace transform techniques to solve Ordinary differential equations BL-3
3. Understand and recall the properties of the Heaviside (unit step) function and its applications BL-2
4. Solve the application of Dirac Delta function by using its properties BL-3

MODULE-5	**Inverse Laplace Transforms**	**8 H**

Definition of Inverse Laplace Transforms, Inverse Laplace Transforms of standard Functions (without proof), Problems. Use of Partial Fractions to find Inverse Laplace Transform- problems. First Translation (or) First Shifting theorem- Statement (without proof), problems. Second Translation (or) Second Shifting theorem Statement (without proof), Problems. Change of scale property- Statement (without proof), problems. Inverse L.T of derivatives- Statement (without proof), problems. Inverse L.T to finite integrals- Statement (without proof), problems. Multiplication by Powers of 's'-Statement (without proof), Problems. Division by 's'-Statement (without proof), problems. Convolution theorem-statement (without proof), problems, Applications to Ordinary Differential Equations-Working method Explanation, problems

At the end of the Module 5, students will be able to:

1. Understand the concepts of inverse Laplace Transforms and convert into frequency to time domine BL-2
2. Solve the wave functions by inverse Laplace transforms BL-3
3. Apply the Convolution Theorem to obtain inverse Laplace transforms BL-3
4. solve the higher order differential equations in limiting case condition by invers Laplace transforms BL-3

MODULE-6	**Fourier Series and Fourier Transforms**	**8 H**

Fourier Series: Introduction to Fourier Series, Periodic function-definition, properties(without proof), Euler's formulae(without proof), Dirichlet's conditions, Fourier series in [0,2π]-formula (without proof), Problems, Fourier series in [-π, π]- formula(without proof), Problems, Fourier series for even and odd functions in [-π, π]- formula(without proof), Problems, Half -Range Fourier sine series in(0, π)- Formula(without proof), Problems, Half -Range Fourier cosine Series in(0, π)- Formula (without derivation), Problems. Fourier Transforms: Introduction to Fourier Transforms, Fourier integral theorem Statement (without proof),Fourier sine and cosine integrals formula(without proof) , problems, Fourier Transform formula &Inverse Fourier Transform formula (without proof), Properties of Fourier Transforms (without proof), problems, Fourier Sine Transform formula & Inverse Fourier Sine Transform formula (without proof), problems, Fourier Cosine Transform formula &Inverse Fourier cosine Transform formula(without proof),problems.

At the end of the Module 6, students will be able to:

1. Find the Fourier series expansion of the given function. BL-1
2. Apply Fourier series and its properties of various engineering problems. BL-3
3. Find the periodic solutions to the differential equation by using Fourier series. BL-1
4. Understand the properties of periodic functions, represent it as a Fourier BL-2
5. Apply the concepts of Fourier transforms to Find impulse BL-3
6. Make use of the Fourier transforms and its inverse in practical applications of electronics engineering. BL-3

Total hours	**48 H**

Complex Fourier series

1. Complex Fourier series
2. Parseval's Identity for Fourier Transforms

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Vector Differentiation	CO1	https://youtu.be/a19x_YG0oLg
2	vector integration	CO2	https://youtu.be/pfCwRLK29h4https://youtu.be/KHiw9Vs-aLM
3	Laplace transforms	CO3	https://youtu.be/luJMl37-nsohttps://youtu.be/EDVJotmT584
4	Inverse Laplace transforms	CO4	https://youtu.be/9NqdBXNyJPkhttps://youtu.be/0ZlThUd-yyw
5	Fourier series	CO5	https://youtu.be/4cSZDHxyBf4
6	Fourier transforms	CO6	https://youtu.be/GtXmS5YH7XM

Text Book(s):

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers.
2. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publication.
3. Ramana B.V., "Higher Engineering Mathematics", McGraw Hill Publishers

Reference Book(s):

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley.
2. Veerarajan T., “Engineering Mathematics” , Tata McGraw-Hill.
3. Dr. M Anita, “Engineering Mathematics-I”, Everest Publishing House, Pune.

Online Resources/ Web References:

1. http://keralatechnologicaluniversity.blogspot.in/2015/06/erwin-kreyszig-advanced-engineering - mathematics-ktuebook-download.html
2. http://www.faadooengineers.com/threads/13449-Engineering-Maths-II-eBooks .
3. http://www.efunda.com/math/math_home/math.cfm
4. http://www.ocw.mit.edu/resources/#Mathematics
5. http://www.sosmath.com/
6. http://www.mathworld.wolfram.com /

NARAYANA ENGINEERING COLLEGE:NELLORE								
20CH1001	CHEMISTRY (COMMON TO ECE,EEE&CSE)							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To impart technological aspects of modern chemistry and its applications
2. Understands the chemistry behind electrochemical energy systems
3. To train the students on the principles and applications of polymers
4. Learn analytical methods useful in characterization of compounds.

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

CO 1	Understand the fundamental concepts of chemistry to predict the structure and bonding of materials **(BL-1)**
CO 2	Infer the knowledge about various kinds of electro chemical cells.**(BL-2)**
CO 3	Describe various energy storage devices and emerging technologies **(BL-1)**
CO 4	Understand the mechanism and applications of different polymers in electronic devices**(BL-2)**
CO 5	Familiarize the various sources of renewable energy and their harneshing **(BL-2)**
CO 6	Apply the electromagnetic radiation to the spectroscopy methods for the analysis of engineering **(BL-3)**

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2										1		
CO2	3	2					2					1		
CO3	3	1	2			1	2					2		
CO4	3	2				2	1					1		
CO5	3	1	1			2	1					2		
CO6	3	1										2		

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	STRUCTURE AND BONDING MODELS	8 hrs

Planks quantum theory, photo electric effect,dual nature of matter -Debroglies equation ,Heisenberg uncertainty principle, molecular orbital theory – bonding in homo- and hetero nuclear diatomic molecules – energy level diagrams of O_2 and CO, etc. π-molecular orbital's of butadiene and benzene, calculation of bond order, crystal field theory – salient features – splitting in octahedral and tetrahedral geometry.

At the end of the Module 1, students will be able to:

1. Understand the fundamental concepts of chemistry to predict the structure, properties and bonding of Engineering materials**.**(BL-1)
2. Iillustrate the molecular orbital energy level diagram of different molecular species.(BL-2)

3. Apply crystal field theory for octa hydral and tetra hydral molecule.(L3)
4. out line the planks quantum theory. (BL-2)
5.Explain heisen berg uncertainty principal.(BL-2)

MODULE -2	ELECTRO CHEMISTRY	8hrs

Electrode potential, EMF of an electrochemical cell,problems on emf Nernst equation;. Electrodes – concepts, reference electrodes (standard hydrogen, Calomel electrode, and glass electrode), potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conduc to metric titrations (acid-base titrations), photovoltaic cell – working and applications .

At the end of the Module 2, students will be able to:

1. **Demonstrate** competency in the basic concepts of electrochemical cells.(BL-2)
2. **Explai**n the significance of electrode potentials (BL-2)
3. **List** the different types of electrodes . (BL-2)
4. **Differentiate** between , potentiometric and conduct metric titrations. (BL-2)
5. **Illustrate** the construction of PV cell.(BL-2)

MODULE-3	BATTERY TECHNOLOGY	7 hrs

Basic concepts, classification of batteries, Important applications of batteries, Modern batteries- zinc air, lithium cells- Li ion cell , Li- MnO_2 cell, ni-cd cell, lead acid storage cell . Fuel cells Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, methanol and oxygen fuel cell, SOFC - Merits of fuel cell

At the end of the Module 3, students will be able to:

1. Classify batteries into different types (BL-2)
2. Explain the concept involved in the construction of batteries . (BL-2)
3. Identify the significance of batteries. (BL-2)
4. Compare the merits of different fuel cells (BL-2)
5. Distinguish between different types of batteries (BL-2)

MODULE-4	POLYMER CHEMISTRY	9 hrs

Basic concepts of polymer, chain growth and step growth polymerization, coordination polymerization, copolymerization with specific examples and mechanisms of polymer formation. Plastics - Thermoplastics and Thermosetting, Preparation, properties and applications of –pvc, Bakelite, urea-formaldehyde, Nylons- Elastomers–Buna-S, Buna-N–preparation, properties and applications. Conducting polymers – poly acetylene, poly aniline, mechanism of conduction and applications.

At the end of the Module 4, students will be able to:

1 Identify different types of polymers.(BL-3)
2. Distinguish between thermoplastic and thermo setting resins . (BL-2)
3. Explain the preparation, properties and applications of some plastic materials (BL-2)
4. Apply the knowledge of advanced polymers, conducting polymers for different applications(BL-3)
5. Outline the properties of polymers and various additives added and different methods of forming.plastic materials (BL-2)

MODULE-5	ENERGY SCIENCE	7 hrs

fuels-classification of fuels characteristics solid fuels-coal, analysis of coal ,refining of petroleum, alternative and non conventional sources of Energy-solar, wind, Geo, Hydro power ,Bio mass advantages and disadvantages, Nuclear energy-Nuclear fission and fusion reactions Nuclear waste disposal

At the end of the Module 5, students will be able to:

1. Differentiate petroleumsynthetic petrol and have knowledge how they are produced (BL-2)
2. Elucidate alternative and non conventional energy resources. (BL-2)
3. Distinguish between Nuclear fission and fusion. (BL-2)
4. out line the fuel characteristics (BL-2)
5. Explain the nuclear waste disposal. (BL-2)

MODULE-6	**INSTUMENTAL METHODS AND APPLICATIONS**	**9 hrs**

Electronic Spectroscopy –EMR, Beer-Lambert's law and its, Applications, instrumentation of UV-visiblespectrophotometer.***IR Spectroscopy*** - Types of vibrations, Instrumentation of IR spectrophotometer and its applications. **Chromatography**-Introduction ,Principle and instrumentation of Gas Chromatography (GC) and thin layer chromatography, separation of gaseous mixtures and liquid mixtures

At the end of the Module 6, students will be able to:

1. Explain the different types of spectral series in electromagnetic spectrum (BL-2)
2. Understand the principles of different analytical instruments (BL-2)
3. Explain the different applications of analytical instruments (BL-2)
4. Outline the beers lamberts law (BL-2)

Total hours:	**48hours**

Content beyond syllabus:

1. Band theory, vulcanization and compounding of rubber

Self-Study:

Contents to promote self-Learning:

SNO	**Topic**	**Reference**
1	Molecular orbital theory	https://www.youtube.com/watch?v=FMxuss0RXOU
2	Reference electrodes	https://www.youtube.com/watch?v=WMfXlncyMDc
3	battreies	https://nptel.ac.in/courses/103/108/103108162/
4	plastics	https://www.youtube.com/watch?v=FATc12opDCA
5	Non conventional energy recourses	https://swayam.gov.in/nd1_noc20_ge06/preview
6	Fundamentals of spectroscopy	https://swayam.gov.in/nd1_noc20_cy08/preview

Text Book(s):

1. P. C. Jain & Monika Jain, *Engineering Chemistry*, Dhanpat Ray Publishing Company
2. K. N. Jayaveera, G. V. Subba Reddy and C. Ramachandraiah, *Engineering Chemistry*, McGraw Hill Publishers, New Delhi.
3. Energy scenario beyond2100,by S.Muthu Krishna Iyer.

Reference Book(s):

1. J. D. Lee, *Concise Inorganic Chemistry*, Oxford University Press, 5th edition 2010.
2. Skoog and West, *Principles of Instrumental Analysis*, Thomson, 6th edition, 2007.
3. Peter Atkins, Julio de Paula and James Keelar, *Atkins' Physical Chemistry*, Oxford University Press, 10th edition, 2010.

Online Resources Web Resources:

1. https://drive.google.com/file/d/0Bz82vSA0C1xlWC11WkpsTmlwQVk/view
2. https://www.cgaspirants.com/2017/08/engineering-chemistry-by-jain-jain.html
3. https://www.pdfdrive.com/concise-inorganic-chemistry-d33405948.html
4. https://chemistry.com.pk/books/skoog-principles-of-instrumental-analysis1/
2. https://www.thermalfluidscentral.org/e-books/book-intro.php?b=39
   file:///C:/Users/DELL/Downloads/HandbookOfInstrumentalTechniquesForAnalyticalChemistryPDFDrive.com.pdf
3. https://nptel.ac.in/courses/104/106/104106096/
4. https://youtu.be/KHh_IX1G6uA
5. https://www.youtube.com/watch?v=MfbxR9ZDs0s&feature=youtu.be
6. .https://nptel.ac.in/courses/113/105/113105028/
7. https://www.youtube.com/watch?v=15MY7abeCDk
8. https://www.youtube.com/watch?v=UeGJpwC1aiQ&feature=youtu.be

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1002	BASIC ELECTRICAL CIRCUITS							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Fundamental of mathematics and physics

Course Objectives:

1. To study the basics of circuit analysis.
2. To study the magnetic circuits.
3. The concepts of real power, reactive power, complex power, phase angle and phase difference.
4. To understand frequency response in electrical circuits.
5. To understand the concept of graphical solution to electrical network.
6. To impart knowledge on solving circuit equations using network theorems.

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

CO 1	Apply the basics of circuit analysis.(BL-3)
CO 2	Analyze the behaviour of magnetic circuit.(BL-4)
CO 3	Explain the fundamentals of AC circuits.(BL-2)
CO 4	Analyze AC circuits along with resonance and locus diagrams.(BL-4)
CO 5	Analyze an electric network using graph theory and different network (BL-4)
CO 6	Analyze the electrical circuits using various network theorems.(BL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1		1							3	3	1
CO2	3	1											2	
CO3	3	3	3	3		1							3	3
CO4	3	3	3	3									2	3
CO5	3	3	2											
CO6	3	3	3										2	2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	INTRODUCTION TO ELECTRICAL CIRCUITS	8hrs

Circuit Concept, R, L and C Parameters - Independent and Dependent Voltage and Current Sources -Source Transformation, Voltage - Current Relationship for Passive Elements (For Different Input Signals: Square, Ramp, Saw Tooth, Triangular). Kirchhoff's Laws, Network Reduction Techniques: Series, Parallel, Series Parallel, Star-to -Delta or Delta-to-Star Transformation. Examples

At the end of the Module 1, students will be able to:

1. Find the series and parallel connections in a circuit.(BL-2)
2. Apply various techniques to analyze an electric circuit. (BL-3)
3. Find the behaviour of an electrical circuit.(BL-2)

MODULE -2	INTRODUCTION TO MAGNETIC CIRCUITS	7hrs

Faraday's Laws of Electromagnetic Induction, Concept of Self and Mutual Inductance, Dot Convention, Coefficient of Coupling, Composite Magnetic Circuit-Analysis of Series and Parallel Magnetic Circuits, MMF Calculations.

At the end of the Module 2, students will be able to:

1. Explain the laws of electromagnetic induction. (BL-2)
2. Explain the dot convention technique.(BL-2)

3. Explain the self Inductance and mutual Inductance. (BL-2)

MODULE -3	SINGLE PHASE AC CIRCUITS	9hrs

R.M.S, Average Values and Form Factor for Different Periodic Wave Forms: Sinusoidal Alternating Quantities. Phase and Phase Difference, Complex and Polar Forms Of Representations, j-Notation, Steady State Analysis of R, L and C (In Series, Parallel and Series Parallel Combinations) With Sinusoidal Excitation, Concept of Power Factor, Concept of Reactance, Impedance, Susceptance and Admittance-Real and Reactive Power and Complex Power. Examples.

At the end of the Module 3, students will be able to:

1. Understand the advantages of single phase AC system. (BL-2)
2. Explain the complex and polar forms representation.(BL-2)
3. Find the AC circuits in order to determine the voltage, current and power for the given problem. (BL-2)

MODULE -4	RESONANCE & LOCUS DIAGRAMS	8hrs

Resonance: Introduction, Definition of quality factor **Q** of inductor and capacitor, Series resonance, Bandwidth of the series resonant circuits, Parallel resonance (or anti-resonance), Conditions for maximum impedance, Currents in parallel resonance, , Bandwidth of parallel resonant circuits, General case of parallel resonance circuit. Locus diagrams of RL & RC circuits

At the end of the Module 4, students will be able to:

1. Explain AC circuits along with resonance and locus diagrams.(BL-2)
2. Understand the effect of resonance on series and parallel resonance circuits.(BL-2)
3. Explain the frequency response for a resonant circuits.(BL-2)

MODULE -5	ANALYSIS OF NETWORK TOPOLOGY	8Hrs

Definitions – Graph – Tree, Incidence Matrix, Basic Cutset and Tieset matrices for planar networks - Nodal Analysis, Mesh Analysis, Super Node Analysis and Super Mesh Analysis for Dependent and Independent Voltage and Current Sources and DC & AC Excitations - Duality and Dual Networks.

At the end of the Module 5, students will be able to:

1. Understand the overview of topology for a given network. (BL-2)
2. Find the graph for the given electrical network. (BL-2)
3. Apply graph theory to solve network equations. (BL-3)

MODULE-6	NETWORK THEOREMS	8hrs

Super position theorem, Compensation theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Tellegen's theorem, Millman's theorem, Reciprocity theorem; Application of network theorems in solving DC and AC circuits.

At the end of the Module 6, students will be able to:

1. Understand the way of approaching to solve for a given network. (BL-2)
2. Solve theorems for finding the solutions of network problem.(BL-3)
3. Explain the application of network theorems.(BL-2)

Total hours:	**48 hours**

Content beyond syllabus:

1. Three Phase circuits and its Importance in Electrical Engineering.
2. Real time applications of network theorems.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference

1	Introduction to the electrical circuit	https://nptel.ac.in/courses/117/106/117106108/
2	Introduction to the magnetic circuit	https://nptel.ac.in/courses/108/105/108105053/
3	Single phase AC circuit	https://nptel.ac.in/courses/108/105/108105053/
4	Locus diagram and resonance	https://nptel.ac.in/courses/108/105/108105112/
5	Analysis of electrical circuit and Graph theory	https://nptel.ac.in/courses/108/105/108105159/
6	Network theorem	https://nptel.ac.in/courses/117/106/117106108/

Text Book(s):

1. A Sudhakar and Shyam Mohan S P, "Circuits and Networks: Analysis and Synthesis", TMH, 5th Edition, New Delhi, 2015.
2. Ravish R., Network Analysis and Synthesis, 2/e, McGraw-Hill, 2015

Reference Book(s):

1. S.Sivanagaraju, G.Kishore & C.Srinivasa Rao, "Electrical Circuit Analysis", Cengage Learning, 1st Edition, 2010.
2. A. Chakrabarti : Circuit Theory (Analysis and Synthesis), Dhanpat Rai &Co
3. Joseph A. Edminister and Mahmood Nahvi, "Electric Circuits Schaum's Outline Series", 6th Edition, Tata McGraw-Hill, 2014, New Delhi.
4. Electric Circuits by N.Sreenivasulu, REEM Publications

Online Resources / Web Reference:

1. https://nptel.ac.in/courses/108/105/108105159/
2. https://nptel.ac.in/courses/108/102/108102042/
3. https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-21(TB)(ET)%20((EE)NPTEL).pdf
4. https://en.wikibooks.org/wiki/Circuit_Theory
5.http://www.mathtutordvd.com/products/Engineering-Circuit-Analysis-Volume-1.cfm
6.http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-andelectronics-spring-2007/video-lectures/lecture-2/
7. http://www.facstaff.bucknell.edu/mastascu/elessonsHTML/Circuit/Circuit1.html
8. https://opencourses.emu.edu.tr/course/view.php?id=3

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1007	**Introduction to Python Programming**							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	2	0	0	32	2	40	60	100

Pre-requisite: **K**nowledge of Mathematics and Basic Programming Language

Course Objectives:

1. To learn the fundamentals of python.
2. To implement python programs for conditional loops and functions.
3. To handle the compound data using python lists, tuples, sets, dictionaries.
4. To learn the files, modules, packages concepts.
5. To introduce the concepts of class and exception handling using python.
6. To train in regular expression concepts.

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

CO 1	Summarize the fundamental concepts of python programming. (BL - 2)
CO 2	Apply the basic elements and constructs the python to solve logical problems.(BL-3)
CO 3	Organize data using different data structures of python . (BL - 3)
CO 4	Implement the files modules and packages in programming. (BL - 3)
CO 5	Apply object oriented &exception handling concepts to build simple applications.(BL-3)
CO 6	Implement the concepts ofTurtle Graphics. (BL - 3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1	2											1	
CO2	2	3	1	2									1	1
CO3	2	2	2	2	2							2	2	
CO4	2	2	2	1	1							1	3	2
CO5	2	2	2	1								1	2	2
CO6	2	1	2	1								1	2	2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**Introduction to Python**	**5H**

Introduction: History of Python, Features of Python Programming, Applications of Python Programming, Running Python Scripts, Comments, Typed Language, Identifiers, Variables, Keywords, Input/output, Indentation, Data types, Type Checking, range( ), format( ), Math module.

At the end of the Module 1, students will be able to:

1. Learn the basics of python. (BL - 1)
2. Write the python programs. (BL - 1)
3. Understand concept of type checking. (BL - 2)

MODULE -2	**Operators Expressions and Functions**	**5 H**

Operators and Expressions: Arithmetic, Assignment, Relational, Logical, Boolean, Bitwise, Membership, Identity, Expressions and Order of Evaluations, Control Statements.

Functions: Introduction, Defining Functions, Calling Functions, Anonymous Function,

Fruitful Functions and Void Functions, Parameters and Arguments, Passing Arguments, Types of Arguments, Scope of variables, Recursive Functions.

At the end of the Module 2, students will be able to:

1. Solve the problems using operators, conditional and looping. (BL - 3)
2. Solve the problems using the functions. (BL -3)
3. Apply the principle of recursion to solve the problems. (BL-3)

MODULE-3	**Strings, Lists, Tuples, and Dictionaries**	**6H**

Strings, Lists, Tuples, and Dictionaries: Strings-Operations, Slicing, Methods, List-Operations, slicing, Methods, Tuple- Operations, Methods, Dictionaries- Operations, Methods, Mutable Vs Immutable, Arrays Vs Lists, Map, Reduce, Filter, Comprehensions.

At the end of the Module 3, students will be able to:

1. Write programs for manipulating the strings. (BL - 1)
2. Understand the knowledge of data structures like Tuples, Lists, and Dictionaries.(BL - 2)
3. Select appropriate data structure of Python for solving a problem.(BL -3)

MODULE-4	**Files, Modules and Packages**	**6H**

Files, Modules and Packages: Files- Persistent, Text Files, Reading and Writing Files, Format Operator, Filename and Paths, Command Line Arguments, File methods, Modules- Creating Modules, Import Statement, Form.Import Statement, name spacing, Packages- Introduction to PIP, Installing Packages via PIP(Numpy).

At the end of the Module 4, students will be able to:

1. Understand the concepts of files. (BL - 2)
2. Implement the modules and packages. (BL - 3)
3. Organize data in the form of files.(BL - 3)

MODULE-5	**Object Oriented Programming, Errors and Exceptions**	**5H**

OOP in Python: Object Oriented Features, Classes, self variable, Methods, Constructors, Destructors, Inheritance, Overriding Methods, Data hiding, Polymorphism.
Error and Exceptions: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions.

At the end of the Module 5, students will be able to:

1. Apply object orientation concepts.(BL -3)
2. Apply the exception handling concepts. (BL -3)
3. Implement OOPs using Python for solving real-world problems.(BL -3)

MODULE-6	**Turtle Graphics**	**5H**

Turtle Graphics: Move and Draw, Turtle Operations, Turtle object, Simple Graphics, The Vagrant, The Beautiful Patterns, Drawing with Colors.

At the end of the Module 6, students will be able to:

1. Understand the concepts of Turtle Graphics. (BL -2)
2. Develop GUI applications using Python. (BL -3)

Total hours:	**48Hours**

Content Beyond Syllabus: Testing, GUI Programming, Matplotlib, Databases.

Self-Study:
Contents to promote self-Learning:

SNo	Module	Reference
1	Introduction to Python	https://www.youtube.com/watch?v=WvhQhj4n6b8
		https://www.youtube.com/results?search_query=History+of+Python%2C+Features+of+Python+Programming%2C+Applications+of+Python+Programming%2C+Running+Python+Scripts%2C+Comments+in+edureka

		https://www.youtube.com/watch?v=9F6zAuYtuFw
		https://www.youtube.com/watch?v=yHFcNNh-SsA
		https://www.youtube.com/watch?v=FuPHs7GLxq8
		https://www.youtube.com/watch?v=6yrsX752CWk
		https://nptel.ac.in/courses/106/106/106106145/
		https://www.youtube.com/watch?v=0Hp7AThTZhQ
		https://www.youtube.com/watch?v=fy10ci10R_g
		https://nptel.ac.in/courses/106/106/106106145/
		https://nptel.ac.in/courses/106/106/106106145/
2	Operators, Expressions and Functions	https://www.youtube.com/watch?v=Pm9FOpOwhlA&t=143s
		https://nptel.ac.in/courses/106/106/106106145/
		https://www.youtube.com/watch?v=oSPMmeaiQ68&t=51s
		https://nptel.ac.in/courses/106/106/106106145/
3	Strings, Lists,Tuples,and Dictionaries	https://nptel.ac.in/courses/106/106/106106145/
		https://nptel.ac.in/courses/106/106/106106145/
		https://www.youtube.com/watch?v=MEPlLAjPvXY
4	Files, Modules and Packages	https://nptel.ac.in/courses/106/106/106106145/
5	Object Oriented Programming, Errors and Exceptions	https://nptel.ac.in/courses/106/106/106106145/
6	Turtle Graphics	https://www.youtube.com/watch?v=WQlKPdKVXfw
		https://www.youtube.com/playlist?list=PLzgPDYo_3xumT2sfELR4_YV3aojaxkUC9

Text Book(s):

1. VamsiKurama, Python Programming: A Modern Approach, Pearson, 2017.
2. Allen Downey, Think Python, 2ndEdition,Green Tea Press

Reference Books :

1. R. Nageswara Rao, “Core Python Programming”, 2nd edition, Dreamtech Press, 2019.
2. Allen B. Downey, “Think Python”, 2ndEdition, SPD/O’Reilly, 2016.
3. Martin C.Brown, “The Complete Reference: Python”, McGraw-Hill, 2018.
4. Mark Lutz, Learning Python, 5th Edition, Orielly, 2013.
5. Wesley J Chun, Core Python Programming, 2nd Edition, Pearson, 2007
6. Kenneth A. Lambert, Fundamentals of Python, 1st Edition, Cengage Learning, 2015

Online Resources / Web Resources:

1. https://www.datacamp.com/learn-python-with-anaconda/
2. https://www.codecademy.com/learn/paths/data-science?
3. https://www.coursera.org/courses?query=python
4. https://www.edx.org/learn/python
5. https://training.crbtech.in/neo/online-it-training-programme.php?
6. https://www.tutorialspoint.com/python/index.htm
7. https://www.w3schools.com/python/
8. https://www.javatpoint.com/python-tutorial
9. https://www.learnpython.org/
10. https://docs.python.org/3/
11. Python - Simplilearn: https://www.youtube.com/playlist?list=PLEiEAq2VkUUKoW1o-A-VEmkoGKSC26i_I
12. Python - edureka: https://www.youtube.com/playlist?list=PL9ooVrP1hQOHY-BeYrKHDrHKphsJOyRyu
13. Python Notes for Professionals book : https://books.goalkicker.com/PythonBook/

NARAYANA ENGINEERING COLLEGE:NELLORE								
20CH1501	CHEMISTRY LAB (COMMON TO ECE,EEE&CSE)							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	0	0	3	48	1.5	40	60	100

Pre-requisite: Nil

Course Objectives: The objective of the laboratory sessions is to enable the learners to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering.

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

CO 1	Determine the cell constant and conductance of solutions
CO 2	Perform quantitative analysis using instrumental methods
CO 3	utilize the fundamental laboratory techniques for analyses such as titrations, separation/purification\ and Spectroscopy
CO 4	analyze and gain experimental skill.

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3													
CO2	3													
CO3	3													
CO4	3													

1: Low, 2-Medium, 3- High

COURSE CONTENT	CO
Task-1 : Conductometrictitration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base	
Objective 1. perform a conductometric titration of a mixture of strong acid and weak acid with a strong base, 2. determine the equivalence point of the titration by plotting titration curve using conductance values and amount of the base added during titration, 3. state the advantages conductometric titrations,	CO2
Task-2 : Determination of cell constant and conductance of solutions	
Objective: 1. To determine conductivity of the given water sample. by using conductivity meter 2. To understand the specific conductance.	CO 1

Task-3- Verify Lambert-Beer's law	
Objective: 1.To use spectroscopy to relate the absorbance of a colored solution to its concentration. 2.Toprepare a Beer's Law Plot to determine the concentration of an unknown.	CO 2
Task-4: pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base	
Objective: 1. To perform a potentiometric titration of an acidic solution of known molarity. 2. To graph the volume of base added vs the pH and to determine the equivalence point 3. To calculate the molarity of the basic solution	CO 2
Task-5: Estimation of Ferrous Iron by Dichrometry.	
Objective: 1. determine the percentage of ferrous iron in an unknown sample by redox titration with potassium dichromate solution . **2.** The student will pre-treat the sample to obtain the iron in the reduced(+2 oxidation) state**.** 3.The student will use a solution of primary standard as the titrant	CO 3
Task-6 : Potentiometry - determination of redox potentials and emfs	
Objective: 1. Determine the concentration of an unknown iron(II) solution. By using potentiometer 2. Discuss how the potential changes with relative concentration of oxidised/reduced from, 3. perform a redox titration of ammonium iron (II) sulphate using potassium dichromate as oxidizing agent, 4. determine the equivalence point of the redox titration by plotting titration curve using potential change values and amount of oxidizing agent added during titration,	CO 3
Task-7 : Preparation of a polymer	
Objective: To prepare phenol formaldehyde resin. (Bakelite) 1. Understand the differences between linear and cross linked polymers. 2. Compare and contrast the recycling properties of linear and cross linked polymers. 3. Compare the combustion properties of various types of material. 4. Define the following terms: polymer, monomer, repeat unit, cross linking, biopolymer	CO 4
Task-8: Thin layer chromatography	
Objective:	CO 2

1. To separate spinach pigments using thin layer chromate graphy 2. To describe the method of chromatography and its applications	
Task-9: Identification of simple organic compounds by IR	
Objective: 1. To learn various function groups encountered in organic chemistry 2. To learn important roll of IR spectroscopy in the study of structure of organic compounds 3. To develop skill in the recognition of characteristic absorption bands 4.to identify compound by an investigation of its IR spectrum	CO 3
Task-10 : Determination of Strength of an acid in Pb-Acid battery	
Objective: 1. To determine the half –reactions involved in spontaneous oxidation –reduction reactions. 2. Explain the function of the lead storage and dry cell batteries …electrolysis involving two lead strips immersed in sulfuric acid.	CO 4

Additional Experiments:	
Task-11 : Measurement of 10Dq by spectro photometric method	
Objective **1.** The purpose of the experiment is three-fold. First, the student verifies that the spectrochemical series **2.** based on this model are generally in poor agreement with experimental values obtained from visible spectra (3). However, because of the octahedral symmetry it is true that the splitting of the d levels predicted by crystal field theory is qualitatively correct.	CO 4
Task-12 : Models of potential energy surfaces	
Objective: 1. Distinguish between potential energies and potential energy surfaces (PESs). 2. Identify the saddle point, the reactant and product valleys and plateaus on the contour diagram of PESs 3. Distinguish between attractive and repulsive potential energy surfaces.	CO4
Virtual Labs: 1. http://vlab.amrita.edu/?sub=2&brch=190&sim=338&cnt=1 2. http://vlab.amrita.edu/?sub=2&brch=190&sim=339&cnt=1	

3. http://vlab.amrita.edu/?sub=2&brch=190&sim=606&cnt=1

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Estimation of Ferrous Iron by Dichrometry.	CO 1	https://www.youtube.com/watch?v=LxgZsMhuyNM
2	Paper chromatography	CO 1	https://www.youtube.com/watch?v=NsI9vJMphKk
	Preparation of polymer	CO 4	https://www.youtube.com/watch?v=PSSK5VGcC_0

Text Book(s):

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.
2. Jain & Jain. Engineering Chemistry: Dhanapathrai Publications., 2015.
3. S.S.Dara, Experiments and Calculations in Engineering Chemistry: S-Chand Publications, Revised edition, 2008.

Reference Book(s):

1. S.K. Bhasin and Sudha Rani, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 2nd edition.
2. Sunitha Rattan, "Experiments in Applied Chemistry", S.K. Kataria & Sons, New Delhi, 2nd edition.

Web References:

1. https://nptel.ac.in/courses/122101001/23
2. https://nptel.ac.in/courses/104103071/39

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1507	BASIC ELECTRICAL CIRCUIT LAB							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	0	0	2	32	1	40	60	100

Pre-requisite: Network Analysis

Course Objectives:

1. Fundamentals of Ohm's law, Kirchhoff's current and voltage laws and its practical implementation.
2. Measurement of voltage, current, power and impedance of any circuit.
3. Analysis of a given circuit depending on types of elements.

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

CO 1	Apply Practical implications of the fundamentals of Kirchhoff's current and voltage Laws
CO 2	Familiar with basic electrical measurement instruments and know how to use them to make different types of measurements.
CO 3	Practically determine band width, Q-factor and verify with theoretical values.
CO 4	Apply suitable theorems for circuit analysis and verify the results theoretically.
CO 5	Analyze the behavior of AC circuts

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	1	1		1	2		1		2	2	2
CO2	2	2	2	1	1		1	2		1		2	2	2
CO3	2	2	2	1	1		1	2		1		2	2	2
CO4	2	2	2	1	1		1	2		1		2	2	2
CO5	2	2	2	1	1		1	2		1		2	2	2

1: Low, 2-Medium, 3- High

COURSE CONTENT	CO
Task 1 - Verification of Kirchoff's laws	
Objective: To verify the KCL and KVL for a given circuit	CO 1
TASK-2 Determination of Self, Mutual Inductances and Coefficient of Coupling	
Objective: To determine the self and mutual inductances and coefficient of coupling for two inductive coils.	CO 2
TASK-3 Locus Diagrams of RL and RC Series Circuits	
Objective: To Plot the current locus diagrams for RL and RC circuits.	CO 3
TASK-4 Frequency response of series resonance circuit with analysis and design	
Objective: To determine resonant frequency, band width and Q-factor for series RLC circuits	CO 3
TASK-5 Frequency response of parallel resonance circuit with analysis and design.	

Objective: To determine resonant frequency, band width and Q-factor for parallel RLC circuits	CO 3
TASK-6 Verification of Thevenin's and Nortons theorems	
Objective: To verify the Thevinis and Nortons Theorem	CO 4
TASK-7 Verification of Reciprocity and Millman's Theorems	
Objective: To verify the reciprocity and Millman's Theorems	CO 4
TASK-8 Verification of Superposition Theorem	
Objective: To verify the superposition theorem	CO 4
TASK-9 Verification of Maximum Power Transfer Theorem	
Objective: To verify the Maximum power transfer theorem	CO 4
TASK-10 Verification of compensation Theorem	
Objective: To verify the compensation theorem	CO 4
TASK-11 Measurement of current in various branches of RLC series and parallel circuits. And draw the phasor diagram.	
Objective: To verify the series and parallel RLC circuits	CO 4
Task – 12 Measurement of Reactive Power for Star and Delta Connected Balanced Loads	
Objective: Measurement of reactive power of an 3- Φ balanced inductance load using one 1- Φ Wattmeter	CO 5

Additional Experiments:	
TASK-13 Measurement of 3-Phase Reactive Power by using one Wattmeter Method	
Objective: To measure the reactive power consumed by a 3 phase load using one wattmeter method	CO 5
TASK-14 Measurement of 3-Phase Power by Two Wattmeter Method for Unbalanced Loads	
Objective: To measure the reactive power consumed by a 3 phase load, using 2 wattmeter method.	CO 5
Virtual Labs: 1. Parallel RC Circuits 2. Parallel LC Circuits 3. Thevenin's theorem 4. Series RL Circuits 5. Norton's Theorem 6. Series LCR Circuit	

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Thevinins and nortons	CO1	**https://www.youtube.com/watch?v=7JfoDFk61o8**
2	Series Resonance in RLC Circuit	CO2	**https://www.youtube.com/watch?v=YLGrugmDvc0**
3	Phasor Diagram of RL, RC and RLC Circuits	CO3	**https://www.youtube.com/watch?v=HaFrY0qO-NU**

Text Book(s):

1. A Chakrabarthy, "Electric Circuits", Dhanpat Rai & Sons, 6th Edition, 2010.
2. A Sudhakar, Shyammohan S Palli, "Circuits & Networks", Tata McGraw- Hill, 4th Edition, 2010

Reference Book(s):

1. Willam Hayt.jr, Jack E.kemmerly,Steven M.Durbin, "Engineering Circuit analysis" Tata McGraw- Hill, 8th Edition2012
2. Rudrapratap, "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 1 st Edition, 1999.

Web References:

1. https://www.ee.iitkgp.ac.in/
2. http://www.vlab.co.in/lab_ready_for_use.php
3. http://vlab.amrita.edu/?sub=1&brch=75

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1504	ENGINEERING GRAPHICS LAB							R2020
I-B.Tech	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	0	1	4	80	3	40	60	100

Pre-Requisite: Basic Mathematics (Geometry)

Course Objectives:

1. To impart skills on using drawing instruments
2. To convey exact and complete information of any physical object.
3. To Construct Engineering Curves.
4. To Learn and practice basic AutoCAD commands.
5. To Instruct the utility of drafting & modeling packages in orthographic and isometric drawings
6. To understand the applications of AUTOCAD for modeling physical objects

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

CO 1	Define the qualities of precision and accuracy in engineering drawing. (BL-1)
CO 2	Draw engineering curves with different methods(BL-3).
CO 3	Develop the orthographic projection of points and straight lines(BL-3)
CO 4	Construct the planes and simple solids.(BL-3).
CO 5	Understand and practice basic AUTOCAD commands (BL-2)
CO 6	Construct Isometric views using AUTOCAD (BL-3).

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2				1							1	1	1
CO2	2	1			1							1	1	2
CO3	2	2			1							2	2	2
CO4	2	2			2	1						2	2	2
CO5	1	1	1		1							1	1	3
CO6	2	2	2		2							1	2	3

1: Low, 2-Medium, 3- High

COURSE CONTENT

Part-A Manual Drawing

TASK– 1	**Introduction and Conic sections**	10 H

Introduction to Engineering graphics:

Principles of Engineering Graphics and their significance; various instruments used, drawing sheet sizes and title block, lettering, BIS conventions, types of lines and dimensioning methods.

Geometrical constructions: simple constructions, construction of Pentagon, Hexagon by general method only.

Conic Sections:. Types of conics: Ellipse, Parabola and Hyperbola (Eccentricity method only),

At the end of the **TASK** -1, students will be able to:

1. Understand of Geometrical Constructions. (BL-2)
2. Draw Conic Sections by using eccentricity method . (BL-3)

TASK–-2	**Orthographic Projections**	10 H

Objectives and Principle of projection,

Methods of projections, Comparison between first angle and third angle projection.

Projections of points: Projection of points placed in different quadrants,

Projection of straight lines: Fundamental concepts**,** Line parallel, perpendicular and inclined to one and two reference planes placed in first quadrant only,

Projections of planes: Projection of planes (Triangle, Square, Pentagon, Circle) parallel, perpendicular and inclined to one and two reference planes placed in first quadrant only

At the end of the **TASK-** 2, students will be able to:

1. Understand Orthographic Projection of points. (BL-2)
2. Draw Projection of lines inclined to one and two reference planes. (BL-3)
3. construct the Projection of planes inclined to one and two reference planes.(BL-3)

TASK–3	**Projections of Solids**	12 H

Types of solids ; Polyhedra, Solids of revolution,

Projections of regular solids(Prisms, Pyramids, Cylinders and Cone),with its axis perpendicular to one plane and parallel to other plane, Axis inclined to one plane and parallel to other plane.

At the end of the **TASK** - 3, students will be able to:

1. Understand Projections of regular Solids. (BL-2)
2. Draw projections of Prisms, Pyramids, Cylinders And Cones(BL-3)

TASK–4	**Isometric and Orthographic views**	10H

Isometric Projections : Principles, Isometric scale, Isometric views ,Conventions, Isometric views of lines, planes, simple solids (Cube, Cylinder, Cone), Conversion of Isometric views to Orthographic views.

At the end of the **TASK** - 4, students will be able to:

1.Understand Principles of Isometric Projections and Isometric scale. . (BL-2)

2.Draw isometric views of simple solids (BL-2)

3.Apply the principles in Conversion of Isometric views in to Orthographic views. (BL-3)

Part B Computer Aided Drafting

TASK–5	**Introduction to AutoCAD**	15 H

Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. Dimensioning principles and conventional representations.

At the end of the **TASK-** 5, students will be able to:

1. Understand the Basic AutoCAD commands. (BL-2)
2. Draw the templates of simple physical objects. (BL-3)
3. Apply the utility of drafting & modelling packages in orthographic and isometric drawings

TASK–6	**Orthographic and Isometric Projections**	18 H

Transformation of Isometric Projections into orthographic projections such as simple solids such as cylinder, cone, square prism, pentagonal pyramid

Draw 3D model of mechanical components such as Stepped block, Bush bearing,

At the end of the **TASK** -6, students will be able to:

1. Develop the usage of 2D and 3D modelling. (BL-3)
2. Create the various views of machines components. (BL-3)

Total H:	**75 H**

Content beyond syllabus:

1. Development of surfaces, Section of solids

Self-Study:

Contents to promote self-Learning:

SNO	**Topic**	**Reference**
1	**Introduction to Basic Engineering Scales**	https://mrcet.com/downloads/hs/Engineering%20Graphics%20Manual%20final.pdf
2	**Engineeringcurves**	www.nptel.ac.in/courses/112104019/
3	**Orthographic Projections**	www.nptel.ac.in/courses/112104019/
4	**Projections of Solids**	www.nptel.ac.in/courses/105104148/
5	**AutoCAD**	https://www.autodesk.in/campaigns/education/fusion-360?mktvar002=3510851|SEM|APAC_GGL_0025&gclid=EAIaIQobChMI25i62KuD6wIVj3wrCh1V1AUJEAAYASAAEgLpmfD_BwE
6	**Isometric and Orthographic Projections**	https://www.youtube.com/watch?v=iXgCzZFrYlg

Text Book(s):

1. Bhatt N.D. "Elementary Engineering Drawing", CharotarPublishers,2014.
2. Shah and Rana, Engineering Drawing, 2/e, Pearson Education,2009
3. K.L.Narayana&P.Kannaiah,EngineeringDrawing,3/e,ScitechPublishers,Chenna i, 2012.
4. Engineering Drawing by Dr AVS Sridhar Kumar, Dr Krishnaiah , T P Vara Prasad. ,Spectrum education, Sun techno Publications,2019

Reference Book(s):

1. Engineering Drawing and Graphic Technology -International Edition, Thomas E.French, Charles J. Vierck, Robert J. Foster, McGraw-Hill, 2014
2. Venugopal.K "Engineering Drawing and Graphics", New Age International (P) Ltd., New Delhi, 2010.

Online Resources:

1. www.nptel.ac.in/courses/112104019/
2. www.nptel.ac.in/courses/105104148/
3. www.vlab.co.in

Web Resources:

1. https://mrcet.com/downloads/hs/Engineering%20Graphics%20Manual%20final.pdf

2.http://cbseacademic.nic.in/web_material/CurriculumMain21/SrSecondary/Engineering_Graphics_Sr.Sec_2020- 21.pdf

3.http://cbseacademic.nic.in/web_material/Curriculum19/Main-/11_Engineering_Graphics.pdf

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1510	**Introduction to Python Programming LAB**							R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	0	0	2	32	1	40	60	100

Pre-requisite: Programming Knowledge

Course Objectives:

1. To gain knowledge on python programs basics
2. To prepare students for solving the programs on functions, data structures, Files
3. To prepare students for solving the programs on Classes, Exception Handiling, Regular Expressions and Multi threading

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

CO1	Understanding and use of python- Basic Concepts(BL -2)
CO2	Solve the concepts of python functions and data structures(BL -3)
CO3	Understand the concepts of files, modules, multithreading and regular expressions (BL -2)
CO4	Solve the concepts of class and exception handling (BL -3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1	1	2										1	
CO2	2	3	2	2									2	1
CO3	2	2	3	2	2								3	2
CO4	2	2	2	1	1								3	2

1-Low, 2-Medium, 3- High

COURSE CONTENT	CO
Task-1 - Python Basics (4H)	
1. Running instructions in Interactive interpreter and a Python Script 2. Write a program to purposefully raise Indentation Error and Correct it 3. Write a program to compute distance between two points taking input from the user (Pythagorean Theorem) 4. Write a program to convert a Binary number to Decimal number and verify if it is a Perfect number.	CO 1
Task-2 - Conditional Statements (2 H)	
1. Write a program to determine if a given string is a Palindrome or not 2. Write a program for Fibonacci sequence is generated by adding the previous two terms by starting with 1 and 2, the first 10 terms will be: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ...	CO 1
Task-3 - Functions (2 H)	
1. Write a function ball_collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding. Hint: Represent a ball on a plane as a tuple of (x, y, r), r being the radius. If (distance	CO 2

between two balls centers) <= (sum of their radii) then (they are colliding)	
TASK-4 - Functions Continued (2 H)	
1. Write a function that draws a Pyramid with # symbols  2. Choose any five built-in string functions of C language. Implement them on your own in Python. You should not use string related Python built-in functions.	CO 2
TASK-5 - Strings(4 H)	
1. Write a program to use split and join methods in the string and trace a birthday with Diction b array data structure. 2. Write a program using map, filter and reduce functions	CO 2
TASK-6 - Lists (4 H)	
1. Write program which performs the following operations on list's. Don't use built-in functions a) Updating elements of a list b) Concatenation of list's c) Check for member in the list d) Insert into the list e) Sum the elements of the list f) Push and pop element of list g) Sorting of list h) Finding biggest and smallest elements in the list i) Finding common elements in the list	CO 2
TASK-7 - Files (2 H)	
1. Write a program to print each line of a file and count the number of characters, words and lines in a file. 2. Write a program that allows you to replace words, insert words and delete words from the file.	CO 3
TASK-8 - Modules and Packages (2 H)	
1. Write a program for creating a module and import a module 2. Write a program to perform any two operations using Numpy	CO 3
TASK-9-Class and Objects (4 H)	
1. Write a program for Class variables and instance variable and illustration of the self variable i) Robot ii) ATM Machine	CO 4
TASK-10 - Exception Handiling (2 H)	
1. Write a program of exception handling to open a file while do not have write permissions	CO 4

2. Write a Programto handle multiple errors with one except statement.	
TASK-11- Regular Expressions(2 H)	
1. Write a Python program to remove the parenthesis area in a string. Sample data : ["example (.com)", "w3resource", "github (.com)", "stackoverflow (.com)"] 2. Write a program to match the name phone , emails, passwords and phone numbers using pattern matching	CO 3
TASK-12-Turtle (2 H)	
1. Write a turtle program to construct a clock dial 2. Write a turtle program to produce a flower in different colours	CO 3

Additional Experiments:	
TASK-1	
1. Write a python program to find the resolution of an image 2. Write a python program to count the number of vowels and consonants 3. Write a python program to print the ASCII value of acharacter	

Virtual Labs:	
Python Lab (IIT Bombay) : http://vlabs.iitb.ac.in/vlabs-dev/labs/python-basics/experimentlist.html	
List of Experiments	
1. Arithmetic Operations 2. Built-in Functions 3. Loops 4. Data Types 5. Strings	6. Classes and Objects 7. Built-in Modules 8. Constructors and Inheritance 9. File Operators

Text Book(s):

1. VamsiKurama, Python Programming: A Modern Approach, Pearson, 2017.
2. Allen Downey, Think Python, 2ndEdition,Green Tea Press

Reference Books :

1. R. Nageswara Rao, “Core Python Programming”, 2nd edition, Dreamtech Press, 2019.
2. Allen B. Downey, “Think Python”, 2ndEdition, SPD/O’Reilly, 2016.
3. Martin C.Brown, “The Complete Reference: Python”, McGraw-Hill, 2018.
4. Mark Lutz, Learning Python, 5th Edition, Orielly, 2013.
5. Wesley J Chun, Core Python Programming, 2nd Edition, Pearson, 2007
6. Kenneth A. Lambert, Fundamentals of Python, 1st Edition, Cengage Learning, 2015

Web References:

1. https://www.tutorialspoint.com/python/index.htm
2. https://www.w3schools.com/python/
3. https://www.javatpoint.com/python-tutorial
4. https://www.geeksforgeeks.org/python-programming-language/

NARAYANA ENGINEERING COLLEGE:NELLORE

20EN1502	ORAL COMMUNICATION SKILLS LAB						R2020
I-B.Tech	Hours / Week			Total hrs	Credit	Max Marks	
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	0	0	2	32	1	40	60	100

Pre-requisite:Nil

Course Objectives:

1. Understand the role of communication in personal & professional success and develop awareness of appropriate communicationstrategies.
2. Understand and learn to distinguish informal speech from formal speech through role plays and can handle a concern or complaint, with empathy andunderstanding.
3. Improves speaking ability in English both in terms of fluency andcomprehensibility.
4. Understand the essential points in preparing an oralpresentation
5. To improve the mass communication and provide an opportunity to exercise their rights to express them effectively
6. To equip students with knowledge and techniques to effectively tackle the interviewprocess

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

CO 1	To develop knowledge, skills, and judgment around human communication that facilitates their ability to work collaboratively with others.
CO 2	Use listening skills to create more effective, less confrontational, more productive professional & personal relationships and understand techniques required for excellent telephone etiquette.
CO 3	Develop their public speaking abilities to speak both formally and informally.
CO 4	Learn the skills necessary to deliver effective presentation with clarity and impact.
CO 5	Understand the nuances of English language and skills required for effective participation in group activities.
CO 6	Learn to face different types of interviews with confidence and understand the procedure & preparation required for attending an interview.

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1									3		2		
CO2	1									2		3		
CO3	1									3		2		
CO4	1									3		3		
CO5	1									3		2		
CO6	1									2		3		
1: Low, 2-Medium, 3- High														

COURSE CONTENT	CO
Module - 1	
Ice - Breaking Activity – Introducing Oneself and Others – Greetings – Taking Leave - Introduction to Communication Skills – Verbal & Non Verbal Communication - Barriers to effective communication - Kinesics - Proxemics – Chronemics - Haptics- Paralanguage.	CO1
Module - 2	
Situational Dialogues and Role play – Expressions in various Situations - Greetings – Apologies – Requests – Giving directions -Social and Professional etiquettes – TelephoneEtiquettes	CO2
Module - 3	
Just a Minute (JAM) - Asking for Information and Giving Directions–Description (Oral): Pictures, Photographs, Products, and Process	CO3
Module – 4	
Presentation Skills – Oral presentations (individual and group) through Seminars / PPTs - Fluency & accuracy in speech – Improving self- expression– Tonal variations – Listener oriented speaking - Developing persuasive speakingskills.	CO4
Module - 5	
Debate : concepts, types, do's and don'ts - intensive practice- Group Discussion and Group Discussion : Dynamics of group discussion,intervention, summarizing, modulationof voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation.	CO5
Module - 6	
Interview Skills: Concept and process, pre-interview planning, opening strategies,answering strategies, interview through Tele - Conference & video - conference and Mock Interviews.	CO6

Reference Book(s):

- *Rizvi,Ashraf.M.,EffectiveTechnicalCommunication,McGrawHill,NewDelhi.2005*
- *Raman, Meenakshi &Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi.2011.*
- *Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition,2018.*
- *English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata McGraw-Hill2009*
- *CommunicationSkillsbyLeenaSen,PHILearningPvtLtd.,NewDelhi,2009*

Web Resources:

- *Grammar/Listening/Writing1-language.com*
- *http://www.5minuteenglish.com/*
- *https://www.englishpractice.com/Grammar/Vocabulary*
- *English Language LearningOnline*
- *http://www.bbc.co.uk/learningenglish/*
- *http://www.better-english.com/*
- *http://www.nonstopenglish.com/*
- *https://www.vocabulary.com/*
- *BBC Vocabulary Games*
- *Free Rice Vocabulary GameReading*
- *https://www.usingenglish.com/comprehension/*
- *https://www.englishclub.com/reading/short-stories.htm*
- *https://www.english-online.at/ Listening*
- *https://learningenglish.voanews.com/z/3613*
- *http://www.englishmedialab.com/listening.htmlSpeaking*
- *https://www.talkenglish.com/*
- *BBC Learning English – Pronunciationtips*
- *Merriam-Webster – Perfect pronunciation Exercises AllSkills*
- *https://www.englishclub.com/*
- *http://www.world-english.org/*
- *http://learnenglish.britishcouncil.org/*

Online Dictionaries

- *Cambridge dictionary online :https://dictionary.cambridge.org/*
- *MacMillan dictionary :https://www.macmillandictionary.com/*
- *Oxford learner's dictionaries :https://www.oxfordlearnersdictionaries.com/*

SEMESTER III

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20MA1006	BS	Probability Statistics and Numerical Methods	3	0	0	3	3	40	60	100
20ES1011	ES	Data Structures	2	0	2	4	3	40	60	100
20ES1013	ES	Electronic Devices and Circuits	3	0	0	3	3	40	60	100
20EE2001	PC	Electrical Circuit Analysis	3	0	0	3	3	40	60	100
20EE2002	PC	DC Machines and Transformers	3	0	0	3	3	40	60	100
20ES1516	ES	Electronic Devices and Circuits Lab	0	0	3	3	1.5	40	60	100
20EE2501	PC	DC Machines and Transformers Lab	0	0	3	3	1.5	40	60	100
20EE2502	PC	Electrical Circuits and Simulation Lab	0	0	3	3	1.5	40	60	100
20CD6001	SC	Career competency Development I	0	0	2	2	1	40	60	100
20CC6001	SC	Value added course/Certificate course I	0	1	0	1	1	40	60	100
20MC8002 -12	MC	Mandatory course II	2	0	0	2	0			
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	16	1	16	33	21.5	400	600	1000

NARAYANA ENGINEERING COLLEGE: NELLORE								
20MA1006	PROBABILITY, STATISTICS AND NUMERICAL METHODS							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	3	0	0	48	3	40	60	100

Pre-requisite: inter mathematics

Course Objectives:

1. To study different coordinate systems, Physical significance of Divergence, Curl and Gradient.
2. To acquire knowledge on electric and magnetic fields in both static and dynamic domains.
3. To understand wave concept with the help of Maxwell's equations.
4. To Analyze reflection and refraction of EM waves and Electromagnetic wave propagation in different media.
5. To introduce concepts of polarization and fundamental theory of electromagnetic waves in transmission lines and their practical applications.

Course Outcomes: After successful completion of the course, the student will able to:

CO 1	Use the concept of discrete and continuous probability distributions in life testing, expected failures for various engineering applications. (L-3)
CO 2	Test the Large samples data by applying inferential techniques. (L-4)
CO 3	Test the small samples data by applying inferential techniques. (L- 4)
CO 4	Apply the knowledge how to solve algebraic and transcendental equations using numerical methods and interpolating the polynomials. (L- 3)
CO 5	Utilize the numerical differentiation and integration techniques to solve engineering problems. (L- 3)
CO 6	Solve initial value problems of ordinary differential equations by using numerical techniques. (L-3)

CO-PO Mapping

CO	PO												PSO	
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3		2										
CO2	3	3	2	2										
CO3	3	3		2										
CO4	3	3	2	2										
CO5	3	3		2										
CO6	3	2		2										

1- Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	Probability Distributions	Hours:10

Introduction of Random variables, Probability mass function and Probability density function concepts. Introduction to Binomial distribution (B.D), Mean, variances(without derivations), properties, application Problems on B.D, fitting of Binomial distribution, Poisson distribution (P.D), Mean, variances (without derivations), properties, some application Problems on P.D, Normal distribution (N.D) and properties, Mean, variances, mode (without derivations derivation), some application Problems on normal distribution, Exponential distribution, its properties and applications

At the end of the Module 1, students will be able to:

1. Apply the mathematical expectation techniques to find the expected value and variance. (L-3)
2. Acquire the knowledge about classification of the variables (characteristics), through. (L-3)
3. Apply an appropriate probability distribution to analysis the data. (L-3)
4. find expected mean life time of the product by using normal distribution. (L-1)

MODULE -2	Large Sample Tests	Hours:8
Population, sample, statistic, Introduction to Sampling distribution and standard error .Introduction to Hypothesis, critical region, type-I, type-II errors, level of the significance, one-tailed and two-tailed tests, test procedure, one sample mean-test, confidence intervals for one sample mean, two-mean test, confidence intervals for two sample mean, one-sample proportion test, confidence intervals for one		
At the end of the Module 2, students will be able to: 1. Apply the testing of hypothesis techniques, decide the product is good or bad. (L-3) 2. How much of sample size is required for testing (L-1) 3. Determine the control limits of the product. (L-3) 4. Select appropriate test statistic to analysis the data. (L-3)		
MODULE-3	**Small Sample Tests**	**Hours:8**
One sample mean-test, confidence intervals for one sample mean, two-mean test, confidence intervals for two sample mean, paired t-test, some application problems on t-test, Chi-square tests are one sample variance test, goodness of fit and test for independence of attributes. Some application problems on Chi-square –test. F-tests and some application problems on F-test		
At the end of the Module 3, students will be able to: 4. Determine the product came from same company or not. (L-3) 5. Applying t-test techniques, to determine the experimentation useful or not (L-3) 6. Use the chi-square test techniques to select the appropriate distribution (L-3) 7. Applying the chi-square test to test whether the attributes are independent or not (L-3)		
MODULE-4	**Solution of Algebraic, Transcendental Equations & Interpolation**	**Hours:8**
Algebraic and Transcendental Equations: Introduction, Transcendental equation Definition, Bisection Method - explanation, problem, The Method of False Position- Explanation, problem, Newton-Raphson Method- Explanation, problem. Interpolation: Introduction, Finite differences, Forward & Backward differences, Newton's Forward Difference interpolation- Formula without proof, problems, Newton's Backward Difference interpolation- Formula without proof, problems, Lagrange's Interpolation- Formula without proof, problems..		
At the end of the Module 4, students will be able to: 1. Solve an algebraic or transcendental equation using an appropriate numerical method. (L-3) 2. Understand the use of different operators in interpolation. (L-2) 3. Estimate the value for the given data through interpolation polynomials. (L-5) 4. Understand the theoretical and practical aspects of the use of numerical methods. (L-2) 5. Proficient in implementing numerical methods for a variety of multidisciplinary applications. (L-2)		
MODULE-5		**Hours:6**
Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations between E & H, Sinusoidal variations, Wave Propagation in lossless and lossy Media, Conductors & Dielectrics- Characterization, Wave Propagation in Good Conductors, good Dielectric and Perfect Dielectrics, Skin effect, Polarization-Linear, Elliptical & Circular, Normal incidence for both Perfect Conductor and Dielectrics, Oblique Incidences for both Perfect Conductor and Dielectrics in Parallel and Perpendicular polarizations, Brewster Angle/Polarizing Angle, Critical Angle, Total Internal Reflection, Surface Impedance, Poynting Vector, and Poynting Theorem – Applications, Power Loss in a Plane Conductor, Illustrative Problems**.** Illustrative Problems.		

At the end of the Module 5, students will be able to:

1. Understand the concept of numerical differentiation and integration. (L-2)
2. Solve integral equations using Trapezoidal rule, Simpson's1/3 Rule, Simpson's 3/8 Rule. (L-3)
3. Apply numerical differentiation and integration techniques to various engineering problems. (L-3)
4. Understand the techniques of Trapezoidal rule, Simpson's 1/3 Rule , Simpson's 3/8 Rule and its applications (L-2)

MODULE-6	**Numerical Differentiation & Integration**	**Hours:8**

Numerical Differentiation: Introduction, Numerical Differentiation formula using Newton's forward & backward Differences (without proof), problems. Numerical Integration: Introduction, Trapezoidal rule-formula (without proof), problems, Simpson's 1/3 Rule- Formula (without proof), problems, Simpson's 3/8 Rule- Formula (without proof), problems.

At the end of the Module 6, students will be able to:

1. Understand the different methods of numerical solution of ordinary differential equations. (L-2)
2. Acquire the knowledge how to solve ordinary differential equations through the numerical method. (L-3)
3. Apply Runge-kutta method in engineering problems (L-3)
4. Workout numerically on the ordinary differential equations using Taylor's series methods. (L-1)

Total hours	**48**

Content beyond syllabus:

1. Analysis variance.
2. lognormal distribution.
3. regression analysis .

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Probability distribution	**CO1**	https://www.youtube.com/watch?v=6x1pL9Yov1k
2	Large sample tests	**CO2**	https://www.youtube.com/watch?v=80YzzIm8NK8
3	Small sample tests	**CO3**	https://www.youtube.com/watch?v=c5YTyGWpcmw
4	Solution of Algebraic and Transcendental Equations	**CO4**	https://www.youtube.com/watch?v=apuEXUAntJo
5	Numerical Differentiation & Integration	**CO5**	https://www.youtube.com/watch?v=0rtaUUonwkU
6	Numerical solution of Ordinary differential equations	**CO6**	https://www.youtube.com/watch?v=QugqSa3Gl-w

Text Book(s):

1. Iyengar T.K.V., Krishna Gandhi B. & Others., (2013), Numerical Methods, Second Revised Edition, New Delhi, S.Chand & Co.Ltd.
2. Miller and Freunds, Probability and Statistics for Engineers, 9/e, Pearson, 2017.
3. S.S. SASTRY, Introductory Methods of Numerical Analysis, 5/e, PHI learning private limited, 2011.

4. B S Grewal, (2017), Higher Engineering Mathematics, 44th Edition, New Delhi, Khanna Publishers.

erence Book(s):

1. S. Ross, a First Course in Probability, Pearson Education India, 2002.
2. Fundamentals of Mathematical Statistics" is written by SC Gupta and VK Kapoor and ... Aug 19, 2016.
3. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.
4. G S S Bhishma Rao (2011), Probability and Statistics, Fifth Edition, Hyderabad, SciTech Publications Pvt.Ltd.

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Online Resources/ Web References:

1. https://www.vfu.bg/en/e-Learning/Math_Soong_Fundamentals_of_ probabilityand statistics for engineers.pdf
2. http://www.math.ust.hk/~machas/numerical-methods.pdf
3. https://www.khanacademy.org/math/statistics-probability
4. http://www.randomservices.org/random/dist/index.htm l
5. https://global.oup.com/uk/orc/biosciences/maths/reed/01student/numerical_tutorials/pdf

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1011	DATA STRUCTURES							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	2	0	2	62	3	40	60	100

Pre-requisite: Knowledge of Mathematics, Computer Programming, Analytical & Logical Skills

Course Objectives:

1. To explain efficient storage mechanisms of data for an easy access.
2. To design and implementation of various basic and advanced data structures.
3. To introduce various techniques for representation of the data in the real world.
4. To develop applications using data structures.
5. To pertain knowledge on improving the efficiency of algorithm by using suitable data structure.

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

CO 1	Understand basic concepts of data structures and algorithm analysis. (BL - 2)
CO 2	Develop the applications using stacks and queues. (BL - 3)
CO 3	Demonstrate the use of linked lists. (BL - 2)
CO 4	Apply tree, graph data structures for various applications. (BL - 3)
CO 5	Implement algorithms for sorting, searching, and hashing methods. (BL - 3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	1	1	2										1	
CO 2	2	3	2	2									2	1
CO 3	2	2	3	2	2								3	2
CO 4	2	2	2	1	1							2	3	2
CO 5	2	1	2	1								1	2	2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	Introduction to Data Structures	10H

Introduction: Overview of Data Structures, Implementation of Data Structures, Algorithm Specifications, Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off.
Arrays: One-Dimensional, Multi-Dimensional, Pointer Arrays.

At the end of the Module 1, students will be able to:

1. Understand the linear and non-linear data structures. (BL - 2)
2. Understand the time and space complexities of an algorithm. (BL - 2)
3. Illustrate representation of data using Arrays. (BL - 2)

MODULE -2	Stacks and Queues	9H

Stacks: Introduction, Representation of a Stack, Stack Operations, Applications of Stacks.
Queues: Introduction, Representation of a Queue, Queue Operations, Circular Queue, Applications of Queues.

At the end of the Module 2, students will be able to:

1. Explain stack ADT and its operations. (BL - 2)
2. Understand the expression evaluation using stacks. (BL - 2)
3. Implement various queue structures. (BL - 3)

MODULE-3	Linked Lists	9H

Introduction, Singly linked lists, Doubly Linked Lists, Circular Linked Lists, Linked Stacks and Queues, Applications of Linked Lists.

At the end of the Module 3, students will be able to:

1. Understand basics concepts of linked lists. (BL - 2)
2. Illustrate various structures of linked lists. (BL - 2)
3. Understand the concept of dynamic memory management. (BL - 2)

MODULE-4	Trees & Graphs	10H

Trees-Introduction, Basic Terminologies, Definition and concepts, Representation of Binary Tree, operations on a BinaryTree, Binary SearchTree, Height BalancedBinaryTree.Graph Terminologies, Representation of Graphs, Graph Operations, Shortest Paths – Warshall's, Floyd's and Dijkstra's algorithms, Topological Sorting.

At the end of the Module 4, students will be able to:

1. Understand the concept of trees. (BL - 2)
2. Compare different tree structures. (BL - 2)
3. Explain the importance of Graphs for solving problems. (BL - 2)
4. Understand graph traversal methods. (BL - 2)
5. Implement algorithms to identify shortest path. (BL - 3)

MODULE-5	Sorting, Searching and Hash Tables	10H

Sorting: Introduction, Bubble Sort, Selection Sort, Quick Sort.Searching: Introduction, Basic Terminology, Linear Search and Binary Search Techniques. Hash Table:Hashing Techniques, Collision Resolution Techniques, Closed Hashing, Open Hashing.

At the end of the Module 6, students will be able to:

1. Implement the sorting algorithms (BL - 3)
2. Select the appropriate sorting algorithm for a given application (BL - 3)
3. Understand the concept of Hash Table (BL - 2)
4. Explain searching techniques. (BL - 2)

Total hours:	**48 hours**

Content beyond syllabus:

1. Heap Sort, Insertion Sort, Merge Sort
2. Optimum Sorting Algorithms

Text Book(s):

1. D. Samanta, "Classic Data Structures", 2nd Edition, Prentice-Hall of India, Pvt. Ltd., India, 2012.
2. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press , 2008.

Reference Books:

1. NarasimhaKarumanchi, Data Structures and Algorithms Made Easy, Careermonk Publications, 2016
2. Peter Bras, “Advanced Data Structures”, Cambridge University Press, 2014.
3. RS Salaria, Data Structures, 3rd Edition, Khanna Publishing House, 2017.
4. YashwantKanetkar, Data Structures through C,3rd Edition, BPB Publications, 2019.
5. RB Patel, Expert Data Structures with C, Khanna Publications, 2019.
6. Richard F. Gilberg, Behrouz A. Forouzan, Data Structures A Pseudo code Approach with C, Second Edition, Cengage Learning.
7. Ananda Rao Akepogu, Radhika Raju Palagiri,Data Structures and Alg. Using C++ ,

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1013	ELECTRONIC DEVICES AND CIRCUITS							R20
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Semiconductor Physics.

Course Objectives:

1. To study the operation and characteristics of PN junction diode and special semiconductor devices..
2. To familiarize the design and analysis of rectifiers with filters.
3. To describe the characteristics of BJT and its configurations.
4. To analyze the biasing circuits of BJT.
5. To study the characteristics of MOSFET.

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

CO 1	Illustrate the V-I characteristics of P-N junction Diode and special semiconductor devices. (BL-2)
CO 2	Demonstrate the performance of rectifiers with and without filters. (BL-2)
CO 3	Compare the operating characteristics of BJT (BL-3)
CO 4	Analyze the BJT biasing techniques. (BL-4)
CO 5	Interpret the characteristics of MOSFET. (BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1											3	
CO2	3	2	3										3	
CO3	3	2											3	
CO4	3	3	2										2	
CO5	3	1	1										3	3

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	**SEMICONDUCTOR DIODE&SPECIAL SEMICONDUCTOR DEVICES**	**10 Hrs**

Semiconductor Diode: Principle and Structure of PN junction diode, Open circuited PN junction diode, Energy band diagram of PN diode, Diode current Equation, Volt-Ampere Characteristics, Temperature dependence of Volt-Ampere Characteristics, Diode capacitance.

Special Semiconductor Devices: Principle of operation and Characteristics of Varactor diode, Tunnel Diode, Photo diode, LED, SCR

At the end of the Module 1, student will be able to:

1.Define PN junction diode (BL-1)
2. Explain the operation of PN junction diode for both forward and reverse bias. (BL-2)
3.Explain the energy band diagram of PN junction diode (BL-2)
4. Interpret the effect of temperature on V-I characteristics of PN junction diode (BL-2)
5. Derive the expression for transition and diffusion capacitance (BL-2)
6. Explain V-I Characteristics of various special diodes. (BL-2)
7. Describe the principle of operation of thyristors. (BL-2)

MODULE -2	RECTIFIERS & FILTERS	10 Hrs

Diode applications: P-N junction diode as a rectifier - Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, rectifier parameters, Harmonic components in Rectifier Circuits. Clippers and Clampers (Qualitative Treatment only)

Filters: Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters, bleeder resistor.

At the end of the Module 2, students will be able to:

1. Explain the operation of a bridge rectifier. (BL-2)
2. Analyze the performance of rectifiers with and without filters. (BL-4)
3. Design half wave and full wave rectifier circuits. (BL-4)
4. Differentiate various rectifier circuits in terms of their parameter metrics.(BL-2)
5. Explain the importance of bleeder resistor (BL-2)

MODULE-3	BIPOLAR JUNCTION TRANSISTOR	9 Hrs

Bipolar junction Transistor : Construction, Principle of Operation, transistor current components , transistor configurations, Transistor h-parameter model, calculation of h-parameters from characteristics, transistor as a switch, transistor as an amplifier.

At the end of the Module 3, students will be able to:

1. Discuss the current components and their relationships in BJT (BL-2)
2. Explain principle, operation and applications of BJT (BL-2)
3. Describe input and output Characteristics of BJT (BL-2)
4. Differentiate BJT configurations (CB,CC,CE) (BL-2)

MODULE-4	TRANSISTOR BIASING	10 Hrs

Transistor Biasing: Need for biasing, operating point, load line analysis, Stabilization against variations in I_{CO}, V_{BE} and β, biasing and stabilization techniques: fixed bias, collector to base bias, voltage divider bias, bias compensation techniques, thermal runaway, heat sink and thermal stability.

At the end of the Module 4, students will be able to:

1. Explain principle, operation and applications of MOSFET (BL-2)
2. Describe the operation and characteristics of Depletion MOSFET. (BL-2)
3. Explain the operation and characteristics of Enhancement MOSFET. (BL-2)
4. Differentiate enhancement and depletion mode MOSFET. (BL-2)

MODULE-5	METAL OXIDE SEMICONDUCTOR FIELD-EFFECT TRANSISTOR	9 Hrs

MOSFET: Construction of depletion mode and enhancement mode of NMOS and PMOS, Drain characteristics of MOSFET, Transfer Characteristics of MOSFET, MOSFET as a Switch, CMOS Inverter and it's Characteristics.

At the end of the Module 5, students will be able to:

1.Define biasing and stabilization (BL-1)
2.Explain the importance of thermal stability (BL-2)
3.Analyze the stabilization techniques.(BL-4)
4. Differentiate compensation techniques. (BL-2)

Total hours:	**48 Hours**

Content beyond syllabus:

1. Multi vibrators-Mono stable, Bi stable & Astable multi vibrators,
2. signal conditioning circuits-input signal determination, amplification, filtering.

Self-Study:

Contents to promote self-Learning:

SNO	Module	Reference
1	Semiconductor	https://www.electronics-tutorials.ws/diode/diode_3.html

		diode & Special semiconductor devices	https://www.electrical4u.com/tunnel-diode	
	2	Rectifiers and filters.	https://www.electricaltechnology.org/2019/01/what-is-rectifier-types-of-rectifiers-their-operation.html	
	3	Bipolar junction Transistor	https://www.electronics-tutorials.ws/transistor/tran_2.html	
	4	Transistor Biasing	https://www.tutorialspoint.com/amplifiers/methods_of_transistor_biasing.htm	
	5	Field effect transistors	https://www.electronics-tutorials.ws/transistor/tran_5.html.	

Text Book(s):

1. 1. J. Milliman and C Halkias, "Integrated electronics", 2nd Edition, Tata McGraw Hill, 1991.
2. L. Boylestad and Louis Nashelsky (2006), Electronic Devices and Circuits, 9th Edition, Pearson/Prentice Hall
3. Electronic Devices and Circuits by Lal Kishore, BS Publications.

Reference Book(s):

1. Behzad Razavi, "Microelectronics", Second edition, Wiley, 2013.
2. S. Salivahanan, N. Suresh Kumar, A. Vallavaraj (2008), Electronic Devices and Circuits, 2nd edition, Tata McGraw Hill, New Delhi.
3. Jimmie J Cathey, "Electronic Devices and Circuits," Schaum's outlines series, 3rd edition, McGraw-Hill (India), 2010.

Online Resources /Web References:

1.http://www.acadmix.com/eBooks_Download
2.https://www.freebookcentre.net/Electronics/Electronic-Circuits-Books.html
3. https://nptel.iitm.ac.in/courses/108/108/108108122/
4.https://www.classcentral.com/course/swayam-microelectronics-devices-to-circuits-14198
5.https://www.khanacademy.org/science/electrical-engineering
6.http://afrotechmods.com/tutorials
7.http://www.tutorialspoint.com/electronic devices

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2001	**Electrical Circuit Analysis**							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks 100		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To know the analysis of three phase balanced and unbalanced circuits and to measure active and reactive powers in three phase circuits.
2. Knowing how to determine the transient response of R-L, R-C, R-L-C series circuits for D.C and A.C excitations.
3. To introduce the various two-port networks parameters for a given circuit.
4. To evaluation of poles and zeros of a given transfer function.
5. To study the different types of filters

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

CO 1	Understand the analysis of three phase balanced and unbalanced circuits.
CO 2	Solve the problems in DC transient response for the given circuit.
CO 3	Solve the problems in AC transient response for the given circuit.
CO 4	Analyze the given network using different two port network parameters.
CO 5	Explain about the fundamental and types of filters.

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	3	2									3	3
CO2	3	3	3	2									3	3
CO3	3	3	3	2									3	2
CO4	3	3	3	2									1	2
CO5	2	2	3	2									2	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

Balanced Three phase circuits

Three phase circuits: Phase sequence- Star and delta connection-Relation between line and phase voltages and currents in balanced systems-Analysis of balanced three phase circuits-Measurement of Active and Reactive power in balanced Three phase systems.

Unbalanced Three phase circuits

Analysis of Three Phase unbalanced circuits-Loop Method- Application of Millman's Theorem-Star Delta Transformation Technique – Two Wattmeter Method of measurement of three phase power, Advantages of Three Phase System.

At the end of the Module 1, students will be able to:

1. Explain about advantages of 3-φ circuits over 1-φ circuits

2. Distinguish between balanced and unbalanced circuits
3. Explain the phasor relationships of voltage, current, power in star and delta connected.
4. Measure the active, reactive powers in balanced circuits
5. Understand the analysis of unbalanced circuits and power calculations

MODULE-2

Transient Analysis

Transient Analysis in DC and AC circuits Transient response of R-L, R-C, R-L-C circuits for DC excitations, Solution using differential equations and Laplace transforms.

At the end of the Module 2, students will be able to:

1. Distinguish between classical method and Laplace transform approach in analysing transient phenomenon in DC excitations
2. Distinguish between classical method and Laplace transform approach in analysing transient phenomenon in sinusoidal excitations

MODULE-3

Transient Analysis in DC and AC circuits Transient response of R-L, R-C, R-L-C circuits for AC excitations, Solution using differential equations and Laplace transforms.

At the end of the Module 3, students will be able to:

1. Distinguish between classical method and Laplace transform approach in analysing transient phenomenon in AC excitations
2. Distinguish between classical method and Laplace transform approach in analysing transient phenomenon in sinusoidal excitations

MODULE-4

Two Port Network Parameters: Impedance, Admittance, Transmission and Hybrid Parameters and their relations, reciprocity and symmetry conditions, concept of transformed network, Two Port Network parameters using Transformed Variables

At the end of the Module 4, students will be able to:

1. Understand the concept of two port network theory
2. Find the transmission line networks for designing the transmission lines.

MODULE-5

Filters

Filters – Low Pass – High Pass and Band Pass – RC, RL filters– derived filters and composite filters design – Attenuators – Network functions for one port and two port networks, pole-zeros of network functions and network stability.

At the end of the Module 5, students will be able to:

1. Understand about Filter, Classification, where they can be used, etc.
2. Understand about attenuators and equalizers used in electronic high frequency circuits
3. Understand the basic of network synthesis.
4. Understand the properties of network function.

Total hours:	**48 hours**

Term work:

Must be submit at least two assignments.

Content beyond syllabus:

1.Locus diagram and Electro magnetism

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Analysis of Three Phase balanced circuits	CO1	https://www.youtube.com/watch?v=xaeob9lTXS0
2	Analysis of Three Phase unbalanced circuits	CO2	https://www.youtube.com/watch?v=xaeob9lTXS0
3	Transient response for RL and RC circuits	CO3	https://www.youtube.com/watch?v=2MaPC8Iw7nc
4	Fourier Theorem	CO4	https://nptel.ac.in/courses/108/104/108104139/
5	RC, RL filters	CO5	https://www.youtube.com/watch?v=AGyjYG88LlE
6	basic synthesis procedure	CO6	https://nptel.ac.in/courses/108/102/108102042/

Text Book(s):

1. William Hayt, Jack E. Kemmerly and Jamie Phillips, "Engineering Circuit Analysis", Mc Graw Hill, 9th Edition, 2019.
2. A. Chakrabarti, "Circuit Theory: Analysis & Synthesis", Dhanpat Rai & Sons, 2008.

Reference Book(s):

1. M.E. Van Valkenberg, "Network Analysis", 3rd Edition, Prentice Hall (India), 1980.
2. V. Del Toro, "Electrical Engineering Fundamentals", Prentice Hall International, 2009.
3. Charles K. Alexander and Matthew. N. O. Sadiku, "Fundamentals of Electric Circuits" Mc Graw Hill, 5th Edition, 2013.
4. Mahamood Nahvi and Joseph Edminister, "Electric Circuits" Schaum's Series, 6th Edition, 2013.
5. John Bird, Routledge, "Electrical Circuit Theory and Technology", Taylor & Francis, 5th Edition, 2014.
6. Sudhakar, A., Circuits and Networks, Tata McGraw
7. Suresh Kumar, K.S. Electrical circuits and Networks, Pearson Education.
8.Network Analysis and Synthesis – Umesh Sinha- Satya Prakashan Publications
9.A. Anand Kumar, Network Analysis and Synthesis, PHI publication

Online Resources:

1. http://www.acadmix.com/eBooks_Download
2. http://www.freetechbook.com/software-engineering-f15.html

Web References:

1)http://www.mathtutordvd.com/products/Engineering-Circuit-Analysis-Volume-1.cfm
2)http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-andelectronics-spring-2007/video-lectures/lecture-2/
3) http://www.facstaff.bucknell.edu/mastascu/elessonsHTML/Circuit/Circuit1.html

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2002	DC MACHINES AND TRANSFORMERS							R2020
II-B.Tech	Hours / Week			Total	Credit	Max Marks		
	L	T	P	hrs	C	CIE	SEE	TOTAL
I-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To understand the constructional features of DC machines.
2. To understand the phenomena of armature reaction and commutation.
3. To understand the characteristics and parallel operation of dc machines.
4. To understand the methods for speed control of DC motors and applications of DC motors.
5. To understand the various types of losses that occurs in DC machines and how to calculate efficiency.
6. To understand the constructional features of a single phase transformer.
7. To understand the efficiency and voltage regulation of a transformer.
8. To understand the Autotransformers Construction & Comparison with two winding transformer.
9. To suggest a suitable three phase transformer connection for a particular operation.
10. To understand the tap changing of transformers.

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

CO 1	Study construction, different phenomena like: armature reaction, commutation in DC machines.
CO 2	Understand about different types of dc generators and significance of OCC.
CO 3	Develop mathematical relations for torque developed by dc motor and learn about speed – torque characteristics of different types of DC motor. Gain knowledge of about different testing methods of dc machines.
CO 4	Identification of physical components of single phase transformer.
CO 5	Learn difference between two windings and auto transformers. Identification of three phase transformers circuits.

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	2		2				1	1	2	2	1
CO2	2	2	2	2		2				1	1	2	1	2
CO3	2	2	2	2		2				1	1	2	2	1
CO4	2	3	3	2		2				1	1	2	2	1
CO5	3	3	3	3		2				1	1	2	1	2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

Principle of Electromechanical Energy Conversion, Energy balance equation, Introduction to DC Generator, principle of operation, Construction details, Design of Armature winding, E.M.F Equation- Numerical problems. Armature Reaction- Cross Magnetizing and De-Magnetizing AT/Pole, Compensating Winding, Commutation, Reactance Voltage, Methods of Improving

Commutation.

At the end of the Module 1, students will be able to:

- Able to understand the electromechanical energy conversion system
- Able to understand the construction, operation and armature windings of a DC generator
- Able to understand the Armature Reaction & Commutation

MODULE -2

Methods of Excitation – Separately Excited and Self Excited Generators, Build-Up of E.M.F - Critical Field Resistance and Critical Speed, Causes for Failure to Self Excite and Remedial Measures, Characteristics & Applications of Generators.
Parallel Operation of D.C shunt Generators, Series Generators-Use of Equalizer Bar and Cross Connection of Field Windings – Load Sharing.

At the end of the Module 2, students will be able to:

- Able to analyze the types of DC generators
- Able to analyze the characteristics of DC generators
- Able to understand the Parallel of operation of DC generators

MODULE-3

D.C Motor – Principle of Operation, Back Emf, Torque and power developed by armature, Types, Characteristics and Applications of dc Motors, speed control of DC motors(Armature control and Flux control methods), Necessity of starters, constructional details of 3-point and 4-point starters, Calculation of Starter Steps for D.C Shunt Motors.
Power stages in a dc machine, Losses – Constant & Variable Losses, Calculation of Efficiency, Condition for Maximum Efficiency & Numerical Problems. Methods of Testing - Brake Test, Swinburne's Test, Hopkinson's Test, Field's Test, Retardation Test.

At the end of the Module 3, students will be able to:

- Analyze the types of DC motors
- Analyze the characteristics & speed control of DC motors.
- Able to understand the calculation of starter resistance in steps.
- Analyze Power stages and types of losses in a DC machines.
- Able to understand the calculation of Efficiency in DC machines.
- Able to Analyze the testing of DC machines.

MODULE-4

Principle, construction and operation of single-phase transformers, EMF equation, equivalent circuit, phasor diagrams(no load and on load), losses and efficiency, voltage regulation, All Day Efficiency , Testing -open circuit, short circuit tests & Sumpner's test, separation of hysteresis and eddy current losses. Parallel operation of single-phase transformers.

At the end of the Module 5, students will be able to:

- Able to understand the construction & operation of transformer
- To predetermine the efficiency and voltage regulation of a transformer
- Able to understand the parallel operation of single phase transformers.

MODULE-5

Autotransformers-construction, principle, applications and comparison with two winding transformer. Three-phase transformer – construction, types of connection and their comparative features, Phase conversion - Scott connection, Tap-changing transformers - No-load and on-load tap changing of transformers.

At the end of the Module 6, students will be able to:

- Able to understand the Autotransformers
- Able to understand and analyze the phase conversions

▪ Analyze the tap changing of transformers	
Total hours:	**60 hours**

Term work:
DC Machines- Lab & Transformers- Filed Work

Content beyond syllabus:
1. Advanced Speed control techniques for DC Motors.
2. Zigzag/star and V/V connections in a 3-Phase Transformers

Self-Study:
Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	DC Machines Introduction & Constructional features	CO1	https://nptel.ac.in/courses/108/102/108102146/
2	DC Generator Characteristics	CO2	https://www.youtube.com/watch?v=TaZjv_sy_jo
3	DC Motor	CO3	https://www.youtube.com/watch?v=GQatiB-JHdI
4	Testing of DC Machines	CO4	https://www.youtube.com/watch?v=8WCbTZPjcTE
5	Transformers	CO5	https://nptel.ac.in/courses/108/105/108105155/
6	Auto Transformers	CO6	https://www.youtube.com/watch?v=lltVwhoPvh0

Text Book(s):
1. Electrical Machinery, P.S. Bimbhra, Khanna Publishers, 7th Edition, 2011.
2. Electrical Machines, S K Bhattacharya, Mc Graw Hill Education (India) Pvt. Ltd., 4th Edition, 2014, 3rd Reprint 2015.
3. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education,2010.

Reference Book(s):
1..Electric Machines 4th edition, D.P.Kothari and I.J. Nagrath, Mc Graw Hill Education (India) Pvt. Ltd., 4th Edition, 2010, 16th Reprint 2015.
2.A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
3. A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.

Online Resources:
1. http://175.101.102.82/moodle/
2. https://www.accessengineeringlibrary.com/
3. https://www.slideshare.net/
4. https://easyengineering.net/electrical-machinery-by-bimbhra/
5.https://books.google.co.in/books?id=dh_gDwAAQBAJ&lpg=PR1&dq=electrical%20machines%20by%20kothari%202020&pg=PR8#v=onepage&q&f=false

Web Resources:

1. https://electrical-engineering-portal.com/
2. https://www.electrical4u.com/
3. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/experimentlist.html
4. https://www.engineering.com/

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2501	DC MACHINES AND TRANSFORMERS Lab							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	0	0	3	30	1.5	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To familiarize students about OCC and internal, external characteristics of dc shunt generator.
2. To know the performance characteristics and speed control method of dc shunt motor
3. To know how to predetermine the efficiency of dc shunt motor.
4. To find efficiency, losses and regulation of single phase transformer.
5. To know how to find motor and generator efficiency by connecting to dc shunt machines back to back
6. To familiarize students about characteristics of dc series motor

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

CO 1	Determine the magnetization and load characteristics of a DC shunt generator
CO 2	Describe the efficiency and performance characteristics of DC motors
CO 3	Predetermination of transformer with different loads

List of Experiments Prescribed and Conducted:

1. Conduct an Experiment to obtain OCC Characteristics of dc Shunt generator.

2. Conduct Brake test on dc shunt motor to obtain performance characteristics.

3. Conduct speed control methods of dc shunt motor.

4. Conduct Swinburne's test on a DC Shunt machine.

5. Conduct OC and SC test on single phase transformer

6. Conduct Sumpner's test on two identical transformers

7. Conduct load test on single phase transformer

8. Conduct an Experiment to obtain internal and external characteristics of dc shunt generator.

9. Conduct an experiment from 3phase to 2 phase conversion by using Scott Connection

10. Conduct load test on dc series motor.

Total hours: 30 hours

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2							2	2			3	2
CO2	2	3							2	2			3	2
CO3	3	3							2	2			3	2
CO4	2	2							2	2			3	2
CO5	2	2							2	2			3	2
CO6	2	2							2	2			3	2
1: Low, 2-Medium, 3- High														

NARAYANA ENGINEERING COLLEGE:NELLORE

20EE2502	**Electrical Circuits And Simulation Lab**							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	0	0	3	30	1.2	40	60	100

Pre-requisite: Basic of Electrical circuit

Course Objectives:

The objectives are to study:

1. To design electrical systems.
2. To analyze a given network by applying various Network Theorems.
3. To measure three phase Active and Reactive power.
4. To understand the locus diagrams

List of Experiments

PART A

1. Measurement of Active Power for Star Connected Balanced Loads
2. Measurement of Reactive Power for Star Connected Balanced Loads
3. Measurement of 3-Phase Power by Two Wattmeter Method for Unbalanced Loads
4. Measurement of Active Power for Delta Connected Balanced Loads 11. Measurement of Reactive Power for Delta Connected Balanced Loads
5. Locus Diagram of RL Series Circuits: a) Variable 'R' and Fixed 'L' b) Variable 'L' and Fixed 'R'
6. Locus Diagram of RC Series Circuits: a) Variable 'R' and Fixed 'C' b) Variable 'C' and Fixed 'R'
7. Constant K Low-Pass and High-Pass Filter.
8. Constant K Band-Pass and Band-Elimination Filters.
9. Study of Full Wave Rectifier with and without Filters

PSPICE Simulation Experiments:

1. Simulation of DC Circuits
2. Simulation of AC Circuits
3. DC Transient Response
4. Mesh Analysis
5. Nodal Analysis

Course Outcomes:

At the end of the course, students will be able to

1. The student will analyze the characteristics of Electrical circuits & P Spice Simulation.
2. To Perform Laboratory Experiments practically.
3. To carry out laboratory experiments on simulation & Networks.
4. To understand the fundamentals of electrical circuits & P Spice simulation

Text Books

1. David A. Bell, Fundamentals of Electric Circuits: Lab Manual OUP Canada, 7th Edition, 2009.
2. Muhammad H. Rashid, Introduction to PSPICE using OrCAD for Circuits and Electronics, Pearson Education, 3rd Edition, 2003.

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2			1				2	2			3	2
CO2	2	3			1				2	2			3	2
CO3	3	3			1				2	2			3	2
CO4	2	2			1				2	2			3	2
1: Low, 2-Medium, 3- High														

SEMESTER IV

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EE2003	PC	Analog Electronic Circuits	2	0	0	2	2	40	60	100
20EE2004	PC	Electro Magnetic Fields	3	0	0	3	3	40	60	100
20EE2005	PC	Induction Motors and Synchronous Machines	3	0	0	3	3	40	60	100
20EE2006	PC	Linear Control Systems	3	0	0	3	3	40	60	100
20EE2007	PC	Power Generation & Transmission	3	0	0	3	3	40	60	100
-	OE	Open elective I	3	0	0	3	3	40	60	100
20EE2503	PC	Analog Electronics and Simulation Lab	0	0	2	2	1	40	60	100
20EE2504	PC	Induction Motors and Synchronous Machines Lab	0	0	3	3	1.5	40	60	100
20CD6002	SC	Career competency Development II	0	0	2	2	1	40	60	100
20CC6002	SC	Value added course/Certificate course II	0	1	0	1	1	40	60	100
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	17	1	10	28	21.5	400	600	1000

NARAYANA ENGINEERING COLLEGE:NELLORE

20EE2003	ANALOG ELECTRONIC CIRCUITS							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	2	0	0	36	2	40	60	100

Pre-requisite: Basic knowledge on concepts of electronic devices.

Course Objectives:

- To introduce linear and non linear wave shaping circuits.
- To explain the effect of negative feedback on amplifier characteristics RC & LC oscillator circuits
- To analyze single and multi stage amplifiers
- To introduce different types of large signal amplifiers
- To discuss op-ampcharacteristics and applications.

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

CO 1	Demonstrate the concept of linear and non linear wave shaping circuits. (BL-02)
CO 2	Illustrate the concept of different types of feedback amplifiersandOscillators.(BL-02)
CO 3	Analyze various configurations of single stage and multistage amplifiers.(BL-04)
CO 4	Analyze the operation and characteristics of Power Amplifiers.(BL-02)
CO 5	Interpret the characteristics and applications Operational Amplifier.(BL-02)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	2	2										3	
CO2	3	2	2										3	
CO3	3	3	2										2	
CO4	3	3											2	
CO5	3	2	2										3	

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	Wave Shaping Circuits	Hours: 10

Linear Wave Shaping: High pass and low pass RC circuits and their response for Sinusoidal, Step, Pulse, Square & Ramp inputs, High pass RC network as Differentiator, Low pass RC circuit as an Integrator.

Non-Linear Wave Shaping: Diode clippers, Transistor clippers, Clipping at two independent levels. Clamping Operation, Clamping circuit by considering Source and Diode resistances

At the end of the Module 1, students will be able to:

1. Understand the concept of high pass and low pass RC circuits. (BL-02)
2. Observe the response of Sinusoidal, step, pulse, square & ramp inputs.(BL-01)
3. Understand the working principle of Clippers and Clampers. (BL-02)

MODULE – 2	Feedback Amplifiers and Oscillators	Hours: 10

FEEDBACK AMPLIFIERS: Feedback principle and concept, types of feedback, feedback topologies, Characteristics of negative feedback amplifiers, Determination of input & output impedance of voltage series, voltage shunt, current series & current shunt configurations

OSCILLATORS: Oscillator principle, condition for oscillations, types of oscillators, Hartley oscillator, Colpitt's oscillator, RC-phase shift oscillator, Wein bridge oscillator,

At the end of the Module 2, students will be able to:

1. Understand the concept of feedback connection to an amplifier. (BL-02)
2. Identify different types of feedback topologies.(BL-01)
3. Summarize input and output impedance of various feedback configurations.(BL-02)
4. Compare characteristics of various types of feedback configurations.(BL-02)
5. Understand the working principle of oscillator. (BL-02)
6. Explain various LC oscillators by calculating frequency of oscillations and condition for oscillations.(BL-02)
7. Explain various RC oscillators by calculating frequency of oscillations and condition for oscillations.(BL-02)

MODULE – 3	**Single Stage &Multistage Amplifiers**	**Hours: 09**

Single Stage Amplifiers: Transistor hybrid model, determination of h-parameters, generalized analysis of transistor amplifier model using h-parameters, analysis of CB, CE and CC amplifiers.

Multi Stage Amplifiers: Classification of amplifiers, Different coupling techniques, Cascaded amplifier, Cascode amplifier.

At the end of the Module 4, students will be able to:

1. Understand the concept of hybrid model for analysis of transistor amplifier circuit. (BL-02)
2. Understand the role of different coupling schemes in cascading. (BL-02)
3. Analyze various multistage amplifiers.(BL-04)
4. Study two stage transistor amplifier circuits viz., Cascade amplifiers &Cascode amplifiers. (BL-02)

MODULE – 4	**Power Amplifiers**	**Hours: 09**

Classification, Series fed Class A large signal Amplifier, Transformer Coupled Class A large signal amplifier, Amplifier Distortion, Push- pull Class B Amplifier, Complementary Symmetry Class B Amplifier, Push- pull Class AB Amplifier, Complementary Symmetry Class AB Amplifier, class D amplifier, Heat sink and Thermal stability.

At the end of the Module 5, students will be able to:

1. Understand the role of power amplifier in multistage amplifiers. (BL-02)
2. Classify power amplifiers based on conduction angle. (BL-02)
3. Understand various distortions in amplifiers.(BL-02)
4. Demonstrate complementary symmetry topologies. (BL-02)
5. Find conversion efficiency of various topologies.(BL-01)

MODULE – 5	**Op-Amp Characteristics**	**Hours: 10**

Introduction, ideal and practical Op-amp, Op-amp characteristics - DC and AC characteristics, 741 Op-amp and its features, modes of operation-inverting, non-inverting, differential. Basic applications of Op-amp, instrumentation amplifier, , sample & Hold circuits, Differentiator and Integrator, Comparators, Schmitt trigger, Multivibrators, Introduction to voltage regulators

At the end of the Module 6, students will be able to:

1. Understand the concept of operational amplifier. (BL-02)
2. compare various modes of op-amp operation. (BL-02)
3. list the applications of operational amplifer.(BL-01)
4. Understand the concept of Multivibrators. (BL-02)

Total hours:	**48 hours**

Term work:

1. Model a single stage amplifier on PCB.

2. Model a multistage amplifier on PCB.
3. Model a Hartley oscillator on PCB
4. Survey and Submit a report on audio power amplifiers available in market.
5. Survey and Submit a report on oscillators available in market.
6. Survey and Submit a report on various op-amps available in market.

Content beyond syllabus:

3. Design of two stage RC coupled amplifier using FET-small signal analysis
4. Differential amplifier-CMRR, Common mode gain, Differential gain, Modes of operation.

Self-Study:

Contents to promote self-Learning:

SNO	Module	Reference
1	**Wave Shaping Circuits**	https://www.tutorialspoint.com/electronic_circuits/electronic_circuits_nonlinear_wave_shapping.htm
2	**Feedback Amplifiers**	https://www.tutorialspoint.com/amplifiers/amplifiers_feedback.htm
3	**Oscillators**	https://www.tutorialspoint.com/sinusoidal_oscillators/sinusoidal_oscillators_introduction.htm
4	**Single Stage &Multistage Amplifiers**	https://www.tutorialspoint.com/amplifiers/multi_stage_transistor_amplifier.htm
5	**Power Amplifiers**	https://www.tutorialspoint.com/amplifiers/classification_of_power_amplifiers.htm
6	**Op-Amp Characteristics**	https://www.electronicstutorials.ws/opamp/opamp_8.html

Text Book(s):

1. Millman‟s Pulse, Digital and Switching Waveforms –J. Millman, H. Taub and Mothiki S. PrakashRao, 2 Ed., 2008, TMH.

2. Donald A. Neaman, “Electronic Circuit Analysis and Design”, McGraw Hill.

3. Op-Amps & Linear ICs – Ramakanth A. Gayakwad, PHI, 2003.

Reference Book(s):

1. Robert T. Paynter, “Introductory Electronic Devices and Circuits”, Pearson Education, 7th Edition

2. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuits Theory” Pearson/Prentice Hall, 9th Edition, 2006.

3. Sedra A.S. and K.C. Smith, “Micro Electronic Circuits”, Oxford University Press, 5th Edition.

4. Integrated Electronics, Jacob Millman, Christos C Halkias, TMH

5. Electronic Devices and Circuits, David A. Bell – 5thEdition, Oxford.

6. Electronic Circuit Analysis 4th Edition – by K. Lal Kishore , BS Publications.

Online Resources/Web references:

1.https://www.academia.edu/28016003/EDC_by_Lal_kishore
2.https://www.academia.edu/9984476/Electronic_devices_and_circuit_theory_robert_boylestad_1_

3. Donald A. Neaman, “Electronic Circuit Analysis and Design”, McGraw Hill.
4.https://nptel.ac.in/courses/122/106/122106025/
5. https://www.tutorialspoint.com/semiconductor_devices/index.htm
6. https://www.allaboutcircuits.com/textbook/semiconductors/
7.http://www.satishkashyap.com/

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2004	ELECTROMAGNETIC FIELDS							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To review the fundamentals of the different coordinate systems, vector algebra and calculus
2. To teach the basic laws of electromagnetism
3. To learn to compute and visualize the electrostatic and magnetostatic fields for simple configurations
4. To analyse the time varying electric and magnetic fields and to understand Maxwell's equations
5. To understand the propagation of electromagnetic waves through different media

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

CO 1	Ability to identify appropriate coordinate systems and visualize and understand the practical significance of vector calculus
CO 2	Understanding of the basic laws of electrostatics, Ability to compute, visualize electrostatic fields along with practical applications
CO 3	Understanding of the basic laws of magnetostatics
CO 4	Ability to compute, visualize magneto static fields along with practical applications
CO 5	Understanding of Maxwell's equations in different forms and medium

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2									2	1
CO2	3	3	2	2									2	1
CO3	3	3	1	1									2	1
CO4	3	3	2	2									2	1
CO5	3	3	2	2									2	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

ELECTROSTATICS -I

Vector algebra , Coordinate systems, Vector calculus- Gradient, Divergence and Curl theorems and applications, Sources and effects of electromagnetic fields, Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and its applications.

At the end of the Module 1, students will be able to:

1. Recollect the basic concepts Vectors
2. Understand the applications of Electrostatics

3. Illustrate the basic laws of Electrostatics
MODULE -2
ELECTROSTATICS -II Electric potential – Electric field and equipotential plots– Electric field in free space, conductors, dielectric -Dielectric polarization – Dielectric strength - Electric fields in multiple dielectrics – Boundary conditions, capacitance, Energy density, Poisson's and Laplace's equations.
At the end of the Module 2, students will be able to: 1. understand the concept of Electric potential 2. Differentiate between conductor and dielectric in electric field
MODULE-3
MAGNETOSTATICS-I Magnetic field intensity (H) – Biot– Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – Magnetic force, Lorentz force, force between two conductors,- Boundary conditions.
At the end of the Module 3, students will be able to: 1. Understand the basic laws of Magnetostatics 2. Analyze the concept of magnetic force
MODULE-4
MAGNETOSTATICS-II Scalar and vector potential, Poisson's Equation, Torque, Inductances and mutual inductances, Neumann's formula, Energy density, Numerical problems.
At the end of the Module 4, students will be able to: 1. Apply the poisson's & Laplace's equations to different problems 2. Analyze the inductance of different coil combinations
MODULE-5
ELECTRODYNAMIC FIELDS Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Time varying potential – Relation between field theory and circuit theory , Applications.
At the end of the Module 5, students will be able to: 1. Understand the Faraday's law of electromagnetic induction 2. Analyze the Maxwell's equations for static and time varying fields
Total hours: 48 hours

Term work:
Content beyond syllabus: 1. Electric power transmission
Self-Study: Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Gauss's law and its applications	CO1	https://www.youtube.com/watch?v=M0GInI0vNh8
2	Poisson's and Laplace's equations	CO2	https://www.youtube.com/watch?v=I-lKnLnnbY4
3	Biot– Savart's Law	CO3	https://www.youtube.com/watch?v=X9mYh8aG2AQ
4	Neumann's formula	CO4	https://www.youtube.com/watch?v=iVANETIf3cM
5	Displacement current	CO5	https://www.youtube.com/watch?v=77PZPBXMl1w
6	Wave parameters; velocity, intrinsic impedance, propagation constant	CO6	https://www.youtube.com/watch?v=z_L58oLkWc

Text Book(s):

1. Mathew N. O. Sadiku, S.V.Kulkarni, 'Principles of Electromagnetics', 6th Edition, Oxford University Press, 2015, Asian Edition
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill ,8th Revised edition, 2014
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), Tata McGraw Hill, 2010

Reference Book(s):

1. Bhag Singh Guru and Huseyin R. Hiziroglu "Electromagnetic field theory fundamentals",Cambridge University Press; Second Revised Edition, 2009.
2. . Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', PHI Learning Private Limited, New Delhi, Second Edition-2009

Online Resources:

1. http://alumni.media.mit.edu/~aggelos/papers/EM_Hayt_6th.pdf
2. https://nptel.ac.in/courses/108/106/108106073/

Web Resources:

1. https://www.youtube.com/watch?v=pGdr9WLto4A&list=PLl6m4jcR_DbOx6s2toprJQx1MORqPa9rG
2. https://www.youtube.com/watch?v=G5P6dInMTFg&list=PLuv3GM6-gsE3-hVNaw-YEb7EeY5XVPZdz

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2005	INDUCTION MOTORS AND SYNCHRONOUS MACHINES							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To understand the Constructional details, principle of operation and the importance of slip in Induction motor operation
2. To understand the slip-torque characteristics and torque calculations of Induction motor
3. To understand the methods of starting and speed control of Induction motor
4. To understand the construction and principle of working of synchronous machines
5. To understand the different methods of predetermining the regulation of alternators
6. To understand the concepts and computation of load sharing among alternators in parallel.
7. To understand the performance characteristics of synchronous motors and their use as synchronous condensers for power factor improvement.
8. To understand the different types of single phase motors and special motors used in house hold appliances and control systems.

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

CO 1	To acquire the basic knowledge of construction, working and operation of induction motor.
CO 2	Identify different speed controlling techniques of Induction motor for the given application.
CO 3	To impart knowledge on Construction and performance of salient and non – salient type synchronous generators and determine how several alternators running in parallel share the load on the system.
CO 4	Analyze the performance characteristics of synchronous motors.
CO 5	To impart knowledge on Construction, principle of operation and performance of single phase induction motors and special machines.

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	1										2	2
CO2	3	2	2										2	2
CO3	3	2	2										2	2
CO4	3	2	1										2	2
CO5	3	2	1										2	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT

MODULE – 1

Polyphase Induction Motors-Constructional Details of Cage and Wound Rotor Machines, Production of Rotating Magnetic Field, Principle of Operation, Slip, Rotor Emf and Rotor Frequency, Rotor Reactance, Rotor Current and Power factor at Standstill and under running

conditions, Rotor Power Input, Rotor Copper Loss and Mechanical Power Developed and Their Inter Relationship.

At the end of the Module 1, students will be able to:

- Able to Analyze Production of Rotating Magnetic Field.
- Able to understand Cage and Wound Rotor Machines.

MODULE -2

Torque Equation, Expressions for Maximum Torque and Starting Torque, Torque Slip Characteristic, Load characteristics, Equivalent Circuit, Phasor Diagram, Crawling and Cogging, Circle Diagram, No Load and Blocked Rotor Tests-Predetermination of Performance.
Starting Methods and Starting Current and Torque Calculations, Speed Control-Change of Frequency; Pole Changing and Methods of Consequent Poles; Cascade Connection. Injection of an Emf.

At the end of the Module 2, students will be able to:

- Able to Analyze Torque Slip Characteristics
- Able to understand Starting Methods of Induction Motors

MODULE-3

Principle and Constructional Features of Salient Pole and Round Rotor Machines – Armature Windings, E.M.F Equation- Armature reaction – Voltage Regulation Methods, Power Flow Equation in Alternators – Synchronizing Power and Torque – Parallel Operation and Load Sharing – Effect of Change of Excitation and Mechanical Power Input – Determination of Sub-Transient, Transient and Steady State Reactances.

At the end of the Module 3, students will be able to:

- Able to understand the construction and principle of operation of synchronous generators.
- Able to understand the Voltage Regulation Methods.
- Able to understand the parallel operation of synchronous generators.
- Able to understand the Sub-Transient, Transient and Steady State Reactances.

MODULE-4

Synchronous Motors Operation – Phasor Diagram – Power Flow Equations in Synchronous Motors- Variation of Current and Power Factor with Excitation – V and Inverted V Curves – Synchronous Condensers – Hunting, and Methods to Eliminate Hunting – Starting Methods of Synchronous Motor.

At the end of the Module 4, students will be able to:

- Able to understand the operation of synchronous motors.
- Able to understand the Starting Methods of Synchronous Motor.

MODULE-5

Single Phase Induction Motors - Constructional Features – Double Revolving Field Theory-Elementary Idea of Cross Field Theory – Split Phase Motors – Capacitor Start and Run Motors – Shaded Pole Motor. Principle and Performance of A.C Series Motor - Universal Motor – Single Phase Synchronous Motors – Reluctance Motor – Hysteresis Motor – Stepper Motor.

At the end of the Module 5, students will be able to:

- Able to understand the operation of Single Phase Induction Motors.
- Able to understand the special Electrical Machines.

Total hours:	**48 hours**

Term work:

Synchronous machines & Induction machines- Power plants & Industrial visits.

Content beyond syllabus:

1. Advanced Speed Control methods for Poly phase Induction Motors.
2. Two Reaction Theory –Determination of Xd and X_q (Slip Test).
3. Principle of operation and control of Brushless DC motor.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	3-phase Induction Motors	CO1	https://nptel.ac.in/courses/108/102/108102146/
2	Circle Diagram	CO2	https://nptel.ac.in/courses/108/105/108105131/
3	Synchronous Generator	CO3	https://www.youtube.com/watch?v=b24jORRoxEc
4	Parallel operation of Alternators	CO4	https://www.youtube.com/watch?v=aZR7JsH9QnM
5	Synchronous motor	CO5	https://www.youtube.com/watch?v=fdMIuEqh48M&list=PLPpCFgQP7QKHSJQnSwaigL89gshecycXs
6	Single Phase Induction motors	CO6	https://nptel.ac.in/courses/108/102/108102146/

Text Book(s):

1. Electrical Machinery, P.S. Bimbhra, Khanna Publishers, 7th Edition, 2011.
2. Electric Machines 4th edition, D.P.Kothari and I.J. Nagrath, Mc Graw Hill Education (India) Pvt. Ltd., 4th Edition, 2010, 16th Reprint 2015.
3. Electrical Machines, S K Bhattacharya, Mc Graw Hill Education (India) Pvt. Ltd., 4th Edition, 2014, 3rd Reprint 2015.

Reference Book(s):

1..Electric Machines 4th edition, D.P.Kothari and I.J. Nagrath, Mc Graw Hill Education (India) Pvt. Ltd., 4th Edition, 2010, 16th Reprint 2015.
2.A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
3. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

Online Resources:

1. http://175.101.102.82/moodle/
2. https://www.accessengineeringlibrary.com/
3. https://www.slideshare.net/
4. https://easyengineering.net/electrical-machinery-by-bimbhra/
5.https://books.google.co.in/books?id=dh_gDwAAQBAJ&lpg=PR1&dq=electrical%20machines%20by%20kothari%202020&pg=PR8#v=onepage&q&f=false

Web Resources:

1. https://electrical-engineering-portal.com/
2. https://www.electrical4u.com/
3. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/experimentlist.html
4. https://www.engineering.com/

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2006	LINEAR CONTROL SYSTEMS							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	CS	TOTAL
II-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Basics concepts of Electrical Circuits & Basics of Laplace transform

Course Objectives:

1. To understand the merits and demerits of open and closed loop control systems
2. To understand the mathematical modeling of Electrical and mechanical control systems
3. To understand the step response of second order control systems
4. To plot Root locus for the given system transfer function
5. To understand the stability analysis from Bode plot, polar plots
6. To understand the state space analysis

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

CO 1	Determine the transfer function for the given electrical or mechanical systems and also determine the transfer function of a system using block diagram reduction techniques and Mason's gain formula
CO 2	Analyze the system behaviour in time domain and step response to various dampings.
CO 3	Determine the stability of given system by applying Routh's stability criteria.
CO 4	Analyze the stability of given system by means of Bode plot and polar plot
CO 5	Determine the state model and assessment of controllability & observability from the given transfer function.

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2												1
CO2	2	1												1
CO3	2	1												1
CO4	2	1	1											1
CO5	2	1	1											1
1: Low, 2-Medium, 3- High														

COURSE CONTENT

MODULE – 1

Examples & Classification of control systems, merits and demerits of Open Loop and closed loop control systems, Effects of positive and negative feedback**.** (3H)

Mathematical modelling and transfer function of Electrical and Mechanical systems, Analogous systems, modelling of DC motor(4h)

Block diagrams: Block diagram representation of control systems, Block Diagram Reduction Rules .(4h)

Signal flow graph: Definitions, Reduction using Mason's gain formula.(3h)

Control System Components: DC Servo motor, AC Servo motor , Synchro Transmitter & Receiver (2h)

At the end of the Module 1, students will be able to:

1. Identify the difference between open loop and closed loop systems
2. Understand the effect of feedback on system performance

3. Model the given electrical or mechanical control system 4. Apply the block diagram reduction to simplify the given system 5. Apply the Signal flow graph reduction to simplify the given system 6. Derive the transfer function of Ac and DC servo motor
MODULE-2
Time Response Analysis: Standard test signals, Time response of first order and second order un damped, under damped, critically damped and over damped systems, Time domain specifications. (5h) Error Analysis**:** Steady state Error**,** static error coefficient of type 0,1, 2 systems (2h)
At the end of the Module 2, students will be able to: 1. Identify the importance of basic test signals 2. Analyze the Time response of second order system with different dampings 3. compute steady state error for the given system for any input signal.
MODULE-3
Stability: The concept of stability, Routh's stability criterion, limitations of Routh's stability.(4h) Root locus plot: The root locus concept, construction of root loci, effects of adding poles and zeros to G(s)H(s) on the root loci. (5h)
At the end of the Module 3, students will be able to: 1. Understand various stability issues 2. Apply Routh's stability criteria to given system for stability assessment 3. Draw Root locus plot for the given system
MODULE-4
Frequency Response Analysis :Introduction, Frequency domain specifications, Bode plot, polar plot, Transfer function from the Bode Diagram, Stability Analysis from Bode Plots. Polar Plots, Nyquist Plots. (6h) Compensation Techniques: Lag, Lead, Lag-Lead Compensators.(3h)
At the end of the Module 4, students will be able to: 1. Understand various frequency domain specifications. 2. Draw the Bode plot for the given system. 3. Determine the stability of given system from Bode plot and polar plot
MODULE-5
State Space Analysis Introduction: Concepts of state, state variables and state model, derivation of state models from differential equations, Diagonalization. (5h) Solution of state equation: Solving the Time invariant state Equations, State Transition Matrix and it's Properties. (2h) The concepts of controllability and observability. (2h)
At the end of the Module 5, students will be able to: 1. Understand the importance of state space analysis 2. Find the state model for the given transfer function through various techniques. 3. Determine the controllability and observability of given state model.
Total hours: 48 hours

Term work: Tutorials & quizzes
Content beyond syllabus: **1.** Introduction to P,PI,PID controllers.

2. State space representation of Armature and Field controlled DC motor.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Open Loop and closed loop control systems	CO1	https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm
2	Block diagram rules	CO2	https://www.tutorialspoint.com/control_systems/control_systems_block_diagram_algebra.htm
3	Time response of second order system	CO3	https://www.tutorialspoint.com/control_systems/control_systems_time_response_analysis.htm
4	Routh's stability criteria	CO4	https://www.tutorialspoint.com/control_systems/control_systems_stability_analysis.htm
5	Frequency domain specifications	CO5	https://www.tutorialspoint.com/control_systems/control_systems_frequency_response_analysis.htm
6	Controllability and observability	CO6	https://www.tutorialspoint.com/control_systems/control_systems_state_space_analysis.htm

Text Book(s):

1. " Control Systems Engineering, I. J. Nagrath and M. Gopal, New Age International Publishers, 5th edition, 2007, Reprint 2012.
2. Control Systems by A. Anand Kumar, PHI Learning pvt. Ltd., second edition

Reference Book(s):

1. Norman S. Nise, "Control Systems Engineering", John Wiley & Sons PTE Ltd, 2013
2. 3. Modern Control Engineering, Katsuhiko Ogata, PEARSON, 1st Impression 2015.

Online Resources:

1. http://www.aoengr.com/SampleBook.pdf
2. http://www.ent.mrt.ac.lk/~rohan/teaching/EN5001/Reading/DORFCH1.pdf

Web Resources:

1. https://nptel.ac.in/courses/107/106/107106081/
2. https://www.tutorialspoint.com/control_systems/index.htm
3. https://www.youtube.com/watch?v=XYbrgwKP_6k

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2007	**POWER GENERATION & TRANSMISSION**							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Basic concepts of electrical circuits and theorems

Course Objectives:

1. To understand the Structure, essential components and their layout in thermal power station
2. To study various aspects and issues involved in Nuclear power generation
3. To understand the electrical power generation from renewable energy sources as sun, wind and ocean
4. To understand the Calculation of different transmission line parameters and their use.
5. To understand the various effects in transmission system and Modeling of transmission line
6.

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

CO 1	Understand the working principle and operation of thermal power plant.(BL=2)
CO 2	Understand the working principle and operation of hydro & Nuclear power plant.(BL=2)
CO 3	Understand the working principle and operation of various Renewable energy sources.(BL=2)
CO 4	Analyze and compute the transmission line parameters.(BL=3)
CO 5	Analyze the performance of transmission Lines(BL=3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1	2	2										2	2
CO2	2	2	1										1	2
CO3	2	3											3	2
CO4	3	2											3	2
CO5	2	3	1		1								1	3

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**THERMAL POWER GENERATING SYSTEMS**	**8 hrs**

Importance of electrical power generation-Sources of energy-Conventional and non-conventional sources-Block Diagram of Thermal Power Station (TPS) - Brief Description of TPS Components: Economizers, Boilers, Super Heaters, Turbines, Condensers, Chimney and Cooling Towers-Environmental Impact of Thermal power plants.

At the end of the Module 1, students will be able to:

1. illustrate, the operation of thermal power plant (BL=2)
2. understand the concept and layout of thermal power plant (BL=2)
3. Explain the operation of each component in thermal power plant (BL=2)

MODULE -2	HYDRO & NUCLEAR POWER GENERATING SYSTEMS	8 hrs

Hydro Power: Merits and demerits of hydroelectric power plants, Selection of site. General arrangement of hydel plant, Classification of the plants based on water flow regulation, water head and type of load the plant has to supply. Water turbines – Pelton wheel, Francis, Kaplan and propeller turbines. Underground, small hydro and pumped storage plants.

Nuclear Power Plants: Introduction, Merits and demerits, selection of site, Nuclear reaction, Nuclear fuels, Nuclear plant and layout, Nuclear reactor and its control, Effects of nuclear plants, Disposal of nuclear waste and effluent, shielding.

At the end of the Module 2, students will be able to:

1. Understand the concept of layout and design aspects of hydro &nuclear power plant. (BL=2)
2. Explain the required flow of river water, cost of generation and number of units generated in hydel power generation (BL=2)
3. Illustrate, the operation of nuclear power plant (BL=2)

MODULE-3	RENEWABLE POWER GENERATING SYSTEMS	10 hrs

Solar Power Generation: Introduction, Solar Cell Fundamentals, Solar Cell Characteristics, Solar Cell Classification, Maximizing the Solar PV Output and Load Matching. Maximum Power Point Tracker, Solar PV Systems, Solar PV Applications.

Wind Power Generation: Introduction – Basic principles of wind energy conversion power in the wind-Forces on blades and thrust on turbines

Bio Energy: Introduction – Biomass conversion technologies – Bio gas generation – Factors affecting bio digestion or generation of gas.

At the end of the Module 3, students will be able to:

1. Explain the working principle of PV cell and applications of solar energy. (BL=2)
2. Understand the electric power generation from renewable energy sources like Biomass,Ocean,Geothermal(BL=2)
3. select best renewable energy power generating system (BL=2)

MODULE-4	TRANSMISSION LINE PARAMETERS	10 hrs

Types of Conductors, Resistance For Solid Conductors – Skin Effect- Calculation of Inductance for Single Phase and Three Phase, Concept of GMR & GMD, Symmetrical and Asymmetrical Conductor Configuration with and without Transposition, Numerical Problems, Capacitance Calculations for Symmetrical and Asymmetrical Single and Three Phase, Effect of Ground on Capacitance, Numerical Problems.

At the end of the Module 4, students will be able to:

1. Explain Inductance & Capacitance for given transmission system(BL=2)
2. Understand GMR & GMD for given transmission system(BL=2)
3. Identify the importance of transposition of asymmetrical transmission lines(BL=4)

MODULE-5	PERFORMANCE OF TRANSMISSION LINE	12 hrs

Insulators: Types of Insulators, String Efficiency and Methods for Improvement, and numerical problem.

Corona: Corona Phenomenon, Factors Affecting Corona, Critical Voltages and Power Loss, Radio Interference and numerical problem..

Sag and Tension Calculations: Sag and Tension Calculations with Equal and Unequal Heights of Towers, Effect of Wind and Ice on Weight of Conductor, Stringing Chart, Sag Template and numerical Problems. Classification of Transmission Lines - Short, Medium and Long Lines and Their Exact Equivalent Circuits- Nominal-T, Nominal-π. Mathematical Solutions to Estimate Regulation and Efficiency of All Types of Lines. Long Transmission Line-Rigorous Solution, Evaluation of A,B,C,D Constants, Interpretation of the Long Line Equations
At the end of the Module 5, students will be able to: 1. Understand various factors in transmission system(BL=2) 2. Illustrate the factors affecting corona(BL=2) 3.Illustrate types of Insulators (BL=2)

Total hours:	**48 hours**

Content beyond syllabus:

1. Betz criterion, wind energy Applications.
2. Underground Cables

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	Thermal power plant	https://swayam.gov.in/nd1_noc19_me63/preview
2	Hydro power plant	https://nptel.ac.in/content/storage2/courses/105105110/pdf/m5l01.pdf
3	Renewable energy sources	https://nptel.ac.in/content/storage2/courses/113104058/mme_pdf/Lecture1.pdf
4	Transmission Line Parameters	https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=49 https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=9
5	Performance Of Transmission Line	https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=51 https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=6 https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=13 https://www.youtube.com/watch?v=_iz8ZkjD7z8
6	Modeling of	https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=50

	Transmission Lines	https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=12 https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=14 https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=49

Text Book(s):

1. Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A.Chakraborti, Dhanpat Rai & Co. Pvt. Ltd., 1999
2. Non Conventional Energy Sources by G.D. Rai, Khanna Publishers, 2000.

Reference Book(s):

1. Principles of power systems by V.K.Mehta,Rohith Mehta S.Chand(P), 4th Edition
2. "Generation of Electrical Energy"- by B.R Gupta-S.Chand Publications,6th Edition(Reprint 2014)
3. Electrical Power Systems for Industrial Plants, Kamalesh Das, JAICO Publishing House, 2008.
4. Electrical power systems, C.L.Wadhwa, New Age International (P) Limited, 6th Edition, 2010, Reprint 2014.

Online Resources/ Web References:

1. https://b-ok.asia/book/3429304/c1e86f
2. https://b-ok.asia/book/2729267/f90c96
3. http://www.acadmix.com/eBooks_Download
4. file:///C:/Users/DELL/Downloads/Electric%20Power%20Generation,%20Transmission,%20and%20Distribution%20%20(%20PDFDrive.com%20).pdf
5. http://nptel.ac.in/course
6. https://freevideolectures.com/course/2342/energy-resources-and-technology
7. https://nptel.ac.in/courses/108/102/108102047/
8. https://nptel.ac.in/courses/108/107/108107112/

NARAYANA ENGINEERING COLLEGE:NELLORE

20EE2503	ANALOG ELECTRONIC CIRCUITS AND SIMULATION LAB							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	0	0	2	32	1	40	60	100

Pre-requisite: Basic knowledge on amplifiers and oscillators.

Course Objectives:

1. Analyze amplifiers for frequency response
2. Analyze feedback circuits, amplifier circuits and oscillator circuits
3. Design and construct simple electronic circuits to accomplish a specific function, e.g., designing amplifiers

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

CO 1	Measure various parameters of analog circuits and compare experimental results in the laboratory with theoretical analysis. **(BL-3)**
CO 2	Analyze negative feedback amplifier circuits, oscillators, Power amplifiers, Tuned amplifiers.**(BL-4)**
CO 3	Design analog electronic circuits using discrete components **(BL-3)**
CO 4	Design RC and LC oscillators, Feedback amplifier for specified gain and multistage amplifiers for Low, Mid and high frequencies. **(BL-3)**

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1				1						1				
CO2	2	2			2					1	1			1
CO3	2	2	2	1	2					1	1	1	1	1
CO4			2		2					1	1	1	1	1

1: Low, 2-Medium, 3- High

COURSE CONTENT	CO
Task-1 : COMMON EMITTER AMPLIFIER	
Objective: Design voltage divider based Common Emitter amplifier with discrete components and calculate the bandwidth of amplifier from its frequency response.	CO1
Task-2 : COMMON COLLECTOR AMPLIFIER	
Objective: Design voltage divider based Common collector amplifier with discrete components and calculate the bandwidth of amplifier from its frequency response.	CO 1
Task-3: RC COUPLED AMPLIFIER	
Objective: Design two stage RC coupled amplifier for given specifications. Determine Gain and Bandwidth from its frequency response curve.	CO 1
Task-4: CE-CB CASCODE AMPLIFIER	
Objective: Design CE – CB Cascode amplifier. Determine Gain and Bandwidth from its frequency response curve.	CO 2
Task-5 : VOLTAGE SERIES FEEDBACK AMPLIFIER	
Objective: Design voltage series feedback amplifier for the given specifications. Determine the effect of feedback on the frequency response of a voltage series feedback amplifier.	CO 2
Task-6 : VOLTAGE SHUNT FEEDBACK AMPLIFIER	
Objective: Design voltage shunt feedback amplifier for the given specifications. Determine the effect of feedback on the frequency response of a voltage series feedback amplifier	CO 2
Task-7: CURRENT SHUNT FEEDBACK AMPLIFIER	
Objective: Design and simulate current shunt feedback amplifier for the given specifications using PSPICE /Multisim. Determine the effect of feedback on the frequency response of a current shunt feedback amplifier.	CO 2

Task-8: CURRENT SERIES FEEDBACK AMPLIFIER	
Objective: Design and simulate current Series feedback for the given specifications using PSPICE /Multisim. Determine the effect of feedback on the frequency response of a current series feedback amplifier.	CO 2
Task-9: RC PHASE SHIFT OSCILLATOR	
Objective: Design and simulate RC Phase shift oscillator for the given specification using PSPICE /Multisim. Determine the frequency of oscillation using simulation tool.	CO 4
Task-10 : HARTLEY AND COLPITTS OSCILLATORS	
Objective: Design and simulate Hartley and Colpitts oscillators for the given specifications using PSPICE /Multisim. Determine the frequency of oscillation using simulation tool.	CO 4
Task-11: CLASS-A POWER AMPLIFIER	
Objective: Design and simulate class A power amplifier using PSPICE /Multisim, find out the efficiency and Plot the output waveforms.	CO 2
Task-12: CLASS-B PUSH PULL AMPLIFIER	
Objective: Design and simulate class B push-pull amplifier using PSPICE /Multisim, find out the efficiency and Plot the output waveforms.	CO 2

Additional Experiments:	
Task-13: WEIN BRIDGE OSCILLATOR	
Objective: Design Wien bridge oscillator for the given specification. Determine the frequency of oscillation.	CO 3
Task-14 : MONO STABLE MULTIVIBRATOR	
Objective: Design and simulate Mono Stable Multivibrator for the given specifications using PSPICE /Multisim.	CO 3
Virtual Labs: 1. http://vlabs.iitkgp.ac.in/tcad/exp10/index.html# 2. http://vlab.amrita.edu/index.php?sub=1&brch=201	

Text Book(s):

1. Introduction to PSPICE Using OrCAD for Circuits and Electronics by Rashid Muhammad H
2. PSPICE and MATLAB for electronics: An integrated approach by John o. Attia
3. Fundamentals of Electronic Circuit Design, Getting Started: MultiSim Textbook Edition byDavid J. Comer, Donald T. Comer.

Reference Book(s):

1. A Guide to Circuit Simulation and Analysis Using PSPICE by Paul W. Tuinenga
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory" Pearson/Prentice Hall, 9th Edition, 2006.
3. Sedra A.S. and K.C. Smith, "Micro Electronic Circuits", Oxford University Press, 5th Edition.

Web References:

1. https://nptel.ac.in/courses/122/106/122106025/
2. https://www.tutorialspoint.com/semiconductor_devices/index.htm
3. https://www.allaboutcircuits.com/textbook/semiconductors/

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2504	**INDUCTION MACHINES AND SYNCHRONOUS MACHINES Lab**							R2020
II-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	0	0	3	30	1.5	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To find the performance of induction motor by calculating the efficiency.
2. To find direct and quadrature axis reactances of synchronous motor.
3. To find voltage regulation by using various methods on synchronous machine
4. To determine 'v' and 'inverted v' curves of synchronous motor.
5. To find the efficiency and power factor from circle diagram byconducting no load and blocked rotor test on 3-phase induction motor.

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

CO 1	Find the performance characteristics of the 3-phase induction motor.
CO 2	Draw the direct and quadrature axis reactance and regulation of synchronous machine.
CO 3	To Know the Equivalent Circuit Parameters of a Single Phase Induction Motor
CO 4	To know how to draw circle diagram and determine the electrical parameters by using 3-phase squirrel cage induction motor.
CO 5	Know the voltage regulation of synchronous machine by using Synchronous Impedance Method.
CO 6	Know the voltage regulation of synchronous machine by using M.M.F.Method.
CO 7	Know the voltage regulation of synchronous machine by using ZPF.Method.
CO 8	Know the voltage regulation of synchronous machine by using ASA.Method.
CO 9	To know how to draw the V and Λ curves of synchronous motor
CO 10	Know the separation of losses of the 1-phase transformer.

List of Experiments Prescribed and Conducted:

1. Conduct Brake test on 3-phase induction motor.
2. Determination of Xd and Xq of a Salient Pole Synchronous Machine
3. Equivalent Circuit of a Single Phase Induction Motor
4. Conduct no load and blocked rotor test on 3-phase squirrel cage induction motor
5. Regulation of a Three –Phase Alternator by using Synchronous Impedance Method.
6. Regulation of a Three –Phase Alternator by using M.M.F.Method.
7. Regulation of a Three –Phase Alternator by using ZPF.Method.
8. Regulation of a Three –Phase Alternator by using ASA.Method.
9. Conduct an experiment to draw V and Λ curves of synchronous motor at no load and load conditions.
10. Separation of Core Losses of a Single Phase Transformer.

Total hours: 30 hours

SEMESTER V

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EE2008	PC	Digital Electronics and logic design	3	0	0	3	3	40	60	100
20EE2009	PC	Power Distribution & Distributed Generation	3	0	0	3	3	40	60	100
20EE2010	PC	Power Electronics	3	0	0	3	3	40	60	100
-	OE	Open elective II	3	0	0	3	3	40	60	100
20EE4001 -05	PE	Professional Elective I	3	0	0	3	3	40	60	100
20EE2505	PC	Control Systems and Simulation Lab	0	0	3	3	1.5	40	60	100
20EE2506	PC	Power Electronics & Simulation Lab	0	0	3	3	1.5	40	60	100
20CD6003	SC	Career competency Development III	0	0	2	2	1	40	60	100
20CC6003	SC	Value added course/Certificate Course III	0	1	0	1	1	40	60	100
20EE7501	PR	Internship/skill development Training I	0	0	0	0	1.5	00	100	100
20MC8002-12	MC	Mandatory course III	2	0	0	2	0	00	00	00
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	17	1	11	29	21.5	360	640	1000

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2008	**Digital Electronics & Logic Design**							R2020
III-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Basic knowledge on number system and algebra.

Course Objectives:

To study the basic concepts of number systems and binary codes.

To minimize Boolean expressions using map and Q-M method.

To design combinational and sequential circuits.

To familiarize Registers &counters using Flip-Flops.

To understand the concept of memory organization

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

CO 1	Use number systems, binary codes and Boolean algebra to implement digital circuits. (BL-3)
CO 2	Apply minimization techniques on Boolean expressions. (BL-3)
CO 3	Design combinational circuits using logic gates. (BL-3)
CO 4	Analyze synchronous sequential circuits. (BL-4)
CO 5	Classify the memories & programmable logic devices. (BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	1										1	
CO2	3	3	3	1									1	
CO3	3	3	3	1									1	1
CO4	3	1	2	1									2	1
CO5	2	2											1	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**NUMBER SYSTEMS & BOOLEAN ALGEBRA**	**10 h**

Number Systems: Introduction, Number Systems, Number base conversions, 1's and 2's Complements, BCD code, Excess -3 codes, Gray code, ASCII code, Error Detection and Correction Codes. Boolean Algebra: Basic definition, Basic theorems and properties, Boolean Functions, Canonical & Standard forms, Logic gates, implementation of Boolean functions using logic gates

At the end of the Module 1, students will be able to:

1. List number systems. (BL-1)
2. Illustrate different code conversions. (BL-2)
3. List Theorem's and properties of Boolean algebra (BL-1)
4. Explain the functionality of logic gates(BL-2)

MODULE -2	**SIMPLIFICATION OF BOOLEAN FUNCTIONS**	**10 h**

Introduction, Karnaugh map simplification, Don't care conditions, Prime Implicants, Quine-McCluskey method Simplification, NAND & NOR Implementations, Two Level Implementations.

At the end of the Module 2, students will be able to:

1. Apply basic laws and De Morgan's theorems to simplify Boolean expressions(BL-3)
2. Explain map and Q-M method to minimize Boolean expressions. (BL-2)
3. Implement Boolean expression using universal gates. (BL-3)
4. Implement Boolean expression using two level methods. (BL-3)

MODULE-3	COMBINATIONAL CIRCUITS	9 h
Introduction, Design Procedure, Adders, Sub tractor, Binary Adder-Sub tractor, BCD Adder, Binary Multiplier, Magnitude Comparator, Multiplexers, De-multiplexers, Decoders, Encoders and Code Converters.		
At the end of the Module 3, students will be able to: 1. Design combinational logic circuits. (BL-3) 2. Implement Boolean expression using multiplexer. (BL-3) 3. Implement higher order MUX using lower order MUX.(BL-3) 4. Design code converters using gates. (BL-3)		
MODULE-4	**SEQUENTIAL CIRCUITS**	**10 h**
Introduction, Latches, Flip-flops, Master-slave flip flops, Edge-triggered flip-flops, Flip-Flop conversions, Design of Synchronous Sequential Circuits: State Equations, State Table, State reduction, State assignment, State diagram , Mealy and Moore machine models, Registers, Shift Registers, Counters: Synchronous counters, Asynchronous counters & other counters.		
At the end of the Module 4, students will be able to: 2. Describe behavior of latches & flip flops. (BL-2) 3. Analyze the flip-flop conversions(BL-3) 4. Analyze synchronous sequential circuits. (BL-3) 5. Explain the design procedure of sequential circuits(BL-2) 6. Design synchronous sequential circuits using state reduction & assignment process. (BL-3)		
MODULE-5	**MEMORY &PROGRAMMABLE LOGIC DEVICES**	**9 h**
Introduction, Random Access Memory, Types of RAM, Memory decoding, Read Only Memory, Types of ROM, Flash memory, Programmable Logic Devices (PLDs): Basic concepts, Programmable Read Only Memory (PROM), Programmable Array Logic (PAL) and Programmable Logic Array(PLA).		
At the end of the Module 6, students will be able to: 1. Explain PROM, PAL and PLA. (BL-2) 2. Compare digital logic families. (BL-2) 3. Illustrate the characteristics of digital IC's . (BL-2)		
	Total hours:	**48 hours**

Content beyond syllabus:

1. Representation of signed & unsigned binary numbers in digital computer
2. Binary subtraction operation using 1's and 2's complement methods in digital circuits

Self-Study:

Contents to promote self-Learning:

SNO	Module	Reference
1	Number systems	https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
2	Simplification of Boolean functions	https://www.electrical4u.com/simplifying-boolean-expression-using-k-map/ https://www.electronicshub.org/k-map-karnaugh-map
3	Combinational circuits	https://www.allaboutcircuits.com/textbook/digital/
4	Sequential Circuits	https://www.electronics-tutorials.ws/sequential/seq_1.html https://technobyte.org/counters-up-down-synchronous-asynchronous/
5	Programmable logic devices	https://www.tutorialspoint.com/digital_circuits/digital_circuits_programmable_logic_devices.htm

Text Book(s):

1. M. Morris Mano, M.D. Ciletti, "Digital Design", 5th edition, Pearson, 2018.
2 John F Wakely Digital Design Principles And Practices, Pearson Publication , Fourth edition
3 Anil K. Maini, "Digital Electronics: Principles, Devices and Applications", Willey, 2007

Reference Book(s):

1. Anand Kumar, Switching Theory and Logic Design, PHI,2008
2. John. M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2006.
3. R. P. Jain, "Modern Digital Electronics", 4th edition, McGraw Hill Education (India Private Limited), 2012.

Online Resources / Web References:

1. https://nptel.ac.in/courses/108/105/108105113/ (IIT- Kharagpur – digital Circuits)
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-004-computation-structures-spring-2017/c4/
3. https://nptel.ac.in/courses/106/105/106105185/(IIT- Kharagpur – Switching Circuits and Logic Design)
4. https://www.researchgate.net/publication/264005171_Digital_Electronics
5. https://www.academia.edu/37445384/Anil_K._Maini_Digital_Electronics_Principles_01.04.16.pdf
6. https://intuitionke.weebly.com/uploads/1/1/8/2/118271274/digital_principles_switching_theory.pdf
7. https://www.javatpoint.com/digital-electronics

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2009	POWER DISTRIBUTION & DISTRIBUTED GENERATION							R2020
III-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	PD&DG	TOTAL
I-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To illustrate the Necessity of distributed generation
2. To Understand different renewable energy sources
3. To Understand the control aspects & Power quality issues of DG's
4. To understand the structure of Electrical distribution system and various factors
5. To understand the technical issues of substations such as location, ratings & Bus bar arrangements

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

CO 1	**Compare the advantages & disadvantages** of various distributed generation**.**
CO 2	**Describe various Distributed Generation systems, Micro-grid** and storage devices
CO 3	**Illustrate the Economic and control aspects** of DGs
CO 4	**Analyze the different load characteristics, distribution factors & Modelling** of distribution system.
CO 5	**Design of Distribution Feeders, Voltage Drop and power loss** in D.C Distributors.

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	2								3	2
CO2	2	3	2	2	2								3	2
CO3	3	3	2	2	2								3	2
CO4	2	2	2	2	2								3	2
CO5	2	2	2	2	2								3	2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

Need for Distribution Generation

Distributed generation, features and operations, advantages and disadvantages of DG, Comparison among the DG Technologies, Non conventional and renewable energy sources. Grid Interconnection-Standards of interconnection, Recent trends in power electronic DG interconnection.

At the end of the Module 1, students will be able to:

1. Understand the advantages & disadvantages of various DGs
2. Understand the Grid Interconnection
3. Identify the recent trends in power electronic DG interconnection

MODULE -2

Distribution Generation Resources

Introduction - Solar photovoltaic (PV) systems, Photovoltaic power characteristics – Wind energy conversion systems (WECS), power curve, power coefficient, wind energy distribution, Biomass Power, Fuel cells types, types of Tidal power generation schemes, mini and micro hydro power schemes - Storage devices: Batteries Storage, ultra-capacitors, flywheels Control of Micro grids.

At the end of the Module 2, students will be able to:

1. Understand the fundamentals of Various DG sources
2. Illustrate various types of storage devices related to DGs

MODULE-3

Economic and control aspects of DGs

Market facts, issues and challenges – Limitations of DGs – Voltage control techniques, Reactive power control, Harmonics, Power quality issues – Reliability of DG based systems – Steady state and Dynamic analysis.

At the end of the Module 3, students will be able to:

1. Understand various voltage & reactive power control techniques
2. Understand Power quality issues & Reliability of DG based systems

MODULE-4

INTRODUCTION TO ELECTRICAL DISTRIBUTION SYSTEMS

Introduction to Distribution Systems, Coincidence Factor, Contribution Factor, Relationship between the Load Factor and Loss Factor, Classification of Loads (Residential, Commercial, Agricultural and Industrial), Load Modeling and Characteristics

POWER FACTOR IMPROVEMENT: Causes of Low P.F -Methods of Improving P.F

At the end of the Module 4, students will be able to:

1. Understand the structure of Electrical Distribution System
2. Understand various factors associated with Distribution system
3. Understand the modeling of various types of Loads

MODULE-5

CLASSIFICATION & DESIGN FEATURES OF DISTRIBUTION SYSTEM

Classification of Distribution Systems - Comparison of DC & AC and Under-Ground & Over -Head Distribution Systems. Voltage Drop and power loss in D.C Distributors.

SUBSTATIONS AND BUSBAR ARRANGEMENT

Location of Substations, Classification of Substations, Single Bus Bar, Sectionalized Single Bus Bar, Main and Transfer Bus Bar, One and Half Breaker System.

At the end of the Module 5, students will be able to:

1. Compare DC vs AC and Under-Ground vs Over - Head Distribution Systems
2. Understand the benefits derived through Optimal Location of Substations
3. Understand Various Bus bar arrangements in Substations

Total hours:	**48 hours**

Term work:

Field work to EHV Substation, Wind & Solar Power plants/ Tutorials/ Quiz's

Content beyond syllabus:

1. Distribution Automation

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Distributed Generation	CO1	https://www.dg.history.vt.edu/ch1/introduction.html
2	Wind Energy Conversion system	CO2	https://www.dg.history.vt.edu/ch2/conversion.html https://www.dg.history.vt.edu/ch2/storage.html
3	Reliability of DG system	CO3	https://b-ok.asia/book/2941113/af547e
4	Distribution Systems	CO4	**https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=49** **https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=9**
5	Classification & Design of DS	CO5	**https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=51** **https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=6** **https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=13** **https://www.youtube.com/watch?v=_iz8ZkjD7z8** **https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=50** **https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=12** **https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=14** **https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=49**

Text Book(s):

1. H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. G. Masters, Renewable and Efficient Electric Power Systems, IEEE- John Wiley and Sons Ltd. Publishers, 2nd Edition, 2013.
3. Electric Power Distribution Engineering, Turan Gonen, CRC Press, 3rd Edition,2014.
4. Electric Power Distribution, A.S. Pabla, Tata Mc Graw Hill (India) Pvt. Ltd., 6th Edition, 2011.

Reference Book(s):

1. "Fundamentals of renewable energy systems "by D.Mukherjee, S.Chakrabarti, New Age International Publishers.
2. Electrical Power Distribution Systems, V. Kamaraju, Jain Book Depot. 2012.
3. Electrical Power Systems for Industrial Plants, Kamalesh Das, JAICO Publishing House, 2008.

Online Resources:

1. https://b-ok.asia/book/1117604/f01d10
2 https://b-ok.asia/book/2729267/f90c96

Web Resources:

1. https://nptel.ac.in/courses/108/102/108102047/
2.https://nptel.ac.in/courses/108/107/108107112/
3. https://www.youtube.com/watch?v=ptiaNGkuylY

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2010	POWER ELECTRONICS							R2020
III-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To understand the various applications of Power electronic devices for conversion, control and conditioning of the electrical power and to get an overview of different types of power semiconductor devices and their dynamic characteristics.
2. To understand the operation, characteristics and performance parameters of controlled rectifiers
3. To study the operation, switching techniques and basics topologies of DC-DC switching regulators
4. To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.

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

CO 1	**Describe the operation** of power semiconductor devices
CO 2	**Illustrate the construction and operation** of silicon controlled rectifier
CO 3	**Analyze the various uncontrolled rectifiers and design suitable** filter circuits
CO 4	**Demonstrate** the operation of the DC-DC converters and inverters
CO 5	**Summarise the operation** of AC controllers.

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3										3	2
CO2	3	2	3										3	2
CO3	3	2	3										3	2
CO4	3	2	3										3	2
CO5	3	2	3										3	2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

Power Semiconductor Devices

Concept of power electronics, application of power electronics, advantages and disadvantages of power electronics converters, power diodes, power transistors, power MOSFETS, IGBT and GTO, uncontrolled converters.

At the end of the Module 1, students will be able to:

1. Discuss the concept, applications, advantages and disadvantages of power electronics
2. understand the switching phenomenon of various power semiconductor devices

MODULE -2

Silicon Controlled Rectifier:
Thyristors, brief description of members of Thyristor family with symbol, V-I characteristics and applications of SCR. Two transistor model of SCR, SCR turn on methods, switching characteristics, ratings, gate triggering circuits, different commutation techniques of SCR.

At the end of the Module 2, students will be able to:

1. understand the switching phenomenon of various members of thyristor family
2. Examine the characteristics, turn on & off methods, ratings & protection of SCR

MODULE-3

Phase controlled converters:
Principle of operation of single phase and three phase half wave, half controlled, full controlled converters with R, R-L and RLE loads, effects of freewheeling diodes and source inductance on the performance of converters.

At the end of the Module 3, students will be able to:

1. Understand the operation of single phase and three phase converters with all possible loads
1. Examine the behaviour of dual converter
3. Analyze the performance parameters of converters

MODULE-4

DC-DC converters and Inverters
Principle of operation, control strategies, step down & step up choppers, types of choppers circuits based on quadrant of operation & commutation technique, Definition, classification of inverters based on nature of input source, wave shape of output voltage, Principle of operation of single phase and three phase bridge inverter with R and R-L loads,

At the end of the Module 4, students will be able to:

1. Explain the control strategies and operation of different choppers
2. Describe the performance of all types choppers.
3. Analyze the performance parameters of inverters.

MODULE-5

AC controllers:
Principle of on-off and phase control, single phase and three phase AC Voltage controllers with R and R-L loads. Principle of operation of cycloconverters, single phase to single phase step up and step down cycloconverters.

At the end of the Module 6, students will be able to:

1. Differentiate between AC Voltage controllers and cycloconverters
2. Explain the operation of AC Voltage controllers and cycloconverters

Total hours:	**48 hours**

Term work:

Content beyond syllabus:

1. Three phase cycloconverters

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	IGBT	CO1	https://www.youtube.com/watch?v=ekSbhm4l0Go
2	Commutation techniques of SCR	CO2	https://www.youtube.com/watch?v=mf-97ZXrOz0 https://www.youtube.com/watch?v=h7cu27etdmg https://www.youtube.com/watch?v=WX5G0RHozAs https://www.youtube.com/watch?v=d4sbVc-r7I4
3	Three phase converters	CO3	https://www.youtube.com/watch?v=VYmd3KKfCQQ
4	Switching mode regulators	CO4	https://www.youtube.com/watch?v=Q7cTuZIH8IA https://www.youtube.com/watch?v=I0ZbC7uCe9A https://www.youtube.com/watch?v=YiYQjdARZ7I
5	Resonant Pulse inverters	CO5	https://www.youtube.com/watch?v=AISpcLLiOPA

Text Book(s):

1. Power Electronics, M.D. Singh and K.B. Khanchandani, Tata Mc Graw Hill. 2007
2. Power Electronics, M.H. Rashid, PHI, 3rd Edition
4. Power Electronics, P.S. Bhimra, Khanna Publishers, 3rd Edition.

Reference Book(s):

1. Modern Power Electronics & AC drives, B.K. Bose, Prentice Hall
2. Power Electronics, V.R. Moorthi, Oxford, 2005
3. Power Electronics, Mohan,Undeland & Riobbins, Wiley India
4. Element of power Electronics, Phillip T Krein, Oxford, 2007

Online Resources:

1. https://books.google.co.in/books?id=0_D6gfUHjcEC&printsec=frontcover#v=onepage&q&f=false
2. https://nptel.ac.in/courses/108/105/108105066/

Web Resources:

1.https://www.youtube.com/watch?v=ZbvWe9xBu3Q&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO
2. https://www.youtube.com/watch?v=1Auay7ja2oY&list=PLA07ACBDE053A8229

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2505	**Control systems & Simulation Lab**							R2020
III-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	CSS	TOTAL
I-Semester	0	0	3	30	1.5	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To provide practical knowledge for Time response of second order system
2. Determine of transfer functions of various systems and control of it by different Methodologies
3. The characteristics of Magnetic Amplifier, servo mechanisms which are helpful in automatic control systems
4. Determine the stability analysis of different system by using PSPICE and MATLAB
5. To study the closed loop performance for the given plant using P, PD, PI, PID Controllers.
6. The design of controllers/compensators to achieve desired specifications.

CO 1	Determine the transfer functions of various system
CO 2	Analyse the knowledge about the effect of poles and zeros location on transient and steady state behaviour of second order systems and can implement them to practical systems
CO 3	Model the systems and able to design the controllers and compensators
CO 4	Get the Practical Knowledge for Time response of second order systems
CO 5	Determine the performance and time domain specifications of first and second order systems
CO 6	Determine the stability analysis of different system by using PSPICE and MATLAB

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	2						2	2				
CO2	3	2	2						2	2				
CO3		2		2					2	2				
CO4	2			2	1				2	2		1		
CO5			2						2	2				2
CO6				2					2	2				2

1: Low, 2-Medium, 3- High

List of Experiments

Any Ten of the following experiments are to be conducted:

1. Time Response of Second Order System
2. Characteristics of Synchro pair
3. Characteristics of AC Servo Motor

4. Characteristics of DC Servo Motor
5. Transfer Function of DC Machine
6. Characteristics of Magnetic Amplifiers
7. Lag and Lead Compensation – Magnitude and Phase Plot
8. Effect of P, PD, PI, PID Controller on a Second Order System.
9. Temperature Controller Using PID
10. Programmable Logic Controller – Study and Verification of Truth Tables of Logic Gates, Simple Boolean Expressions and Application of Speed Control of Motor.
11. Characteristics of Magnetic Amplifier
12. Simulation of transfer functions using operational amplifier

Any two simulation experiments are to be conducted:

1. PSPICE Simulation of Op-Amp Based Integrator and Differentiator Circuits.
2. Linear System Analysis (Time Domain Analysis, Error Analysis) Using MATLAB.
3. Stability Analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant System Using MATLAB
4. State Space Model for Classical Transfer Function Using MATLAB – Verification.

Total hours:	**36hours**

Term work:

Lab seminars

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Time response of second order system	CO1	https://www.tutorialspoint.com/control_systems/control_systems_time_response_analysis.htm
2	Synchro Pair	CO2	https://circuitglobe.com/synchro.html
3	AC & DC Servo Motor	CO3	https://circuitglobe.com/servo-motor.html
4	Transfer function of DC Machine	CO4	https://www.eeeguide.com/transfer-function-of-a-field-controlled-dc-motor/

5	Magnetic amplifiers	CO5	http://www.tubebooks.org/Books/mag_amp.pdf

Text Book(s):

1 . Simulation of Electrical and electronics Circuits using PSPICE - by M.H Rashid, M/S PHI Publications.
2. PSPICE A/D user's manual --Microsim USA
3. MATLAB and its Tool Books yser's manual and - Mathworks, USA

Reference Book(s):

1.. PAPICE reference guide -Microsim, USA

Online Resources:

1.http://www.acadmix.com/eBooks_Download
2.

Web Resources:

1. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/2017/Control-lab-manual-final.pdf

NARAYANA ENGINEERING COLLEGE:NELLORE

20EE2506	**Power Electronics Lab**							R2020
III-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	0	0	3	30	1.5	40	60	100

Pre-requisite: Basic of Electrical circuit

Course Objectives:

The objectives are to study:

1. The characteristics of power electronic devices with gate firing circuits
2. Various forced commutation techniques
3. The operation of single-phase voltage controller, converters and Inverters circuits with R and RL loads
4. Analyze the TPS7A4901, TPS7A8300 and TPS54160 buck regulators

List of Experiments

PART A

1. Single Phase AC Voltage Controller with R and RL Loads
2. DC Jones Chopper with R and RL Loads
3. Forced Commutation Circuits (Class A, Class B, Class C, Class D and Class E)
4. Buck Convertor
5. Single Phase Parallel Inverter with R and RL Loads
6. Single Phase Series Inverter with R and RL Loads
7. Single Phase Dual Converter with RL Loads
8. Illumination control / Fan control using TRIAC

NI Multisim Simulation Experiments:

1. Simulation of Single Phase Half Controlled Converter
2. Simulation of Single Phase Fully Controlled Converter
3. Simulation of PWM Inverter
4. Simulation of Single Phase AC Voltage Controller

Course Outcomes:

At the end of the course, students will be able to

1. The student will analyze the characteristics of power semiconductor devices & P Spice Simulation.
2. To Perform Laboratory Experiments practically.
3. To carry out laboratory experiments on simulation & Kits.

Text Books

1. Muhammad H. Rashid, Introduction to PSPICE using OrCAD for Circuits and Electronics, Pearson Education, 3rd Edition, 2003.
2. Simulation of Power Electronic Circuits by M. B. Patil , M. C. Chandorkar , V. Ramanarayanan , V.T. Ranganathan.

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	2			2				2	2			3	2
CO2	2	3			2				2	2			3	2
CO3	3	3			2				2	2			3	2

1: Low, 2-Medium, 3- High

SEMESTER VI

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EE2011	PC	Electrical Measurements & Instrumentation	2	0	0	2	2	40	60	100
20EE2012	PC	Modern Power System Analysis	3	0	0	3	3	40	60	100
20EE2013	PC	Switch Gear and Protection	3	0	0	3	3	40	60	100
-	OE	Open Elective III	3	0	3	3	3	40	60	100
20EE4006 -10	PE	Professional Elective II	3	0	0	3	3	40	60	100
20EE4011 -15	PE	Professional elective III	3	0	0	3	3	40	60	100
20EE2507	PC	Measurements & Instrumentation Lab	0	0	2	2	1	40	60	100
20EE2508	PC	Power Systems Lab	0	0	3	3	1.5	40	60	100
20CD6004	SC	Career competency Development IV	0	0	2	2	1	40	60	100
20CC6004	SC	Value added course/Certificate course IV	0	1	0	1	1	40	60	100
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	17	1	13	28	21.5	400	600	1000

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2011	**Electrical Measurements and Instrumentation**							R2020
III-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	2	0	0	32	2	40	60	100
Pre-requisite: Nil								
Course Objectives: **1.** The basic principles of different types of electrical instruments for the Measurement of voltage, current, power factor, power and energy. **2.** The measurement of R, L, and C parameters using bridge circuits. 3. The principles of magnetic measurements. 4. The use of Current Transformers, Potential Transformers, and Potentiometers.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	**Describe** the concepts and principles of Measuring Instruments to measure voltage and current.							
CO 2	**Analyze** the working principles of single and three phase wattmeters & energy meter to measure power and energy in circuits.							
CO 3	**Demonstrate** the concepts and principles of AC and DC bridges to evaluate resistance, inductance and Capacitance for AC and DC Circuits.							
CO 4	**Demonstrate** the operating principles of instrument transformers and potentiometer to measure unknown voltage, Current & Resistance in circuits.							
CO 5	**Identify** the physical variables to describe operating principle of the transducers.							

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	2										3	2
CO2	3	3	2										3	2
CO3	3	3	2										3	2
CO4	3	3	2										3	2
CO5	3	3	2										3	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT
MODULE – 1
Measurement of voltage & current General principles of measurements –essentials of indicating instruments - deflecting, damping, controlling torques-Ammeters and voltmeters - moving coil, moving iron, constructional details, operation, Expression for deflecting & controlling torques and errors compensations- principles shunts and multipliers – extension of range.
At the end of the Module 1, students will be able to: 1. Understand the basic principles of different types of electrical instruments for the Measurement of voltage, current 2. Use the MI & MC instruments 3. Extend the range of ammeters and voltmeters 4. Understand the working and applications of cathode ray oscilloscope.

MODULE -2

Measurement of Power, Energy, Power factor

power meters :Dynamometer type wattmeter –1-phase and 3-phase - LPF and UPF- Double Element and Three Element wattmeter's.

Energy meters : Single Phase Induction Type Energy Meter – Driving and Braking Torques – Errors and Compensations. Three Phase Energy Meter-TOD meter

P.F. Meters : Dynamometer and Moving Iron Type – 1-ph and 3-ph Meters.

At the end of the Module 2, students will be able to:

1. Illustrate the working principle of wattmeter, energy meter
2. Measure active power, reactive power, power factor, and energy in both 1-phase and 3-phase circuits
3. To have an adequate knowledge in the measurement techniques for power ,energy

MODULE-3

Measurement of Resistance, Inductance and Capacitance

Measurement of Resistance: Kelvin's double bridge -Whetstone's bridge, sensitivity, limitations- loss of charge method -Megger method.

Measurement of Inductance and Capacitance*:* Maxwell's inductance and capacitance bridge-Hay's bridge-Anderson's bridge- Desauty's bridge -Schering bridge-weins bridge- Problems

At the end of the Module 3, students will be able to:

1. Measurement of R, L, and C parameters using bridge circuits
2. able to measure resistance ,inductance & capacitance using appropriate bridges

MODULE-4

Extension of Instrument Ranges

Instrument transformers*:* Current Transformers and Potential Transformers – Ratio and Phase Angle Errors – Methods for Reduction of Errors-Design Considerations.

Potentiometers: Principle and Operation of D.C. Crompton‟s Potentiometer – Standardization – Measurement of unknown Resistance, Current, Voltage -AC Potentiometers: Polar and Coordinate types-Standardization – Applications.

At the end of the Module 4, students will be able to:

1. Use CTs and PTs for measurement of very large currents and high voltages
2. Ability to measure current and voltage using potentiometric method.
3. Analyse the concept of extension of range of meters used in electrical measurements.

MODULE-5

TRANSDUCERS

Definition and classification - common transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain and temperature -LVDT, electromagnetic and ultrasonic flow meters, piezoelectric force transducer, load cell, strain gauge- bridge configuration for four strain gauges, RTD, Thermistors,thermocouple,

Need for instrumentation system, data acquisition system.

At the end of the Module 6, students will be able to:

1. Identify the transducers for physical variables and to describe operating principle
2. understand the various electrical measuring instruments

Total hours:	**32 hours**

Term work:

Term work shall consist of report on substation where various measuring instruments can be observed , ,seminars and practical session based on syllabus.

Content beyond syllabus:

1. Miscellaneous Measuring Instruments: Maximum demand indicators

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	PMMC INSTRUMENT	CO1	https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_dc_voltmeters.htm
2	ENERGY METER	CO2	https://circuitglobe.com/energy-meter.html
3	DC & AC BRIDGES	CO3	https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_dc_bridges.htm
4	POTENTIOMETER	CO4	https://www.youtube.com/watch?v=i05A2sfO7Xc&list=PL227ZNwByTlTGq1atJsFst_qnEptI870O&index=33
5	TRANSDUCERS	CO5	https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_transducers.htm

Text Book(s):

1. Electrical & Electronic Measurements and Instrumentation by AK Sawhney, Dhanpat Rai & Sons Digital Instrumentation, A.J. Bouwens, Tata Mc-Graw hill.
2. J. B. Gupta - A course in Electronic and Electrical measurements and Instrumentation, S. K. Kataria Publication
3. Electrical Measurements & Measuring Instruments by M.L.Anand (Author)

Reference Book(s):

1. E. W. Golding - Electrical & Electronic Measurements & Instrumentation
2. A. D. Helfrick and W.D. Cooper- Modern Electronic Instrumentation and Meas. Techniques

Online Resources:

1. https://b-ok.asia/book/2563619/2f98e0
2. https://civildatas.com/download/electronic-and-electrical-measuring-instruments-machines-by-bakshi
3. https://books.google.co.in/books?id=Q6uBCgAAQBAJ&pg=PA9&lpg=PA9&dq=measurements+for+today&source=bl&ots=oXNqMKSLxk&sig=ACfU3U2cEvMiC6pSV205CRFO3WM8vC1HMQ&hl=en&sa=X&ved=2ahUKEwjNq6Lsx4_qAhXlQ3wKHaM4DZ0Q6AEwD3oECAgQAQ#v=onepage&q=measurements%20for%20today&f=false

Web Resources:

1. https://nptel.ac.in/courses/108/105/108105153/
2. http://www.instrumentationtoday.com/
3. https://www.youtube.com/watch?v=n1MinLtvnPY&list=PL227ZNwByTlTGq1atJsFst_qnEptI870O&index=2

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2012	MODERN POWER SYSTEM ANALYSIS							R2020
III-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. Discuss the power system network matrices, formation of Y_{Bus} and Z_{Bus}
2. Calculation of power flow in a power system network using various techniques
3. Discuss the Short Circuit Analysis
4. Examine the Power system stability

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

CO 1	Discuss the Representation of power system matrices with formation of Y_{BUS} .
CO 2	Describe the Representation of power system matrices with formation of Z_{BUS} .
CO 3	Apply the concepts of algorithm for the given power system network.
CO 4	Analyse the symmetrical faults and unsymmetrical faults of a power system network.
CO 5	Develop the steady State, Dynamic and Transient Stabilities for a power system.

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3								3	3
CO2	3	3	3	3	3								3	3
CO3	3	3	3	3	3								3	2
CO4	3	3	3	3	3								3	2
CO5	3	3	3	3	3								3	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT

MODULE – 1

P.U SYSTEM AND Y_{bus} FORMATION

Per-Unit representation of Power system elements - Per-Unit equivalent reactance network of a three phase Power System - Graph Theory: Definitions, Bus Incidence Matrix, YBus formation by Direct and Singular Transformation Methods, Numerical Problems.

At the end of the Module 1, students will be able to:

1. Discuss the Matrices, construction of primitive network element
2. Formation of Y_{BUS} by using different methods
3. Discuss the Per Unit Quantities

MODULE -2

Formation of Z_{Bus}: Partial network, Algorithm for the Modification of Z_{Bus} Matrix for addition element for the following cases: Addition of element from a new bus to reference, Addition of element from a new bus to an old bus, Addition of element between an old bus to reference and Addition of element between two old busses - Modification of $Z_{Bus}$for the changes in network (Problems)

At the end of the Module 2, students will be able to:

1. Formation of Z_{BUS} and Algorithm for the Modification of $Z_{BUS.}$
2. Explain the concept of Zbus.
3. Understand the Modification of $Z_{Bus}$for the changes in network

MODULE-3

POWER FLOW ANALYSIS

Static load flow equations – Load flow solutions using Gauss Seidel Method: Algorithm and Flowchart. Acceleration Factor, Load flow Solution for Simple Power Systems (Max. 3-Buses): Newton Raphson Method in Polar Co-Ordinates Form: Load Flow Solution- Jacobian Elements, Algorithm and Flowchart. Decoupled and Fast Decoupled Methods.- Comparison of Different Methods

At the end of the Module 3, students will be able to:

1. Describe the Load Flow studies by using different methods
2. Discuss the Comparison of Different Methods

MODULE-4

SHORT CIRCUIT ANALYSIS

Short Circuit Current and MVA Calculations, Fault levels, Application of Series Reactors. Symmetrical Component Theory: Positive, Negative and Zero sequence components, Positive, Negative and Zero sequence Networks. Symmetrical Fault Analysis: LLLG faults with and without fault impedance, Unsymmetrical Fault Analysis: LG, LL and LLG faults with and without fault impedance, Numerical Problems.

At the end of the Module 4, students will be able to:

1. Describe e the Equivalent Reactance Network of a Three Phase Power System.
2. Listen the Symmetrical fault Analysis and Unsymmetrical Fault Analysis.

MODULE-5

STABILITY ANALYSIS

Elementary concepts of Steady State, Dynamic and Transient Stabilities. Derivation of Swing Equation, Power Angle Curve and Determination of Steady State Stability. Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation.
Numerical methods for solution of swing equation - Methods to improve Stability - Application of Auto Reclosing and Fast Operating Circuit Breakers.

At the end of the Module 5, students will be able to:

1. Describe the Power system stabilities
2. Examine the Swing Equation
3. Distinguish the Equal Area Criterion

Total hours: 48 hours

Term work:

Field work of load flow in power system

Content beyond syllabus:

1. knowledge of Multi machine stability in power system.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Representation of	CO1	http://175.101.102.82/moodle/mod/folder/view.php?id=17046

		power System Network Matrices		
	2	Load Flow Studies	CO2	http://175.101.102.82/moodle/mod/folder/view.php?id=17046
	3	Newton Raphson Method	CO3	http://175.101.102.82/moodle/mod/folder/view.php?id=17046
	4	Short Circuit current and MVA Calculations	CO4	http://175.101.102.82/moodle/mod/folder/view.php?id=17046
	5	Power system Stabilities	CO5	http://175.101.102.82/moodle/mod/folder/view.php?id=17046

Text Book(s):

1. Elements of power systems analysis by W D Stevenson Jr Fourth Edition TMH International students edition
2. Modern power system analysis by D.P.Kothari and I.J.Nagrath , TMH 3rd Edition
3. Electrical power systems by C.L. Wadhwa , New age International (P) Limited
4. Power system Analysis by TK Nagasarkar and Sukhija , Oxford press

Reference Book(s):

1. Power System Stability by Kimbark vol - I willey Publications, Inc
2. Power system Stability and control by P. Kundur , TMH
3. A.R. Bergen and V.vittal; "Power system Analysis", Pearsib Publication

Online Resources: http://175.101.102.82/moodle/course/view.php?id=693

1.http://www.acadmix.com/eBooks_Download
2. https://nptel.ac.in/courses/108105067/
3.https://nptel.ac.in/course.html

Web Resources: http://175.101.102.82/moodle/course/view.php?id=693

1. https://lecturenotes.in/subject/482/power-system-analysis-psa/note
2.https://www.youtube.com/watch?v=j44kQiphUB4&list=PL1XaeVNXKsvwkfUAGQiUuqWBswJ4VM3Ed
3.https://www.youtube.com/watch?v=-bX0k5Dlwek&list=PLgzsL8klq6DJv0G1l7ji4OI8BTXgEADfP
4.https://www.youtube.com/watch?v=tb3gCr9m0LU&list=PLtcRcIUOKppXWUMEVXGwwULXgzEBygOK-
5.https://www.youtube.com/watch?v=fBm1dr_gRBk&list=PL36A60B630E8C7B56
6. https://www.youtube.com/watch?v=NfnrupJ0BwY&list=PLfDaOYdi9aZyO2oYhr7G9DYMhoFmqS4A1

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2013	**Switch Gear & Protection**							R2020
III-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	PSP	TOTAL
II-Semester	3	0	0	48	3	40	60	100
Pre-requisite: Nil								
Course Objectives: 1. To Learn in detail about Switch gear Protective equipments 2. To Learn about the technical aspects involved in the operation of Circuit Breakers 3. To Learn about Basic Requirements of Protective Relays 4. To Learn different types Relays & Applications								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	**Demonstrate** the operation of different types of Circuit Breakers							
CO 2	**Describe** the operation & application of various types of protective relays.							
CO 3	**Compare** the different types of comparators.							
CO 4	**Analyze** the various protection schemes of various power system components like alternators, transformers and bus-bars.							
CO 5	I**llustrate** the various methods of over voltage protection in power systems							

CO-PO Mapping													
CO	**PO**											**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2											3	2
CO2	3	2											3	2
CO3	3	2											3	2
CO4	3	2											3	2
CO5	3	2											3	2
1: Low, 2-Medium, 3- High													

COURSE CONTENT
MODULE – 1
CIRCUIT BREAKERS: Circuit Breakers: Arc Phenomenon, Methods of Arc Interruption, Restriking and Recovery Voltage - Restriking Phenomenon, RRRV, Current Chopping and Resistance Switching. Constructional features & Principle operation of Minimum Oil Circuit Breakers, Air Blast Circuit Breakers, Vacuum and SF6 Circuit Breakers, Ratings of CB's, Auto Reclosure's.
At the end of the Module 1, students will be able to: 1. Understand the constructional features & principle of operation of various Circuit Breakers 2. Identify applications of various Circuit Breakers in real time. 3. Understand the concept of Auto Reclosing of Circuit Breakers
MODULE-2
PROTECTIVE RELAYS: Basic Requirements of Protective Relays-Primary and Backup Protection **CLASSIFICATION OF RELAYS-I :** Types of Electromagnetic Relays, Over current Relays, Directional & Non Directional Relays

At the end of the Module 2, students will be able to:

1. Understand the basic requirements of protective relay
2. Understand the applications of Electromagnetic, Over current Relays in real time
3. Identify the difference between Directional & Non Directional Relays

MODULE-3

CLASSIFICATION OF RELAYS-II: Differential Relays, Distance Relays, Static Relays-Advantages & Disadvantages, Microprocessor Based Relays-Advantages & Disadvantages, Universal Relay Torque equation.

COMPARATORS: Amplitude and Phase Comparators

At the end of the Module 3, students will be able to:

1. Understand the applications of Differential, Distance Relays in real time
2. Identify the difference between Static Relays, Microprocessor Based Relays
3. Explain the Universal Relay Torque equation

MODULE-4

GENERATOR PROTECTION: Protection of Generators against Stator Faults, Rotor Faults and Abnormal Conditions, Numerical Problems on percentage winding unprotected.

TRANSFORMER PROTECTION: Differential Protection, Buccholz Relay Protection, Numerical Problems on Design of CT Ratio.

FEEDER PROTECTION: Protection of Feeder (Radial & Ring Main) Using Over Current Relays, Protection of Transmission Line – Three Zone Protection Using Distance Relays.

At the end of the Module 4, students will be able to:

1. Understand various faults occurring in Generator, Transformer.
2. Explain the Protective schemes for Generator, Transformer & Feeder.
3. Compute the Percentage of winding unprotected.

MODULE-5

NEUTRAL GROUNDING: Advantages, Types of Neutral Grounding

OVER VOLTAGE PROTECTION: Causes of Over Voltages in Power Systems.-Phenomenon of Lightning, Protection against Lightning Over Voltages, Lightning Arresters –Rod Gap, Horn Gap, Valve Type and Zinc-Oxide Lighting Arresters.

At the end of the Module 5, students will be able to:

1. Understand the advantages of Neutral Grounding.
2. Understand the causes of over voltages in power systems.
3. Explain the phenomenon of Lightning.

Total hours:	**48 hours**

Term work:

Field work to EHV Substation / Tutorials/ Quiz's

Content beyond syllabus:

1. Carrier current protection
2. Insulation Coordination, Basic Impulse Insulation Level

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Circuit Breakers	CO1	https://www.electrical4u.com/electrical-circuit-breaker-operation-and-types-of-circuit-breaker/
2	Protective relays	CO2	https://circuitglobe.com/types-of-circuit-breaker.html
3	Electromagnetic Relays	CO3	https://www.electrical4u.com/electromagnetic-relay-working-types-of-electromagnetic-relays/
4	Generator protection	CO4	https://circuitglobe.com/differential-protection-relay.html https://circuitglobe.com/impedance-type-distance-relay.html https://www.engineeringenotes.com/electrical-engineering/comparators/amplitude-comparators-and-its-types-devices-electrical-engineering/32806
5	Neutral grounding	CO5	https://circuitglobe.com/differential-protection-of-a-generator.html https://circuitglobe.com/differential-protection-of-a-transformer.html https://circuitglobe.com/feeder-protection.html#:~:text=Feeder%20Protection,the%20various%20type%20of%20fault.

Text Book(s):

1. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, TMH Publications,2011.
2. Switchgear and Protection, Sunil S Rao, Khanna Publishers, 1992.

Reference Book(s):

1. Electrical Power Systems, C.L.Wadhwa, New Age international (P) Limited, Publishers, 2012.
2. Transmission network Protection, Y.G. Paithankar , Taylor and Francis,2009.
3. Power system protection and switch gear, Bhuvanesh Oza, TMH, 2010
4. Principles of power systems by V.K.Mehta,Rohith Mehta S.Chand(P), 4th Edition

Online Resources:

1. http://175.101.102.82/moodle/course/view.php?id=691
2. https://subjects.ee.unsw.edu.au/elec9712/ELEC9712%20-%20Lec8%20-%20Circuit%20breakers%20Notes.pdf
3. https://b-ok.asia/book/5482781/8e4867
4. https://b-ok.asia/book/5482780/4ec690

Web Resources:

1. https://nptel.ac.in/courses/108/101/108101039/
2. https://www.youtube.com/watch?v=GSh0f94JwaA&t=54s
3. https://www.youtube.com/watch?v=dPInm2zoirA&t=40s
4. https://www.youtube.com/watch?v=OH7-NJRdDyA
5. https://www.youtube.com/watch?v=Kd_73FnTueI
6. https://www.youtube.com/watch?v=OElOqRSN0FE
7. https://www.youtube.com/watch?v=Y5dAaeLPzzk
8. https://www.youtube.com/watch?v=ODj4sWxKm9o

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2507	MEASUREMENT & INSTRUMENTATION LAB							R2020
III-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	0	0	2	30	1	40	60	100

Pre-requisite: Nil

Course Objectives:

1. Measurement of coefficient of coupling between two coupled coils.
2. Accurate determination of inductance and capacitance using D.C and A.C Bridges
3. Calibration of various electrical measuring instruments.

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

CO 1	Accurately determine the values of inductance and capacitance using a a.c bridges
CO 2	Compute the coefficient of coupling between two coupled coils
CO 3	Calibrate various electrical measuring instruments
CO 4	Accurately determine the values of very low resistances

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	2	1					2	2				1
CO2	2	2	2	1				1	2	2				2
CO3	2	2	1	1				1	2	2				1
CO4	2	2	2	1	1			1	2	2				2

1: Low, 2-Medium, 3- High

COURSE CONTENT

List of Experiments

Any 12 of the following experiments are to be conducted:

1. Calibration and Testing of Single phase energy meter

2. Calibration of dynamometer wattmeter using phantom loading Test

3. Calibration of dynamometer power factor meter

4. Measurement of 3 -phase reactive power with single -phase wattmeter for balanced loading

5. Measurement of parameters of a choke coil using 3-Voltmeter and 3-Ammeter methods

6. Crompton D.C Potentiometer - Calibration of PMMC Ammeter and PMMC Voltmeter

7. Kelvin's Double Bridge - Measurement of low resistance - Determination of Tolerance

8. Capacitance Measurement using Schering Bridge

9. Inductance Measurement using Anderson Bridge.

10. LVDT and capacitance pickup - characteristics and calibration

11. Measurement of % Ratio Error and Phase angle Error of Given C.T by using Silsbee's Method.

12. Measuremnt of 3-phase power by using Two Wattmeter method **13. Resistance strain gauge- Strain measurement and calibration**	
Total hours:	**36 hours**

Term work:

Calibrate the Electrical & Electronics Instruments

Content beyond syllabus:

1. **Measurement of 3-phase power with single wattmeter and 2 No's CT**

Online Resources:

1.http://www.acadmix.com/eBooks_Download

Web Resources:

1. http://sreevahini.edu.in/pdf/electrical-measurements-lab.pdf
2. http://www.eee.griet.ac.in/wp-content/uploads/2014/12/EMI-Lab-Manual.pdf

NARAYANA ENGINEERING COLLEGE: NELLORE								
20EE2508	POWER SYSTEM LAB							R2020
III-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II-Semester	0	0	3	30	1.5	40	60	100
Pre-requisite: Must have the basic knowledge in Generation, Transmission & Distribution								
Course Objectives: 1. To study the different methods of power system analysis. 2. To learn about the power system control. 3. To learn about the concepts of Power system stability.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Examine the power system analysis **(BL=4)**							
CO 2	Identify characteristics of various Relays**(BL=3)**							
CO 3	Understand various tests on Motors and Transformers **(BL=2)**							

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	2	1	1				2	2		1	2	3
CO2	2	2	1	1	1				2	2		1	2	3
CO3	2	2	1	1	1				2	2		1	1	3
1: Low, 2-Medium, 3- High														

COURSE CONTENT	CO
Task - 1 - Determination of Sub transient Reactance of Salient Pole Synchronous Machine.	**CO 1**
Objective: To determine the sub transient direct axis reactance and Quadrature axis reactance of a salient pole synchronous machine.	
Task -2 -Determination of Sequence Impedances of Cylindrical Rotor Synchronous Machine.	**CO 1**
Objective: To determine experimentally Positive, Negative and Zero sequence reactance's of a cylindrical rotor synchronous machine.	
Task -3 - LG -Fault Analysis	**CO 1**
Objective: To find the fault currents and fault voltages when a single line to ground (L-G) fault occurred on unloaded alternator.	
TASK -4 - LLG -Fault Analysis	**CO 1**
Objective: To find the fault currents and fault voltages when a double line to ground (LLG) fault occurred on unloaded alternator.	
TASK -5 -Equivalent Circuit of a Three Winding Transformer.	**CO 3**
Objective: To determine the equivalent circuit parameters of a 3-Ø three winding transformer.	
TASK-6 - Separation of No-Load Losses of Three-Phase Squirrel Cage Induction Motor.	**CO 3**

Objective: To separate the No-Load losses(Iron losses and Mechanical losses) of a three phase squirrel cage induction motor.	
Task -7 - LL -Fault Analysis	**CO 1**
Objective: To find the fault currents and fault voltages when a line to line (L-L) faults occurred on unloaded alternator.	
TASK -8 - LLLG -Fault Analysis	**CO 1**
Objective: To find the fault currents and fault voltages when a Triple line to ground (LLLG) faults occurred on unloaded alternator.	
TASK -9 -Characteristics of IDMT Over Current Relay -Electromagnetic Type.	**CO 2**
Objective: To determine the Time-Current characteristics of IDMT Over Current Relay	
TASK -10 - Characteristics of Over Voltage Relay -Electromagnetic Type.	**CO 2**
Objective: : To determine the operating characteristics of Over Voltage Relay	
TASK -11 - Characteristics of Over Voltage Relay- Microprocessor Type.	**CO 2**
Objective: To determine the operating characteristics of the numerical Over Voltage Relay	
TASK -12 - Characteristics of Percentage Biased Differential Relay-Electromagnetic Type	**CO 2**
Objective: To determine the operating characteristics of Percentage Biased Differential Relay	

Additional Experiments:	
TASK -13 – Performance of Digital Distance Relay	**CO 2**
Objective: To verify the performance of Numerical Distance Relay	
TASK -14 - Characteristics of Percentage Biased Differential Relay- Static Type	**CO 2**
Objective: To determine the operating characteristics of Percentage Biased Differential Relay	
TASK - 15 – Ferranti Effect in Transmission Lines	**CO 1**
Objective: To study the Ferranti Effect of transmission line/cable	
TASK - 16 - Buchholz relay for Transformer protection	**CO 1**
Objective: To Study the abnormal conditions in a oil filled transformer by gas actuated Buchholz relay	
TASK - 16 - ABCD parameters of transmission line	
Objective: To study the performance of a transmission line. Also compute its ABCD parameters	

Virtual Labs:

1. http://www.ee.iitkgp.ac.in/faci_ps.php
2. https://vp-dei.vlabs.ac.in/Dreamweaver/list.html

Self-Study:

Contents to promote self-Learning:

SNO	CO	Reference
1	**CO 1**	https://nptel.ac.in/courses/108/105/108105067/
2	**CO 2**	https://nptel.ac.in/content/storage2/courses/108101039/download/Lecture-15.pdf
3	**CO 3**	https://nptel.ac.in/courses/108/105/108105017/

Text Book(s):

1. POWER SYSTEM ANALYSIS – by – HADI SAADAT - Tata McGraw-Hill Education, 01-Aug-2002.
2. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, TMH Publications, 2011.

Reference Book(s):

1. Power Systems Analysis, Grainger and Stevenson, Tata Mc Graw-hill, 2005.
2. Modern Power system Analysis 2nd edition, I.J.Nagrath&D.P.Kothari: Tata McGraw- Hill Publishing Company, 2003.
3. Kundur, P., "Power System Stability and Control", Mc. Graw Hill inc. 1994.
4. Jim Arlow, Ila Neustadt, "UML 2 and the Unified Process: Practical Object-Oriented Analysis and Design", 2nd Edition, Pearson, (2005).

Web Resources:

1. http://www.academia.edu/Documents/in/Power-System-Analysis-by-Hadi-Saadat-Electrical-Engineering
2. https://nptel.ac.in/courses/108/101/108101040/
3. https://nptel.ac.in/courses/108/104/108104052/
4. https://nptel.ac.in/courses/108/105/108105067/
5. https://nptel.ac.in/courses/108/101/108101039/

SEMESTER VII

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20HS5001-8	HE	Humanities and Social Science Elective	2	0	0	2	2	40	60	100
20EE2014	PC	Solid State Electric Drives	3	0	0	3	3	40	60	100
20EE2015	PC	Power System Operation and Control	3	0	0	3	3	40	60	100
-	OE	Open Elective IV	2	0	2	4	3	40	60	100
20EE4016-20	PE	Professional elective IV	3	0	0	3	3	40	60	100
20EE4021-25	PE	Professional elective V	3	0	0	3	3	40	60	100
20EE2509	PC	Electronic systems design lab	0	0	2	2	1	40	60	100
20EE2510	PC	Power Systems Simulation Lab	0	0	3	3	1.5	40	60	100
20CD6005	SC	Career competency Development V	0	0	2	2	1	40	60	100
20CC6501	SC	Skill development Training	0	0	2	2	1	40	60	100
20EE7502	PR	Internship II/on job training/Com Ser	0	0	3	3	1.5	00	100	100
20MC8002-12	MC	Mandatory course IV	2	0	0	2	0	00	00	00
		Counseling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	18	0	17	35	23	400	700	1100

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2014	**Solid State Electrical Drives**							R2020
IV-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To understand steady state operation and transient dynamics of a motor load system.
2. To study and analyze the operation of the converter fed dc drive, both qualitatively and quantitatively.
3. To study and analyze the operation of the chopper fed dc drive, both qualitatively and quantitatively.
4. To study and understand the operation and performance of AC Induction motor drives.
5. To study and understand the operation and performance of AC Synchronous motor drives.

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

CO 1	Describe the basic requirements of motor selection for different load profiles.
CO 2	Analyze the operation of the converter fed dc drive
CO 3	Demonstrate the operation of the chopper fed dc drive
CO 4	Illustrate the operation and performance of AC Induction motor drives
CO 5	Analyze the induction motor drive using inverter

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	2	2	2								3	2
CO2	2	2	2	2	2								3	2
CO3	2	2	2	2	2								3	2
CO4	2	2	2	2	2								3	2
CO5	2	2	2	2	2								3	2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

Electric Drive

Classification of Electric Drives, Basic elements of Electric Drive, Dynamic Control of a Drive system, Stability analysis, Introduction to Thyristor Controlled Drives, Single Phase Semi and Fully Controlled Converters Connected to D.C Separately Excited motor-Output Voltage and Current Waveforms – Speed and Torque Expressions -problems.

At the end of the Module 1, students will be able to:

1. Understand the basic requirements of motor selection
2. Analyze the converter fed DC drives

MODULE -2

Three Phase Semi and Fully Controlled Converters Connected to D.C Separately Excited and D.C Series Motors – Continuous Current Operation – Output Voltage and Current Waveforms – Speed and Torque Expressions – Speed – Torque Characteristics- Problems. Introduction to Four Quadrant Operation – Motoring Operations, Electric Braking – Plugging, Dynamic and Regenerative Braking Operations. Four Quadrant Operation of D.C Motors by Dual Converters

At the end of the Module 2, students will be able to:

1. Analyze the three phase converter fed DC drives
2. Differentiate between braking methods of motors
3. Understand the four quadrant operation

MODULE-3

DC motor drives:

Single Quadrant, Two Quadrant and Four Quadrant Chopper Fed DC Separately Excited and Series Excited Motors – Continuous Current Operation – Output Voltage and Current Wave Forms – Speed Torque Expressions – Speed Torque Characteristics.

At the end of the Module 3, students will be able to:

1. Understand the chopper fed DC drives
2. Analyze the characteristics of chopper fed DC drives

MODULE-4

Induction Motor Stator Voltage Control and Characteristics. AC Voltage Controllers – Waveforms – Speed Torque Characteristics - Stator Frequency Control and Characteristics. Voltage Source and Current Source Inverter - PWM Control – Speed Torque Characteristics.

At the end of the Module 4, students will be able to:

1. Understand the stator side control of induction motor drives
2. Analyze the inverter fed Induction Motor Drives

MODULE-5

Induction motor drives:

Static Rotor Resistance Control – Slip Power Recovery – V/f control of Induction Motor – Their Performance and Speed Torque Characteristics – Advantages- Applications – Problems.

Synchronous motor drives:

Separate Control & Self Control of Synchronous Motors – Operation of Self Controlled Synchronous Motors by VSI and CSI

At the end of the Module 5, students will be able to:

1. Understand the rotor side control of induction motor drives
2. Analyze the performance of induction motor drives.
3 Understand the performance of synchronous motor drives

Total hours:	**48 hours**

Term work:

Tutorials/Quizes

Content beyond syllabus:

1. Cycloconverter fed synchronous motor drives

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Thyristor Controlled Drives	CO1	https://www.youtube.com/watch?v=-EC6q5_grM4
2	Four Quadrant Operation	CO2	https://www.youtube.com/watch?v=Tfrv9DJfVgs
3	Chopper Fed DC Motors	CO3	https://www.youtube.com/watch?v=pdjVSWSQ83w
4	AC Voltage Controller fed AC drives	CO4	https://www.youtube.com/watch?v=Pc7txXwvhBM
5	Slip Power Recovery scheme	CO5	https://www.youtube.com/watch?v=9Z0Tn5iTYyE

Text Book(s):

1. Power semiconductor controlled drives, G K Dubey, Prentice Hall, 1995.
2. Modern Power Electronics and AC Drives, B.K.Bose, PHI, 2002.

Reference Book(s):

1. Power Electronics, MD Singh and K B Khanchandani, Tata McGraw-Hill Publishing company, 2008.
2. Power Electronic Circuits, Devices and applications, M.H.Rashid, PHI, 2005.
3. Electric drives Concepts and Applications, Vedam Subramanyam, Tata McGraw Hill

Online Resources:

1. https://doku.pub/documents/electric-drives-by-gk-dubey-59qge6y3vm0n
2. https://nptel.ac.in/courses/108/104/108104140/

Web Resources:

1. https://www.youtube.com/watch?v=1AT1yuQ9awM&list=PLFW6lRTa1g83sIfVY1p1xGqPGYUmXyahx
2. https://www.youtube.com/watch?v=WsDPqDqnpyw&list=PLuv3GM6-gsE3UGP1cSOl1KuEXscGFdKXB

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE2015	POWER SYSTEM OPERATION & CONTROL							R2020
IV-B.Tech	Hours / Week			Total	Credit	Max Marks		
	L	T	P	hrs	C	CIE	SEE	TOTAL
I-Semester	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To understand the importance of optimal power flow and power system.
2. To Describe the hydrothermal scheduling, and its constraints.
3. To listen about single area and two area load frequency control , modeling of turbines
4. To understand the Deregulation, Restructuring models.

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

CO 1	Enumerate the Heat rate curves, Economic operations of power systems
CO 2	Describe the Hydrothermal power stations Scheduling
CO 3	Discuss the single area load frequency control, modelling of turbines , speed governing systems.
CO 4	Illustrate two area load frequency control , tie line and economic dispatch control for load frequency control.
CO 5	Discuss the deregulation and conditions of deregulation in a power systems.

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1	2	2		2								3	2
CO2	2	2	2		2								3	2
CO3	2	2	2	2	2								3	2
CO4	2	2	2	2	2								3	2
CO5	2	2	2		2								3	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT

MODULE – 1

UNIT – ECONOMIC OPERATION OF THERMAL POWER STATION

Over view of power system operation and Control, System Load variation, Formulation of Economic dispatch in Thermal Power station - Heat Rate Curve – Cost Curve –Incremental Fuel and Production Costs, Input-Output Characteristics , Constraints of power systems, Optimum Scheduling of Thermal power station

Optimum Generation Allocation:

Optimum Generation Allocation with Line Losses Neglected. Loss Coefficients, General line loss formula, Optimum Generation Allocation with Line Losses

At the end of the Module 1, students will be able to:

1. Discuss the Economic dispatch in Thermal power station
2. Determine the Optimum Generation Allocation without losses
3. Discuss the Optimum Generation Allocation with and without losses

MODULE -2

UNIT–II-HYDROTHERMAL SCHEDULING and Governing

Optimal scheduling of Hydrothermal system: Scheduling problems, Optimal Scheduling of Hydrothermal System, short term Hydro thermal Scheduling(4h)

MODELLING OF TURBINE AND SPEED GOVERNING SYSTEM

Modeling of Turbine: First Order Turbine Model, Approximate Linear models, Modeling of Governor, Mathematical Modeling of Speed Governing System, Derivation of Small Signal Transfer Function – Block Diagram (4h)

At the end of the Module 2, students will be able to:

1. Listen the Hydro Electro Power Plant Models
2. Examine the constraints
3. Enumerate the Hydrothermal Scheduling problems

MODULE-3

LOAD FREQUENCY SINGLE AREA CONTROL

Necessity of Keeping Frequency Constant.–Definition of control Area, – Mathematical modeling of generator , loads, for LFC & corresponding block diagram representation, Block Diagram Representation of an Isolated Power System – Steady State Analysis – Dynamic Response – Uncontrolled Case. (8h)

At the end of the Module 3, students will be able to:

1. Discuss the Necessity of keeping frequency constant
2. Listen the Load Frequency Single Area Control
3. Describe the steady state Analysis

MODULE-4

Load Frequency Control of 2-Area System: Load Frequency control of 2-Area system and its Block diagram, Uncontrolled case and controlled case. Tie-Line Bias Control. Proportional Plus Integral Control of Single Area and Its Block Diagram Representation, Economic Dispatch Control.

At the end of the Module 4, students will be able to:

1. Discuss the Load Frequency Control of 2-Area system
2. Examine the Tie Line Bias Control
3. Describe the Economic Dispatch Control

MODULE-5

Deregulation of Power system:

Deregulation, Need and conditions for deregulation, Basics of public good economics, Components of Deregulation, Technical , economic & Regulatory issues involved in deregulation of power industry, Privatization, Competition in the electricity sector, conditions, barriers, benefits of Challenges, Reregulation.

At end of the Module 5 , students will be able to :

1. Describe the Deregulation and its conditions
2. Examine Technical, economic & Regulatory issues of deregulation of power industry
2. Discuss the Deregulation and benefits of deregulation

Total hours:	**48 hours**

Term work:

Field work of power system operation & Deregulation in Thermal power plant

Content beyond syllabus:

1. **Knowledge of Voltage control in Power systems**

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Economic Operation of Thermal power station	CO1	http://175.101.102.82/moodle/mod/folder/view.php?id=13928
2	Hydro thermal scheduling	CO2	http://175.101.102.82/moodle/mod/folder/view.php?id=13928
3	Load frequency single area control	CO3	http://175.101.102.82/moodle/mod/folder/view.php?id=13928
4	Load frequency two area control	CO4	http://175.101.102.82/moodle/mod/folder/view.php?id=13928
5	Deregulation of Power system	CO5	http://175.101.102.82/moodle/mod/folder/view.php?id=13928

Text Book(s):

1. Power Generation Operaton and control - Wood and Wollenerg, wiley Publishers
2. Power systems operation and Control - Chakravarthi, Halder
3. D.P.Kothari and I.J.Nagrath, " Modern Power System Analysis" Tata Mc Graw Hill publishing company Ltd., 2003.

Reference Book(s):

1. S Sivanagaraju and G Sreenivasan, " Power System Operation and Control ", Pearson"MeriPustak-Machwan Communication & Research publishing Company Ltd,2004
2 Geoffrey Rothwell, Tomas Gomez (Eds), " Electricity Economics Regulation and Deregulation", IEEE Press Power Engineering series , John Wiley & Sons, 2003
3. Loi Lei Lai, "Power System Restructuring and Deregulation", John Wiley & Sons Ltd, England, 2001
4. Mohammad Shahidehpour , Muwaffaq Alomoush, "Restructured Electric power Systems:Operation, Trading and Volatility", Marcel Dekker , Inc., 2001

Online Resources: http://175.101.102.82/moodle/course/view.php?id=610

1.http://www.acadmix.com/eBooks_Download

Web Resources: http://175.101.102.82/moodle/course/view.php?id=610

1.https://lecturenotes.in/notes/14667-note-for-power-system-operation-and-control-psoc-by-jntu-heroes?reading=true&continue=2
2.https://lecturenotes.in/notes/17488-note-for-power-system-operation-and-control-psoc-by-sucharita-das
3.http://www.crectirupati.com/sites/default/files/lecture_notes/PSOC%20-%20%20IV%20-%20EEE_0.pdf
4.http://www.tutorialspoint.com/

NARAYANA ENGINEERING COLLEGE: NELLORE								
20EE2510	POWER SYSTEM SIMULATION LAB							R2020
IV-B.Tech	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I-Semester	0	0	3	30	1.5	40	60	100
Pre-requisite: Nil								
Course Objectives: 1. To study the different methods of power system analysis. 2. To learn about the power system control. 3. To learn about the concepts Power system stability.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Examine the power system analysis- (BL-4)							
CO 2	Construct the controllers of a power system. (BL-3)							
CO 3	Analyze the various power system stabilities- (BL-4)							

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	2	1	2				2	2		1	2	3
CO2	2	2	1	1	2				2	2		1	2	3
CO3	2	2	1	1	2				2	2		1	1	3
1: Low, 2-Medium, 3- High														

COURSE CONTENT	CO
Task - 1 - FORMATION OF BUS ADMITTANCE MATRIX(Y_{BUS})	**CO 1**
Objective: To form Bus Admittance matrix by using Matlab and verify output with theoretical output.	
Task -2 -POWER FLOW ANALYSIS USING GAUSS SEIDAL METHOD	**CO 1**
Objective: To run the power flow of the given system using Gauss Seidal Method and verify the obtained results with theoretical calculations.	
Task -3 - POWER FLOW ANALYSIS USING NEWTON RAPHSON METHOD	**CO 1**
Objective: To run the power flow of the given system using Newton Raphson Method and verify the obtained results with theoretical calculations.	
TASK -4 -LOAD FLOW ANALYSIS USING FAST DECOUPLED METHOD	**CO 1**
Objective: To obtain PV & QV curves on IEEE 30-bus by applying Fast Decoupled Method.	
TASK -5 -STEP RESPONSE OF TWO AREA SYSTEM WITH AND WITHOUT INTEGRAL CONTROL AND ESTIMATION OF FREQUENCY DEVIATION USING SIMULINK	**CO 2**
Objective: To obtain the frequency deviation of the two-area power system with and without integral controller for a sudden change of load in any area.	
TASK-6 STEP RESPONSE OF TWO AREA SYSTEM WITH INTEGRAL CONTROL AND ESTIMATION OF TIE-LINE POWER DEVIATION USING	**CO 2**

SIMULINK	
Objective: To obtain the power deviation of the two-area power system with and without integral controller for a sudden change of load in any area.	
TASK -7 - ANALYSIS OF STEADY STATE STABILITY OF A SINGLE MACHINE CONNECTED TO INFINITE BUS USING POINT BY POINT METHOD.	**CO 2**
Objective: To develop a MATLAB program for the analysis of steady state stability in the case of single machine connected to infinite bus. (OR) To develop a MATLAB program to solve swing equation of the problem.	
TASK -8 - DESIGN OF P-I-D CONTROLLER	**CO 2**
Objective: To Design a P-I-D controller of a Transfer Function and to obtain the Proportional, Integral and derivative gains.	
TASK -9 -DESIGN OF FUZZY LOGIC AIR CONDITIONER	**CO 2**
Objective: To design a fuzzy air conditioner using MATLAB	
TASK -10 - LOAD FLOW ANALYSIS USING NEURAL NETWORKS	**CO 2**
Objective: To implement Neural Network on load flow analysis.	
TASK -11 - PROGRAM FOR SWING CURVE WHEN THE FAULT IS CLEARED.	**CO 3**
Objective: To determine the Swing curve when the fault is cleared i) At the beginning of the Line ii) At the middle of the line	
TASK -12 - SWING CURVE FOR SUSTAINED FAULT AND CRITICAL CLEARING ANGLE & TIME.	**CO 3**
Objective: To determine swing curve for sustained fault and critical clearing angle & time.	

Additional Experiments:	
TASK -13 - DESIGN OF KALMAN FILTER	**CO 3**
Objective: To design a time varying and a steady state "KALMAN FILTER" and to obtain its response, covariance error, values before and after filtering.	
Task - 14- FORMATION OF BUS IMPEDANCE MATRIX(Z_{BUS})	**CO 1**
Objective: To form Bus Impedance matrix by using MATLAB and verify output with theoretical output.	
TASK - 15 - MATLAB PROGRAM TO FIND OPTIMUM LOADING OF GENERATORS NEGLECTING TRANSMISSION LOSSES	**CO 2**
Objective: To find optimum loading of two units for the given load neglecting transmission losses and verify using MATLAB.	
TASK - 16 - MATLAB PROGRAM TO FIND OPTIMUM LOADING OF	**CO 2**

GENERATORS WITH PENALTY FACTORS	
Objective: To find optimum loading of two units for the given load with penalty factors and verify using MATLAB.	

Self-Study:

Contents to promote self-Learning:

SNO	CO	Reference
1	**CO 1**	https://nptel.ac.in/courses/108/105/108105067/
2	**CO 2**	1. https://nptel.ac.in/courses/108/101/108101040/ 2. https://nptel.ac.in/courses/108/104/108104052/
3	**CO 3**	1. https://nptel.ac.in/courses/108/101/108101040/ 2. https://nptel.ac.in/courses/108/104/108104052/

Text Book(s):

1. POWER SYSTEM ANALYSIS – by – HADI SAADAT - Tata McGraw-Hill Education, 01-Aug-2002.
2. MATLAB for Electrical Engineers and Technologists: MATLAB Tutorial with Practical Electrical Examples- Stephen P. Tubbs, 2010

Reference Book(s):

1. Power Systems Analysis, Grainger and Stevenson, Tata Mc Graw-hill, 2005.
2. Modern Power system Analysis 2nd edition, I.J.Nagrath & D.P.Kothari: Tata McGraw- Hill Publishing Company, 2003.
3. Kundur, P., “Power System Stability and Control”, Mc. Graw Hill inc. 1994.
2. Jim Arlow, Ila Neustadt, “UML 2 and the Unified Process: Practical Object-Oriented
3. Analysis and Design”, 2nd Edition, Pearson, (2005).

Web Resources:

1. http://www.academia.edu/Documents/in/Power-System-Analysis-by-Hadi-Saadat-Electrical-Engineering
2. https://nptel.ac.in/courses/108/101/108101040/
3. https://nptel.ac.in/courses/108/104/108104052/
4. https://nptel.ac.in/courses/108/105/108105067/

SEMESTER VIII

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EE7503	PR	Project work, seminar and internship	0	0	0	0	12	60	140	200
		Activity Point Programme	During the Semester					20 points		
			0	**0**	**0**	**0**	**12**	**60**	**140**	**200**

PROFESSIONAL ELECTIVES (PE)

Elective Track/Group	Professional Elective-1	Professional Elective-2	Professional Elective-3	Professional Elective-4	Professional Elective-5
Advanced Power systems	Industrial Electrical Systems (20EE4001)	Power System Planning (20EE4006)	Reactive Power Compensation and Management (20EE4011)	Power Quality (20EE4016)	Smart Grid Technologies (20EE4021)
Control Systems	System Modeling and Identification (20EE4002)	Advanced Control systems (20EE4007)	Digital Signal Processing (20EE4012)	Multivariable Control System (20EE4017)	Real Time Control System (20EE4022)
Electromechanical Systems	Machine Modeling and Analysis (20EE4003)	Electrical Machine Design (20EE4008)	Programmable Control Devices and Applications (20EE4013)	Hybrid Electrical Vehicles (20EE4018)	Automotive Electrical Engineering (20EE4023)
Energy Systems	Renewable Energy Conversion Systems (20EE4004)	Solar and Fuel Cell Energy Systems (20EE4009)	Wind and Biomass Energy Systems (20EE4014)	Utilization of Electrical Energy (20EE4019)	Energy Audit &Demand side Management (20EE4024)
Power Electronics	Advanced Power Electronics (20EE4005)	Advanced Electrical Drives (20EE4010)	HVDC & FACTS (20EE4015)	Advanced Power Converters (20EE4020)	Advanced Power Semiconductor Devices and Protection (20EE4025)

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4001	INDUSTRIAL ELECTRICAL SYSTEMS							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To make students understand the fundamental theory governing the photovoltaic devise and make them carry out preliminary system design.
2. To learn the fundamental knowledge about various fuel cell technologies.

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

CO 1	Understand the electrical wiring systems for residential, commercial and industrial consumers through symbols, drawings and SLD (BL-2)
CO 2	Justify the need of industrial electrical system components and industrial automation (BL-3)
CO 3	Analyze the size, rating and cost of electrical installations for residential and commercial applications (BL-4)
CO 4	Analyze the appropriate electrical system with protective equipments for industrial applications (BL-4)
CO 5	Understand the role of industrial automation (BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2										2	1
CO2	3	2											3	2
CO3	3	2	2										2	2
CO4	3	2	2	2									3	3
CO5	2	2			2								2	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	Electrical System Components	10 Hours

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, Protection components- Fuse, MCB, MCCB, ELCB, Symbols for wiring components, Single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

At the end of the Module 1, students will be able to:

1. Understand the different types protecting devices (BL-2)
2. Discuss the various performance characteristics of protecting devices.(BL-2)

MODULE -2	Residential and Commercial Electrical Systems	10 Hours

Types of residential and commercial wiring systems, General rules and guidelines for installation, Load calculation and sizing of wire, Rating of main switch, distribution board and protection devices, Earthing system calculations, Requirements of commercial installation, Deciding lighting scheme and number of lamps, Earthing of commercial installation, Selection and sizing of components

At the end of the Module 2, students will be able to:

1. Discuss the different types of wiring systems (BL-3)
2. Discuss the concepts of Earthing system and its calculation (BL-3)

MODULE-3	Illumination Systems	09 Hours

Understanding various terms regarding light- lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, Various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, Energy saving in illumination systems, Design of a lighting scheme for a residential and commercial premises, Flood lighting

At the end of the Module 3, students will be able to:

1. Predict the performance of various lighting systems in industry. (BL-4)

MODULE-4	**Industrial Electrical Systems**	**10 Hours**

HT connection, Industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks

At the end of the Module 4, students will be able to:

1. Analyze the application of various equipments in industrial electrical system. (BL-4)

MODULE-5	**Industrial Electrical System Automation**	**09 Hours**

Study of basic PLC, Role of automation, Advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation

At the end of the Module 5, students will be able to:

1. Understand the performance of industrial automation for better operation of industry. (BL-2)

Total hours:	**48 hours**

Term work:

1. Field trip

Content beyond syllabus:

1. Introduction of hydrogen energy systems
2. Hydrogen production processes
3. Hydrogen storage and safety

Self-Study:

Contents to promote self-Learning:

SNO	MODULE	Reference
1	Electric shock and Electrical safety practices	https://electrical-engineering-portal.com/21-safety-rules-for-working-with-electrical-equipment
2	General rules and guidelines for installation	https://www.tutorhelpdesk.com/homeworkhelp/Engineering-/General-Rules-For-Wiring-Assignment-Help.html
3	Flood lighting	https://www.tutorialspoint.com/what-is-flood-lighting-definition-purpose-calculation-and-applications
4	Selection of UPS and Battery Banks	https://myelectrical.com/notes/entryid/164/ups-battery-sizing#:~:text=Example%20of%20UPS%20battery%20sizing,cells%20of%202%20V%20each).
5	Introduction to SCADA system for distribution automation	https://www.scadalink.com/support/knowledge-base/an-introduction-to-scada/#:~:text=The%20term%20SCADA%20stands%20for,for%20control%20or%20monitoring%20purposes.

Text Book(s):

1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.

2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
3. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.

Reference Book(s):

1. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008
2. 5. IS Standards : https://bis.gov.in

Online Resources:

1. https://electrical-engineering-portal.com/21-safety-rules-for-working-with-electrical-equipment
2. https://www.tutorhelpdesk.com/homeworkhelp/Engineering-/General-Rules-For-Wiring-Assignment-Help.html
3. https://www.tutorialspoint.com/what-is-flood-lighting-definition-purpose-calculation-and-applications
4. https://myelectrical.com/notes/entryid/164/ups-battery-sizing#:~:text=Example%20of%20UPS%20battery%20sizing,cells%20of%202%20V%20each).
5. https://www.scadalink.com/support/knowledge-base/an-introduction-to-scada/#:~:text=The%20term%20SCADA%20stands%20for,for%20control%20or%20monitoring%20purposes.

Web References:

1. https://nptel.ac.in/courses/108107112

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4006	**POWER SYSTEM PLANNING**							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To make students understand the fundamental theory governing the power system planning and forecasting.
2. To make the students to understand the economics related to expansion of power system.
3. To learn the fundamental knowledge about transmission and distribution planning for future expansion.
4. To make the students to understand the reliability concept in power system to better operation of power system.
5. To make the students to make the planning with respect to electricity market based demand.

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

CO 1	Discuss primary components of power system planning, planning methodology for optimum power system expansion and show knowledge of forecasting of future load requirements of both demand and energy by deterministic and statistical techniques using forecasting tools. (BL-2)
CO 2	Discuss methods to mobilize resources to meet the investment requirement for the power sector and understand economic appraisal to allocate the resources efficiently and appreciate the investment decisions to power generation and planning for system energy in the country (BL-2)
CO 3	Analyze the operating states of transmission system, their associated contingencies and the stability of the system and discuss principles of distribution planning, supply rules, network development and the system studies. (BL-4)
CO 4	Discuss reliability criteria for generation, transmission, distribution and reliability evaluation and analysis, grid reliability, voltage disturbances and their remedies (BL-2)
CO 5	Discuss planning and implementation of electric –utility activities, market principles and the norms framed by CERC for online trading and exchange in the interstate power market. (BL-2)

CO-PO Mapping

CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	2	2	1	2		2	2	2		2	2	1
CO2	2	3	2	1	2	2		2				2	3	2
CO3	3	2	2	2	2	2		1	2	2		2	2	2
CO4	3	2	2	2	1	2		2				2	3	3
CO5	3	2	2	2	2	2		2	2	2		2	2	1
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	Power System	**10 Hours**

Power System:

Power Systems, Planning Principles, Planning Process, Project Planning, Power Development, Power Growth, National and Regional Planning, Enterprise Resources Planning, Structure of a Power System, Power Resources, Planning Tools, Power Planning Organisation, Regulation, Scenario Planning.

Electricity Forecasting:

Load Requirement, System Load, Electricity Forecasting, Forecasting Techniques, Forecasting Modelling, Spatial – Load Forecasting, Peak Load - Forecast, Reactive – Load Forecast, Unloading of a System.

At the end of the Module 1, students will be able to:

1. Discuss primary components of power system planning, planning methodology for optimum power system expansion, various types of generation, transmission and distribution.
2. Show knowledge of forecasting of future load requirements of both demand and energy by deterministic and statistical techniques using forecasting tools.

MODULE -2	Power-System Economics	**10 Hours**

Power-System Economics:

Financial Planning, Techno – Economic Viability, Private Participation, Financial Analysis, Economic Analysis, Economic Characteristics – Generation Units, Transmission, Rural Electrification Investment, Total System Analysis, Credit - Risk Assessment, Optimum Investment, Tariffs.

Generation Expansion:

Generation Capacity and Energy, Generation Mix, Conventional Generation Resources, Nuclear Energy, Clean Coal Technologies, Distributed Power Generation, Renovation and Modernization of Power Plants.

At the end of the Module 2, students will be able to:

- Discuss methods to mobilize resources to meet the investment requirement for the power sector
- Understand economic appraisal to allocate the resources efficiently and appreciate the investment decisions
- Discuss expansion of power generation and planning for system energy in the country

MODULE-3	**Transmission & Distribution Planning:**	**08 Hours**

Transmission:

Transmission Planning Criteria, Right – of – Way, Network Studies, High – Voltage Transmission, Conductors, Sub – Stations, Power Grid, Reactive Power Planning, Energy Storage.

Distribution:

Distribution Deregulation, Planning Principles, Electricity – Supply Rules, Criteria and Standards, Sub – Transmission, Basic Network, Low Voltage Direct Current Electricity, Distribution(continued): Upgradation of Existing Lines and Sub – Stations, Network Development, System Studies, Urban Distribution, Rural Electrification, Villages Self – Sufficiency in Energy,

Community Power, Self – Generation.

At the end of the Module 3, students will be able to:

- Evaluation of operating states of transmission system, their associated contingencies and the stability of the system.
- Discuss principles of distribution planning, supply rules, network development and the system studies

MODULE-4	**Reliability and Quality**	**10 Hours**

Reliability Models, System Reliability, Reliability and Quality Planning, Functional Zones, Generation Reliability Planning Criteria, Transmission Reliability Criteria, Distribution Reliability, Reliability Evaluation, Grid Reliability, Reliability Target, Security Requirement, Disaster Management, Quality of Supply, Reliability and Quality Roadmap.

At the end of the Module 4, students will be able to:

- Discuss reliability criteria for generation, transmission, distribution and reliability evaluation and analysis, grid reliability, voltage disturbances and their remedies

MODULE-5	Demand-Side Planning	**10 Hours**

Demand-Side Planning:

Demand Response, Demand – Response Programmes, Demand– Response Technologies, Energy Efficiency, Energy - Economical Products, Efficient – Energy Users, Supply – Side Efficiency, Energy Audit.

Electricity Market:

Market Principles, Power Pool, Independent System Operator, Distribution System Operator, Power Balancing, Market Participants, Power Markets, Market Rules, Bidding, Trading, Settlement System, Locational Marginal Pricing, Transmission Charges, Merchant Power, Differential Electricity, Congestion Management, Ancillary Services, Hedging, Smart Power Market.

At the end of the Module 5, students will be able to:

- Discuss planning and implementation of electric –utility activities, market principles and the norms framed by CERC for online trading and exchange in the interstate power market.

Total hours:	**48 hours**

Term work:

1. Open book based exam

Content beyond syllabus:

1.

Self-Study:

Contents to promote self-Learning:

SNO	MODULE	Reference
1	Power System Regulation, Scenario Planning	https://www.nrel.gov/docs/fy08osti/42297.pdf
2	Modernization of Power Plants	https://www.powermag.com/history-of-power-plant-renovation-and-modernization-in-india/#:~:text=The%20GoI%20initiated%20a%20new,the%20existing%20thermal%20power%20plants.
3	Reactive Power Planning	https://www.igi-global.com/dictionary/reactive-power-planning/63461
4	Reliability and Quality Roadmap	https://www.slideshare.net/ASQwebinars/reliability-roadmap-using-quality-function-deployment
5	Smart Power Market	https://www.alliedmarketresearch.com/smart-energy-market-A09434

Text Book(s):

1. Electric Power Planning A. S. Pabla McGraw Hill, 2nd Edition, 2016

Online Resources:

1. https://www.nrel.gov/docs/fy08osti/42297.pdf
2. https://www.powermag.com/history-of-power-plant-renovation-and-modernization-in-india/#:~:text=The%20GoI%20initiated%20a%20new,the%20existing%20thermal%20power%20plants.
3. https://www.igi-global.com/dictionary/reactive-power-planning/63461
4. https://www.slideshare.net/ASQwebinars/reliability-roadmap-using-quality-function-deployment
5. https://www.alliedmarketresearch.com/smart-energy-market-A09434

Web References:

1. https://nptel.ac.in/courses/108101040

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4011	**Reactive Power Compensation and Management**							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

- To identify the necessity of reactive power compensation
- To describe load compensation
- To select various types of reactive power compensation in transmission systems
- To contrast reactive power coordination system
- To characterize distribution side and utility side reactive power management.

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

CO 1	Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads (BL-3)
CO 2	Observe various compensation methods in transmission lines (BL-2)
CO 3	Construct model for reactive power coordination (BL-3)
CO 4	Understand the demand side reactive power management (BL-2)
CO 5	Understand the user side reactive power management (BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	2	2		2					2		2	1
CO2	3	3	2	2		2					2		3	2
CO3	3	3	2	2		2					2		2	2
CO4	3	3	2	2		2					2		3	3
CO5	3	3	2	2		2					2		2	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**Load Compensation**	**10 Hours**

Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

At the end of the Module 1, students will be able to:

1. Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads (BL-3)

MODULE -2	**Steady – State Reactive Power Compensation in Transmission System**	**10 Hours**

Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation –examples Transient state reactive power compensation in transmission systems: Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation – compensation using synchronous condensers – examples

At the end of the Module 2, students will be able to:

1. Observe various compensation methods in transmission lines (BL-2)

MODULE-3	**Reactive Power Coordination**	**09 Hours**

Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency –Harmonics, radio frequency and electromagnetic interferences

At the end of the Module 3, students will be able to:

1. Construct model for reactive power coordination (BL-3)

MODULE-4	**Demand Side Management**	**10 Hours**

Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels Distribution side Reactive power Management:: System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks

At the end of the Module 4, students will be able to:

1. Understand the demand side reactive power management (BL-2)

MODULE-5	**User Side Reactive Power Management**	**09 Hours**

KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations Reactive power management in electric traction systems and are furnaces: Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace

At the end of the Module 5, students will be able to:

1. Understand the user side reactive power management (BL-2)

Total hours:	**48 hours**

Term work:

1.

Content beyond syllabus:

1. Modern tool usage to analyze the reactive power in power system

Self-Study:

Contents to promote self-Learning:

SNO	MODULE	Reference
1	power factor correction of unsymmetrical loads	http://ethesis.nitrkl.ac.in/6395/1/E-8.pdf
2	series capacitor compensation	https://circuitglobe.com/series-compensation.html
3	radio frequency and electromagnetic interferences	https://en.wikipedia.org/wiki/Electromagnetic_interference
4	retrofitting of capacitor banks	https://www.theelectricalguy.in/tutorials/5-types-of-power-factor-correction-capacitor-bank-locations/
5	power factor of an arc furnace	https://www.ijert.org/research/power-quality-improvement-in-electric-arc-furnace-IJERTV4IS040198.pdf

Text Book(s):

- Reactive power control in Electric power systems by T.J.E. Miller, John Wiley and sons, 1982.

- Reactive power Management by D. M. Tagare, Tata McGraw Hill, 2004.

Reference Book(s):

- Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide, April, 2012, Wiely publication.

Online Resources:

1. http://ethesis.nitrkl.ac.in/6395/1/E-8.pdf
2. https://circuitglobe.com/series-compensation.html
3. https://en.wikipedia.org/wiki/Electromagnetic_interference
4. https://www.theelectricalguy.in/tutorials/5-types-of-power-factor-correction-capacitor-bank-locations/
5. https://www.ijert.org/research/power-quality-improvement-in-electric-arc-furnace-IJERTV4IS040198.pdf

Web References:

1. https://www.youtube.com/watch?v=OR5Fdfh9Hbw

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4016	POWER QUALITY							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. Power quality issues and standards.
2. The sources of power quality disturbances and power transients that occur in power systems.
3. The sources of harmonics, harmonic indices, Devices for controlling harmonic distortion.
4. The principle of operation of DVR and UPQC.

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

CO 1	Address power quality issues to ensure meeting of standards (BL-2)
CO 2	Apply the concepts of compensation for sags and swells using voltage regulating devices (BL-3)
CO 3	Assess harmonic distortion and its mitigation. (BL-4)
CO 4	Understand the power measurement data according to standards (BL-2)
CO 5	Analyze the power quality improvement with custom power devices (BL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2									2	1
CO2	3	3	2	2									3	2
CO3	3	3	2	2	2								2	2
CO4	3	3	2	2	2								3	3
CO5	3	3	2	2	2								2	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	INTRODUCTION	10 Hours

Definition of Power Quality- Power Quality Terminology – Classification of Power Quality Issues- Magnitude Versus Duration Plot - Power Quality Standards - Responsibilities of Suppliers and Users of Electric Power-CBEMA and ITI Curves.

At the end of the Module 1, students will be able to:

1. Address power quality issues to ensure meeting of standards (BL-2)

MODULE -2	TRANSIENTS, SHORT DURATION AND LONG DURATION VARIATIONS	10 Hours

Categories and Characteristics of Electromagnetic Phenomena in Power Systems- Impulsive and Oscillatory Transients-Interruption - Sag-Swell-Sustained Interruption - Under Voltage – Over Voltage–Outage. Sources of Different Power Quality
Disturbances- Principles of Regulating the Voltage- Conventional Devices for Voltage Regulation.

At the end of the Module 2, students will be able to:

1. Apply the concepts of compensation for sags and swells using voltage regulating devices (BL-3)

MODULE-3	FUNDAMENTALS OF HARMONICS & APPLIED HARMONICS	09 Hours

Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quality Under Non Sinusoidal Conditions, Harmonic Indices, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads. Applied Harmonics**:** Effects Of Harmonics, Harmonic Distortion Evaluations, Principles of Controlling Harmonics, Devices for Controlling Harmonic Distortion.

At the end of the Module 3, students will be able to:

1. Assess harmonic distortion and its mitigation. (BL-4)

MODULE-4	**POWER QUALITY MONITORING**	**10 Hours**

Power Quality Benchmarking-Monitoring Considerations- Choosing Monitoring Locations-Permanent Power Quality Monitoring Equipment-Historical Perspective of Power Quality Measuring Instruments- Power Quality Measurement Equipment-Types of Instruments- Assessment of Power Quality Measurement Data- Power Quality Monitoring Standards.

At the end of the Module 4, students will be able to:

1. Understand the power measurement data according to standards (BL-2)

MODULE-5	**POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES**	**09 Hours**

Introduction to Custom Power Devices-Network Reconfiguring Type: Solid State Current Limiter (SSCL)-Solid State Breaker (SSB) -Solid State Transfer Switch (SSTS) - Compensating Type: Dynamic Voltage Restorer (DVR)-Unified Power Quality Conditioner(UPQC)-Principle of Operation Only.

At the end of the Module 5, students will be able to:

1. Analyze the power quality improvement with custom power devices (BL-4)

Total hours:	**48 hours**

Term work:

1.

Content beyond syllabus:

1. AI based power quality improvement methods.

Self-Study:

Contents to promote self-Learning:

SNO	MODULE	Reference
1	Responsibilities of Suppliers and Users of Electric Power	https://pure.tue.nl/ws/files/2804575/712690.pdf
2	Conventional Devices for Voltage Regulation	https://www.electrical4u.com/voltage-regulator/
3	Devices for Controlling Harmonic Distortion	https://www.brainkart.com/article/Devices-for-Controlling-Harmonic-Distortion_11725/
4	Power Quality Monitoring Standards	https://www.engineeringenotes.com/electrical-engineering/power-quality/standards-for-monitoring-power-quality-electricity/32560
5	Custom Power Devices	https://www.ripublication.com/irph/ijeee_spl/ijeeev7n7_11.pdf

Text Book(s):

1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition, 2012.

2. Power quality, C. Sankaran, CRC Press, 2001.

Reference Book(s):

1. Understanding Power quality problems – Voltage Sags and Interruptions, Math H. J. Bollen IEEE Press Series on Power Engineering, WILEY, 2007.
2. Power quality – VAR Compensation in Power Systems, R. Sastry Vedam, Mulukutla S. Sarma, CRC Press, 2009, First Indian Reprint 2013.
3. Fundamentals of Electric Power Quality, Surya Santoso, Create Space, 2012.

Online Resources:

1. https://pure.tue.nl/ws/files/2804575/712690.pdf
2. https://www.electrical4u.com/voltage-regulator/
3. https://www.brainkart.com/article/Devices-for-Controlling-Harmonic-Distortion_11725/
4. https://www.engineeringenotes.com/electrical-engineering/power-quality/standards-for-monitoring-power-quality-electricity/32560
5. https://www.ripublication.com/irph/ijeee_spl/ijeeev7n7_11.pdf

Web References:

1. https://onlinecourses.nptel.ac.in/noc21_ee103/preview

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4021	**SMART GRID TECHNOLOGIES**							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

- To understand various aspects of smart grid
- To study various smart transmission and distribution technologies
- To appreciate distribution generation and smart consumption
- To know the regulations and market models for smart grid

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

CO 1	Understand technologies for smart grid (BL-2)
CO 2	Understand the smart transmission system and its technologies (BL-2)
CO 3	Understand the smart distribution system and its technologies (BL-2)
CO 4	Realize the distribution generation and smart consumption (BL-3)
CO 5	Know the regulations and market models for smart grid (BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	3	2		2	2						2	1
CO2	3	3	3	2		2	2						3	2
CO3	3	3	3	2		2	2						2	2
CO4	3	3	3	2		2	2	2					3	3
CO5	3	3	3	2		2	2	2					2	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**Introduction to Smart Grids**	**10 Hours**

Definition, justification for smart grids, smart grid conceptual model, smart grid architectures, Interoperability, communication technologies, role of smart grids standards, intelligrid initiative, national smart grid mission (NSGM) by Govt. of India

At the end of the Module 1, students will be able to:

1. Understand technologies for smart grid (BL-2)

MODULE -2	**Smart Transmission Technologies**	**10 Hours**

Substation automation, Supervisory control and data acquisition (SCADA), energy management system (EMS), phasor measurement units (PMU), Wide area measurement systems (WAMS)

At the end of the Module 2, students will be able to:

1. Understand the smart transmission system and its technologies (BL-2)

MODULE-3	Smart Distribution Technologies	**09 Hours**
Distribution automation, outage management systems, automated meter reading (AMR), automated metering infrastructure (AMI), fault location isolation and service restoration (FLISR), Outage Management Systems (OMS), Energy Storage, Renewable Integration		
At the end of the Module 3, students will be able to: 1. Understand the smart distribution system and its technologies (BL-2)		
MODULE-4	Distributed Generation and Smart Consumption	**10 Hours**
Distributed energy resources (DERs), smart appliances, low voltage DC (LVDC) distribution in homes / buildings, home energy management system (HEMS), Net Metering, Building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Microgrid		
At the end of the Module 4, students will be able to: 1. Realize the distribution generation and smart consumption (BL-3)		
MODULE-5	Regulations and Market Models for Smart Grid	**09 Hours**
Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc. Cost benefit analysis of smart grid projects.		
At the end of the Module 5, students will be able to: 1. Know the regulations and market models for smart grid (BL-2)		
Total hours:		**48 hours**

Content beyond syllabus:

1. Cost Estimation of Smart Gird in India

Self-Study:

Contents to promote self-Learning:

SNO	MODULE	Reference
1	National smart grid mission (NSGM) by Govt. of India	https://www.nsgm.gov.in/#:~:text=NSGM%20Establishment,January%202016%20with%20dedicated%20team.
2	Wide area measurement systems (WAMS)	https://www.energy.gov/sites/default/files/oeprod/DocumentsandMedia/8-Securing_WAMS.pdf
3	Renewable Integration	https://www.energy.gov/oe/services/technology-development/renewable-energy-integration
4	Home energy management system (HEMS)	https://www.osti.gov/servlets/purl/1423114
5	Cost benefit analysis of smart grid projects	https://www.slideshare.net/sustenergy/multicriteria-and-cost-benefit-analysis-for-smart-grid-projects

Text Book(s):

1. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009.
2. Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley-ISTE, IEEE Press, May 2012

Reference Book(s):

- Janaka Ekanayake, Kithsiri Liyanage, Jianzhong. Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
- James Momoh, "Smart Grid: Fundamentals of Design and Analysis" – Wiley, IEEE Press, 2012.

Online Resources:

1. https://www.nsgm.gov.in/#:~:text=NSGM%20Establishment,January%202016%20with%20dedicated%20team.
2. https://www.energy.gov/sites/default/files/oeprod/DocumentsandMedia/8-Securing_WAMS.pdf
3. https://www.energy.gov/oe/services/technology-development/renewable-energy-integration
4. https://www.osti.gov/servlets/purl/1423114
5. https://www.slideshare.net/sustenergy/multicriteria-and-cost-benefit-analysis-for-smart-grid-projects

Web References:

1. India Smart Grid Knowledge Portal

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4002	System Modelling and Identification							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	ACS	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1.To Understand the Modelling of Dynamic Systems
2 To Understand the Stability margins, correlation of frequency domain and time domain
3. To Understand the Concepts of linear sampled data systems
4. To Understand the computation Z-transform
5. To Understand the compensation in Z domain and W plane

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

CO 1	Learn the design of Modelling of Dynamic Systems
CO 2	Analyze the Stability margins, correlation of frequency domain and time domain
CO 3	Analyse linear sampled data systems
CO 4	Learn the computation Z-transform
CO 5	Understand the compensation in Z domain and W plane

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1	1										1	1
CO2	3		1										1	1
CO3	1	2												1
CO4	1	2	1										1	1
CO5	1		2											2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

Modelling of Dynamic Systems

State variable Modelling of Continuous Dynamic Systems.
Solution methods for Nonlinear Differential equations. Bond Graph Techniques.

At the end of the Module 1, students will be able to:

1. Understand the importance of State variable approach
2. Analyze Nonlinear Differential equations

MODULE -2

Classical control theory:

Review of classical control theory: Stability margins, correlation of frequency domain and time domain parameters, design specifications, compensation of continuous systems, actuator selection and design.
State variable modelling of linear continuous systems, controllability and observability

At the end of the Module 2, students will be able to:

1. Understand the Stability margins
2. Analyze correlation of frequency domain and time domain parameters, design
3. Understand the concepts of controllability and observability

MODULE-3

Concepts of linear sampled data systems: Discrete equivalents of continuous data systems, reconstruction of sampled signals, sample and 0 order holds, stability of linear sampled data systems.
State variable modelling of linear discrete data systems, controllability and observability.

At the end of the Module 3, students will be able to:

1. Analyze stability of linear sampled signals.
2. Understand the State variable modelling of linear discrete data systems

MODULE-4

Digital Control Theory: **I**
Review of Z-transform. Computation of time response of Discrete Data system. Bilinear Transformation. W-plane, prewarping, inverse transformation. Design of discrete controllers.

At the end of the Module 4, students will be able to:

1. Understand the Z-transform & Bilinear Transformation
2. Analyze the design of discrete controllers

MODULE-5

Digital Control Theory: **II**
Z-domain compensation, w-plane compensation, state variable feedback, deadbeat controller sampled data version of PID controllers. Effect of Data Digitization. Effect of finite word size, limit cycle Determination.

At the end of the Module 5, students will be able to:

1. Analyze compensations in Z domains, W domains
2. Understand the concepts of controllers

Total hours:	**50 hours**

Term work:
Assignments followed by quizzes

Content beyond syllabus:
Simulation Software. Skeletal Structure of Simulation software

Self-Study:
Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Bond Graph Techniques	CO1	https://researchonline.gcu.ac.uk/ws/portalfiles/portal/3218404/bond_graph_modeling_postprint.pdf
2	State variable modelling of linear continuous systems	CO2	https://www.ijert.org/state-variable-analysis-of-continuous-time-systems
3	controllability and observability	CO3	https://www.ece.rutgers.edu/~gajic/psfiles/chap5traCO.pdf
4	W-plane, prewarping	CO4	https://en.wikibooks.org/wiki/Digital_Signal_Processing/Bilinear_Transform
5	Effect of finite word size	CO5	http://www.dsp-book.narod.ru/DSPMW/03.PDF

Text Book(s):
1. G.P. Rao, "Identification of continuous-time systems" suggested by Kranthi Deveerasetty (Entry level)

2. Modeling & Identification of Dynamic Systems Hardcover – Import, 23 August 2016
by Lennart Ljung (Author), Torkel Glad (Author)

3. K. P. Mohandas, “Modern Control Engineering”, Sanguine Technical Publishers, 2006.

Reference Book(s):

1. Highlights of system identification provided by Manuel De la Sen.
. Heij, A.C.M. Ran, F. van Schagen, "Introduction to Mathematical Systems Theory: Linear Systems, Identification and Control" suggested by Mahmood Dadkhah
2.System Identification: An Introduction Book by Karel J. Keesman

Online Resources:

1. https://ptolemy.berkeley.edu/books/Systems/PtolemyII_DigitalV1_02.pdf

Web Resources:

1. https://hal.archives-ouvertes.fr/hal-00718864/document
2. https://www.mathworks.com/help/ident/gs/about-system-identification.html

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4007	ADVANCED CONTROL SYSTEMS							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	ACS	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To Understand state feedback control and state observer
2. To Understand the phase plane analysis
3. To Understand the Analysis of describing functions with non-linearities
4. To Understand the design of optimal controller
5. To Understand the design of optimal estimator including Kalman Filter, Lyapunov's Stability

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

CO 1	Learn the design of state feedback controller and state observer
CO 2	Analyze the linear and nonlinear systems using phase plane method.
CO 3	Analyse nonlinear systems using describing function method..
CO 4	Learn the optimal control problem
CO 5	Understand the Solution of Kalman Filter by duality principle, Direct method of Lypanov for Linear and Nonlinear continuous time autonomous systems.

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1	1										1	2
CO2	3		1										1	1
CO3	1	2												1
CO4	2	2	3										1	2
CO5	2		1											2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

STATE VARIABLE DESIGN:

Introduction to state model: Effect of state feedback - Pole placement design: Necessary and sufficient condition for arbitrary pole placement, State regulator design - Design of state observers- Separation principle- Design of servo systems: State feedback with integral control

At the end of the Module 1, students will be able to:

1. Understand the importance of State variable approach
2. Analyze the state observers and pole placement
3. Develop the State feedback with integral control

MODULE -2

PHASE PLANE ANALYSIS:

Features of linear and non-linear systems - Common physical non-linearities – Phase plane method: Basic concept, Singular points, Limit cycles, Phase trajectories - Construction of phase trajectories of linear and non-linear systems: Analytical method, Isocline method.

At the end of the Module 2, students will be able to:

1. Understand the Features of linear and non-linear systems
2. Implement the Phase plane method
3. Understand the Construction of phase trajectories of linear and non-linear systems

MODULE-3

DESCRIBING FUNCTION ANALYSIS:

Basic concepts, Derivation of describing functions for common non-linearities: Dead zone, Saturation, Relay, Hysteresis, Backlash – Describing function analysis of non-linear systems, Limit cycles, Stability of oscillations.

At the end of the Module 3, students will be able to:

1. Derive the describing functions for common non-linearities.
2. Understand the concept of Stability of oscillations

MODULE-4

OPTIMAL CONTROL:

Introduction: Classical control and optimization, formulation of optimal control problem, Typical optimal control performance measures - Optimal state regulator design: Lyapunov equation, Matrix Riccati equation - LQR steady state optimal control – Application examples.

At the end of the Module 4, students will be able to:

1. Understand the formulation of optimal control problem
2. Analyze the optimal control performance measures
3. Understand the Lyapunov and Matrix Riccati equations

MODULE-5

OPTIMAL ESTIMATION:

Introduction: Discrete systems - Optimal estimation: Kalman Filter, Kalman Bucy Filter, Solution by duality principle - Application examples.

STABILITY ANALYSIS:

Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems. Direct method of Lypanov for the Linear and Nonlinear continuous time autonomous systems.

At the end of the Module 5, students will be able to:

1. Analyze the operation of Kalman and Kalman Bucy Filter
2. Understand the Solution by duality principle
3. Understand the Direct method of Lypanov for autonomous systems.

Total hours:	**50 hours**

Term work:

Assignments followed by quizzes

Content beyond syllabus:

Real-time Embedded Control Systems

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	state feedback controller and state observer	CO1	https://nptel.ac.in/content/storage2/courses/108103008/PDF/module9/m9_lec3.pdf
2	linear and nonlinear systems using phase plane method	CO2	https://nptel.ac.in/courses/108/106/108106162/
3	Analysis of describing functions with non-linearities	CO3	https://people.unica.it/eliousai/files/2015/10/Describing-Function-analysis-v1.pdf
4	Optimal control problem	CO4	https://nptel.ac.in/courses/108/105/108105019/#
5	Solution of Kalman Filter by duality principle	CO5	https://nptel.ac.in/content/storage2/courses/101108047/module15/Lecture%2040.pdf https://nptel.ac.in/courses/101/108/101108047/

Text Book(s):

1. M.Gopal, “Digital Control and State Variable Methods”, 4th edition, Mc Graw Hill India, 2012
2. K. Ogata, ‘Modern Control Engineering’, 5th Edition, Pearson, 2012
3. K. P. Mohandas, “Modern Control Engineering”, Sanguine Technical Publishers, 2006.

Reference Book(s):

1. William S Levine, “Control System Fundamentals,” The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
2. M.Gopal, Modern Control System Theory, 3rd edition, New Age International Publishers, 2014

Online Resources:

1. https://b-ok.asia/book/1193802/dec93b
2. https://b-ok.asia/book/459450/7e89ab

Web Resources:

1. https://www.youtube.com/watch?v=bbm79-UcNN0&list=PLbMVogVj5nJTNkhtkCEKQHhPOr2bpS3za
2. https://www.youtube.com/watch?v=DSvBXXnZv34&list=PLUY5PVaLSLNEKzeQv13ZevTL5AhnQOkWX

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4012	Digital Signal Processing							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	ACS	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To Understand Discrete-time signals and systems & properties
2. To Understand z- Transform, inverse z- Transform & properties
3. To Understand the design of low pass, high pass, band pass & stop band IIR digital filters
4. To Understand Computer aided design of Equiripple Linear phase FIR filters
5. To Understand arithmetic round off errors, Low sensitivity digital filters

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

CO 1	Understand Discrete-time signals and systems & properties
CO 2	Analyze the z- Transform, inverse z- Transform & properties
CO 3	Understand the design of low pass, high pass, band pass & stop band IIR digital filters
CO 4	Learn Computer aided design of Equiripple Linear phase FIR filters
CO 5	Understand arithmetic round off errors, Low sensitivity digital filters.

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	1										1	2
CO2	1		3										1	2
CO3	2	2												1
CO4	2	1	3										1	2
CO5	2		1											2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

Short introduction, Analog to digital and Digital to Analog conversion, sampled and Hold circuit, Continuous time Fourier Transforms. Discrete-time signals and systems, Discrete-time Fourier transform- its properties and applications, Fast Fourier Transform (in time-domain and Frequency domain) , IDFT and its properties.

At the end of the Module 1, students will be able to:

1. Understand Analog to digital and Digital to Analog conversion
2. Analyze Discrete-time signals & Continuous time Fourier Transforms

MODULE -2

z- Transforms

Definition and properties, Rational z-transforms, Region of convergence of a rational z- Transform, The inverse z-Transform, Z-Transform properties, Computation of the convolution sum of finite length sequences, The transfer function

Digital Filter Structures: Block Diagram representation, Equivalent structures, Basic FIR Digital Filter structures, Basic IIR Digital Filter structures, Realization of Basic structures using MATLAB, All pass filters, Computational complexity of Digital filter structures.

At the end of the Module 2, students will be able to:

1. Understand the Digital Filter structures
2. Able to Compute of the convolution sum of finite length sequences
3. Able to form Basic structures using MATLAB

MODULE-3
IIR Digital Filter Design: Preliminary considerations, Bilinear transformation method of IIR Filter design, Design of low pass IIR Digital filters, Design of High pass, Band pass and band stop IIR digital filters, Spectral Transformations of IIR filter, IIR digital filter design using MATLAB, Computer aided design of IIR digital filters.
At the end of the Module 3, students will be able to: 1. Able to design Computer aided IIR digital filters 2. Understand the concept Bilinear transformation
MODULE-4
FIR Digital Filter Design: Preliminary considerations, FIR filter design based on windowed Fourier series, Computer aided design of Equiripple Linear phase FIR filters, Design of Minimum phase FIR filters, FIR digital filter design using MATLAB, Design of computationally efficient FIR digital filters.
At the end of the Module 4, students will be able to: 1. Understand the concept of windowed Fourier series 2. Analyze the Design of Minimum phase FIR filters
MODULE-5
Analysis of Finite word length effects: The quantization process and errors, quantization of Fixed point numbers, Quantization of floating point numbers, Analysis of coefficient quantization effects, Analysis of arithmetic round off errors, Low sensitivity digital filters, Reduction of product round off errors using error feedback, Round off errors in FFT algorithms. The basic sample rate alteration devices, Multi rate structures for sampling rate conversion, Multistage design of decimator and interpolator, The Poly phase decomposition, Arbitrary-rate sampling rate converter.
At the end of the Module 5, students will be able to: 1. Analyze the coefficient quantization effects 2. Understand the Multi rate structures for sampling rate conversion 3. Understand the Multistage design of decimator and interpolator.
Total hours: 50 hours

Term work:
Assignments followed by quizzes

Content beyond syllabus:
Nyquist Filters and some applications of digital signal processing.

Self-Study:
Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Discrete-time Fourier transform- its properties	CO1	https://cnx.org/contents/KilsjSQd@10.18:AMguPRlV@11/Properties-of-the-DTFT
2	Basic FIR Digital Filter structures	CO2	https://www.ni.com/docs/en-US/bundle/labview-2014-digital-filter-design-toolkit-api-ref/page/lvdfdtconcepts/fir_filter_specs.html
3	Computer aided design of IIR digital filters.	CO3	https://www.tutorialspoint.com/digital_signal_processing/dsp_computer_aided_design.htm
4	Design of Minimum phase FIR filters	CO4	https://www.dsprelated.com/freebooks/filters/Minimum_Phase_Filters.html
5	Analysis of arithmetic round off errors	CO5	https://en.wikipedia.org/wiki/Round-off_error

Text Book(s):

1. S.K. Mitra, Digital Signal Processing-, Tata McGraw-Hill, Third Edition, 2006.
2. B.P. Lathi, Principle of Signal Processing and Linear Systems-, Oxford International Student Version, 2009
3. M. Mondal and A Asif, Continuous and Discrete Time Signals and Systems, Cambridge,2007

Reference Book(s):

1. Li Tan, Digital Signal Processing- Fundamentals and Applications-, Indian reprint, Elsevier, 2008.
2. Alan V. Oppenheim, Ronald W. Schafer, and John R.Buck, Discrete- Time Signal Processing-, Pearson Edu, 2008.

Online Resources:

1. https://www.tutorialspoint.com/digital_signal_processing/dsp_unstable_systems.htm
2.softwaretestinghelp.com/digital-signal-processing-tutorial/

Web Resources:

1. https://www.youtube.com/watch?v=6dFnpz_AEyA
2. https://www.youtube.com/watch?v=JpHXMcDxNiA
3.https://www.youtube.com/watch?v=p8cina5Ke_c

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4017	MULTIVARIABLE CONTROL SYSTEMS							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	ACS	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To Understand Multivariable Connections, Multivariable Representation
2. To Understand Performance Specification in Multivariable Systems
3. To Understand Stability of Multivariable Feedback
4. To Understand Controllability and Observability and Realization in Multivariable Systems
5. To Understand Multivariable Control System Design

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

CO 1	Learn the Multivariable Connections, Multivariable Representation
CO 2	Analyze the Performance Specification in Multivariable Systems.
CO 3	Analyse Stability of Multivariable Feedback
CO 4	Learn the Controllability and Observability and Realization in Multivariable Systems
CO 5	Understand the Multivariable Control System Design

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1	1										1	2
CO2	3		1										1	1
CO3	1	2												1
CO4	2	2	3										1	2
CO5	2		1											2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

Introduction in Multivariable Control Systems:
Multivariable Connections, Multivariable Representation
Poles and Zeros in Multivariable Systems : Multivariable Poles and Zeros, Direction of Poles and Zeros, Smith-McMillan Form, Matrix Fraction Description, Transmission Zero Assignment

At the end of the Module 1, students will be able to:

1. Understand the Multivariable Control Systems
2. Analyze the Transmission Zero Assignment

MODULE -2

Performance Specification in Mulivariable Systems and Their Limitations:
A Brief Review of Linear Control System, Scaling and Performance, Shaping Closed-loop Transfer Function, Fundamental Limitation on Performance

At the end of the Module 2, students will be able to:

1. Understand the Performance Specification in Mulivariable Systems
2. Understand the Limitations

MODULE-3

Stability of Multivariable Feedback Control Systems: Well-Posedness of Feedback Loop, Internal Stability, The Nyquist Stability Criterion, Co-prime Factorization over Stable Transfer Functions, Stabilizing Controllers, Strong and Simultaneous Stabilization

At the end of the Module 3, students will be able to:

1. Understand the concept of Stabilizing Controllers
2. Understand the concept of Stability

MODULE-4

Controllability and Observability and Realization in Multivariable Systems:

Controllability and Observability, Output Controllability, Realization, Model Order Reduction

At the end of the Module 4, students will be able to:

1. Understand the concept of Controllability and Observability
2. Analyze the Realization techniques

MODULE-5

Multivariable Control System Design: Sequential Loop Closing, Characteristic-Locus Method, PI Controller for MIMO Systems ,Decoupling, Diagonal Controller, Nyquist-Array Method

At the end of the Module 5, students will be able to:

1. Analyze the Sequential Loop Closing
2. Understand the Decoupling, Diagonal Controllers

Total hours:	**50 hours**

Term work:

Assignments followed by quizzes

Content beyond syllabus:

Robust stability and performance analysis via integral quadratic constraints.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Multivariable Control Systems	CO1	https://www.youtube.com/watch?v=mMtFuYeJp5A
2	Scaling and Performance ns	CO2	https://www.dynatrace.com/news/blog/performance-vs-scalability/
3	Stability of Multivariable Feedback Control Systems	CO3	https://www.sciencedirect.com/topics/engineering/multivariable-control-systems
4	Model Order Reduction	CO4	https://www.hindawi.com/journals/sv/2021/6631180/
5	Controllability and Observability and Realization in Multivariable Systems	CO5	http://profsite.um.ac.ir/~karimpor/multi/Multivariable_lec5.pdf

Text Book(s): **1.Multivariable Control Systems: An Engineering Approach (Advanced Textbooks in Control and Signal Processing) 2004th Edition, Kindle Edition by Pedro Albertos (Author), Sala Antonio (Author) Format: Kindle Edition**
Reference Book(s): 1. Multivariable Feedback Control - Analysis and Design 2e (English, Paperback, Skogestad S)
Online Resources: 1. https://research.iaun.ac.ir/pd/mahmoodian/pdfs/UploadFile_3352.pdf
Web Resources: 1. https://research.iaun.ac.ir/pd/mahmoodian/pdfs/UploadFile_3352.pdf

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4022	REAL TIME CONTROL SYSTEMS							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	ACS	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To Understand Real - time systems
2. To Understand Hierarchical representation of complex DES
3. To Understand Real - time Operating Systems, Interrupts
4. To Understand Real – time Programming.
5. To Understand Real - time process and applications

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

CO 1	Analyze the Characteristic features of RT applications and develop features from Non - RT and Off - line system
CO 2	Understand the Hierarchical representation and analyzing Logical properties
CO 3	Derive the Example of checking safety and timing properties and also understand the Requirements and features of real - time Computing Environments
CO 4	Understand and analyze the Real – time Programming for real-time systems.
CO 5	Analyze the Real - time process, Applications and understand the Distributed Real - time systems

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	2	2									1	2
CO2	3	3	2	2									1	1
CO3	3	3	2	2										1
CO4	3	3	2	2									1	2
CO5	3	3	2	2										2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

Introduction to Real - time systems: Typical examples of RTS, Characteristic features of RT Applications. Structural, Functional and Performance requirement of Reactive RTS. Distinctive Features from Non - RT and Off - line system. Modelling RTS: Representation of time, Concurrency and Distributedness in discrete event systems.

At the end of the Module 1, students will be able to:

1. Understand the Real - time systems
2. Analyze the Characteristic features of RT applications
3. Develop features from Non - RT and Off - line system

MODULE -2

Hierarchical representation of complex DES. Input, Output and Communication. Examples of Modelling practical systems as RT DES. Modelling programs as RTS. Analyzing RTS: Analyzing Logical properties of DES such as Reachability, Deadlock etc. Analyzing timing related properties, Specification and Verification of RT DES properties.

At the end of the Module 2, students will be able to:

1. Understand the Hierarchical representation
2. Analyzing Logical properties

MODULE-3

Temporal logic, Model checking of industrial systems. Requirements and features of real - time Computing Environments: Real - time Operating Systems, Interrupts, clock, Device support.
At the end of the Module 3, students will be able to: 1. Derive the Example of checking safety and timing properties. 2. Understand the Requirements and features of real - time Computing Environments
MODULE-4
Real time System, Multi tasking, Static and Dynamical Scheduling of resource Allocation, Real – time Programming.
At the end of the Module 4, students will be able to: 1. Understand the Real time System 2. Analyze the Real – time Programming.
MODULE-5
Real - time process and applications, Distributed Real - time systems.
At the end of the Module 5, students will be able to: 1. Analyze the Real - time process 2. Understand the Real - time Applications 3. Understand the Distributed Real - time systems
Total hours: 48 hours

Term work:
Assignments followed by quizzes

Content beyond syllabus:
Dynamic Scheduling Algorithms

Self-Study:
Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Distributedness in discrete event systems	CO1	https://www.intechopen.com/chapters/38818
2	Specification and Verification of RT DES properties	CO2	https://hal.archives-ouvertes.fr/hal-01589479/document
3	Requirements and features of real - time Computing Environments	CO3	https://www.sciencedirect.com/topics/computer-science/real-time-computing
4	Multi tasking of Real time System	CO4	https://www.razorrobotics.com/multitasking-real-time-operating-systems/
5	Distributed Real - time systems	CO5	https://link.springer.com/book/10.1007/978-3-030-22570-4

Text Book(s):
1. Jane W S Liu, "Real- Time Systems", Pearson publications, 1st edition, 2006.

Reference Book(s):
1. Rajib Mall**, "**Real-Time Systems: Theory and Practice", Pearson Education India**,** 2009.

Online Resources:

1. https://www.intechopen.com/chapters/38818
2. https://hal.archives-ouvertes.fr/hal-01589479/document
3. https://www.sciencedirect.com/topics/computer-science/real-time-computing
4. https://www.razorrobotics.com/multitasking-real-time-operating-systems/
5. https://link.springer.com/book/10.1007/978-3-030-22570-4

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs98/preview

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4003	MACHINE MODELING AND ANALYSIS							R2020
	Hours / Week			Total	Credit	Max Marks		
	L	T	P	**hrs**	C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Fundamental concepts of Electrical Machines and Electro Magnetic Fields.

Course Objectives:

Able to understand the

1. Able to analyze the Basic Concepts of Modeling Electrical machines.
2. To understand Mathematical model of the DC Motor.
3. Able to analyze the dynamic modeling and phase transformation.
4. To understand the Modeling of Induction Machine.
5. To understand the Dynamic Analysis of Synchronous Machine.

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

CO 1	Understand the basic concepts of AC/ DC machine modeling. (BL-2)
CO 2	Understand the Mathematical model of the DC Machine. (BL-2)
CO 3	Analyze the Reference frame theory model of Electrical machine.(BL-3)
CO 4	Analyze the steady state and dynamic state operation of three-phase induction machine.(BL-3)
CO 5	Analyze the modeling and simulation of three phase synchronous machine .(BL-3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	2	2		2							1	3
CO2	2	2	2										2	3
CO3	2	2	2			2							2	3
CO4	3	2											2	3
CO5	2	3				2							1	3

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**BASIC CONCEPTS OF MODELING**	**08 Hours**

Basic Two - pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine - voltage, current and Torque equations.

At the end of the Module 1, students will be able to:

1. Understand the Two - pole Machine representation of Commutator machines. (BL-2)
2. Study the Kron's primitive Machine. (BL-2)
3. Understand the voltage, current and Torque equations. (BL-2)

MODULE -2	**MODELING OF DC MACHINES**	**08 Hours**

Mathematical model of separately excited D.C motor –Steady State analysis - Transient State analysis - Sudden application of Inertia Load - Transfer function of Separately excited D.C Motor - Mathematical model of D.C Series motor, Shunt motor - Linearization Techniques for small perturbations.

At the end of the Module 2, students will be able to:

1. Compare the Mathematical model of Different of DC Motors. (BL-2)
2. Explain the Steady State analysis. (BL-2)
3. Understand the Linearization Techniques for small perturbations. (BL-2)

MODULE-3	REFERENCE FRAME THEORY	08 Hours

Reference frame theory Real time model of a two phase induction machine - three phase to two phase transformation - Dynamic modeling of three phase Induction Machine - Stator reference frame model - Rotor reference frame model Synchronously rotating reference frame model.

At the end of the Module 3, students will be able to:

1. Understand the Real time model of a two phase induction machine. (BL-2)
2. Explain the three phase to two phase transformation. (BL-2)
3. Understand the Stator and Rotor reference frame model. (BL-2)

MODULE-4	MODELING OF INDUCTION MACHINES	08 Hours

Three phase induction machine, equivalent circuit and analysis of steady state operation – free acceleration characteristics – voltage and torque equations in machine variables and arbitrary Reference frame variables – analysis of dynamic performance for load torque variations.

At the end of the Module 4, students will be able to:

1. Demonstrate on steady state operation of induction machine. (BL-2)
2. Understand the voltage and torque equations in induction machines. (BL-2)
3. Analysis of dynamic performance of induction machines. (BL-3)

MODULE-5	MODELING AND ANALYSIS OF SYNCHRONOUS MACHINES	08 Hours

Synchronous machine inductances – voltage equations in the rotor's dq0 reference frame - electromagnetic torque - current in terms of flux linkages - simulation of three phase synchronous machine.

Dynamic performance of synchronous machine, three -phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria.

At the end of the Module 5, students will be able to:

1. Understand the electromagnetic torque.(BL-2)
2. Explain the Synchronous machine inductances. (BL-2)
3. Demonstrate on simulation of three phase synchronous machine.(BL-2)

Total hours:	40 hours

Term work:

1. Compare and Contrast the Mathematical model of different types of DC Motors submit the report.
2. Compare and Contrast the 3 phase synchronous machine with and without damper bars and submit the report.
3. Analyze the two phase induction machine and three phase induction machine and submit the report.
4. Analyze the Synchronous motor and PM Synchronous motor and submit the report.

Content beyond syllabus:

1. Symmetrical Two phase Induction Machine.
2. Unsymmetrical Two phase Induction Machine.
3. Modeling of PM Synchronous motor.

Self-Study:

Contents to promote self-Learning:

SNO	Module	Reference
1	BASIC CONCEPTS OF MODELING	https://nptel.ac.in/courses/112/107/112107220/
2	MODELING OF DC MACHINES	https://nptel.ac.in/courses/108/106/108106023/
3	REFERENCE FRAME THEORY	http://nptel.vtu.ac.in/econtent/courses/EEE/06EE63/index.php
4	MODELING OF INDUCTION MACHINES	https://nptel.ac.in/courses/108/106/108106023/
5	MODELING AND ANALYSIS OF SYNCHRONOUS MACHINES	https://nptel.ac.in/courses/108/101/108101004/
6	DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINES	https://nptel.ac.in/courses/108/106/108106023/

Text Book(s):

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis & Control", PHI Learning Private Ltd, 2009.
2. Paul C.Krause, Oleg Wasyzczuk, Scott S, Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley, Second Edition, 2010.
2. Sawhney, A.K., "A Course in Electrical Machine Design", Dhanpat Rai & Sons, New Delhi, 2013.

Reference Book(s):

1. P S Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers, 5th Edition, 2014.
2. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, "Electric Machinery", Tata McGraw Hill, 5th Edition, 1992.
3. Chee Mun Ong –"Dynamic simulation of Electric machinery using MATLAB / Simulink", Prentice Hall of India Publications.
4. Ramamoorthy M, "Computer Aided Design of Electrical Equipment", East-West Press.

Online Resources/ Web References:

1. https://books.google.co.in/books?id=0_D6gfUHjcEC&printsec=frontcover#v=onepage&q&f=false
2. http://nptel.ac.in/courses/108106023/
3. https://easyengineering.net/electrical-machinery-by-bimbhra/
4. https://www.hindawi.com/journals/mpe/2017/7348263/
5. https://nptel.ac.in/courses/108/106/108106023/
6. https://nptel.ac.in/courses/108/102/108102146/
7. http://www.ijrimsec.com/assoc_art/volume7_1/Ch_10.pdf
8. https://nptel.ac.in/courses/108/106/108106023/#

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4008	**Electrical Machine Design**							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Basic Electrical Engineering, DC Machines, Induction machines, Transformers and Synchronous machines

Course Objectives:

1. To discuss the properties of electrical, magnetic and insulating materials used in the design of electrical machines.
2. To design armature and field systems for D.C. machines.
3. To design core, yoke, windings and cooling systems of transformers.
4. To design stator and rotor of induction machines.
5. To design stator and rotor of synchronous machines and study their thermal behavior.

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

CO 1	Understand the basic principles of machine design. (BL-2)
CO 2	Analyze the performance design DC motor. (BL-4)
CO 3	Analyze the performance design winding and core of transformer. (BL-4)
CO 4	Analyze the performance design winding and core of rotating electrical machine. (BL-4)
CO 5	Analyze the short circuit ratio and its effects on performance of synchronous machines. (BL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2													
CO2	2	3	3	3	3								3	
CO3	2	3	3	3	3								3	
CO4	2	3	3	3	3								3	
CO5	2	3	3	3	3								3	

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	PRINCIPLES OF ELECTRICAL MACHINE DESIGN	8Hrs

Introduction, considerations for the design of electrical machines, limitations. Different types of materials and insulators used in electrical machines.

At the end of the Module 1, students will be able to:

1. Understand the limitations of electrical machines. . (BL-2)
2. Understand the different types of material used in electrical machines. (BL-2)
3. Understand the different types of Insulators used in electrical Machines. (BL-2)

MODULE -2	DESIGN OF DC MACHINES	10Hrs

Output equation, choice of specific loadings and choice of number of poles, design of Main dimensions of the DC machines, Design of armature slot dimensions, commutator and brushes, magnetic circuit - estimation of ampere turns, design of yoke and poles- main and inter poles, field windings – shunt, series and inter poles.

At the end of the Module 2, students will be able to:

1. Explain the output equation of DC machine. (BL-2)
2. Explain the choice of specific loadings for DC machine. (BL-2)
3. Understand the design of main dimension of DC machine and Design of armature slot, commutator yoke and pole. (BL-2)

MODULE-3	DESIGN OF TRANSFORMERS	10Hrs

Output Equations for single phase and three phase transformers, expression for volts/turn, Main Dimensions, Window space factor, Design of core and winding, Overall dimensions , expression for leakage reactance and voltage regulation, No load current , Temperature rise in Transformers ,Design of Tank, Methods of cooling of Transformers.

At the end of the Module 3, students will be able to:

1. Understand the main dimensions of transformers. (BL-2)
2. Understand the calculation of no load current.(BL-2)
3. Understand the design of transformer tank. (BL-2)

MODULE-4	Design of Induction Motors	10Hrs

Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance of single phase and Three Phase Induction motor.

At the end of the Module 4, students will be able to:

1. Understand the specific loadings and main dimensions of single phase and three phase induction motor. (BL-2)
2. Understand the design of slip ring and squirrel cage rotor. (BL-2)
3. Understand the Design of end rings and slip rings. (BL-2)

MODULE-5	Design of Three Phase Synchronous Machines	10Hrs

Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding.

At the end of the Module 6, students will be able to:

1. Understand the output equation of synchronous machines. (BL-2)
2. Understand the knowledge applied by designing a machine for an industrial application. (BL-2)
3. Explain the Magnetic Circuit and Field Winding of a synchronous machine. (BL-2)

Total hours:	**48 hours**

Term work:

1. Field trip visit at Voltactive Power Technologies Pvt Ltd Vijayawada to understand the design of transformer .
2. Develop armature winding diagram for DC and AC machines Develop a layout for substation using the standard symbols for substation equipment through Auto CADD
3. Draw sectional views of core and shell types transformers using the design data through Auto CADD
4. Draw sectional views of assembled DC machine or its parts using the design data or the sketches through Auto CADD.

Content beyond syllabus:

1. Design of small transformer
2. Modelling Of Electro Static and Magnetic Device.

3. Estimation of material and electrical installation of motor in different industry

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	Principles Of Electrical Machine Design	http://nptel.vtu.ac.in/econtent/courses/EEE/06EE63/index.php
2	Design of DC Machines	https://nptel.ac.in/courses/108/106/108106023/
3	Design of Transformers	http://nptel.vtu.ac.in/econtent/courses/EEE/06EE63/index.php
4	Design of Induction Motors	https://nptel.ac.in/courses/108/106/108106023/ https://nptel.ac.in/courses/108/106/108106023/
5	Design of Three Phase Synchronous Machines	https://nptel.ac.in/courses/108/106/108106023/

Text Book(s):

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 2011.
2. M.V.Deshpande "Design and Testing of Electrical Machine Design" Wheeler Publications, 2010.
3. V.N. Mittle and A. Mittle, "Design of Electrical Machines", 5th Edition, Standard Publications and Distributors, 2014, New Delhi.

Reference Book(s):

1. A.Shanmuga Sundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
2. R.K.Agarwal " Principles of Electrical Machine Design" Esskay Publications, 5th Edition Delhi, 2014.
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987
4. Ramamoorthy M, "Computer Aided Design of Electrical Equipment", East-West Press.
5. M. N. O. Sadiku, " Numerical techniques in Electromagnetics", CRC Press Edition-2001.
6. M.V. Deshpande, "Design and Testing of Electrical Machines"PHI learning, New Delhi.

Online Resources:

https://nptel.ac.in/courses/108/106/108106023/

Web Resources:

http://nptel.vtu.ac.in/econtent/courses/EEE/06EE63/index.php

JuhaPyrhonen, TapaniJokinen, Valeria Hrabovcova "Design of Rotating Electrical Machines", ISBN: 978-0-470-69516-6. Willey Publication Hardcover. 538 pages. February 2009. .

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4013	**Programmable Control Devices and Applications**							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: To Learn about Power Electronic devices, Semiconductor drives, Energy storage systems(Battery, Fuel Cell, Super Capacitor etc).

Course Objectives:

1. Understand the basic functions and types of PLCs.
2. Get exposure of Easy Veep software, its applications.
3. Classification of PLCs and applications
4. Programming using PLCs .
5. Troubleshooting aspects using PLCs.

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

CO 1	Understand different types of PLCs (BL-2)
CO 2	Understand the usage of Easy Veep software (BL-1)
CO 3	Understand the hardware details of Allen Bradley PLC . (BL-2)
CO 4	Programming of PLCs . (BL-2)
CO 5	Know about few applications of PLCs in different fields of Science and Technology . (BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2						2						2	3
CO2	2												2	2
CO3	3		1										1	2
CO4	2												1	
CO5	2												2	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	INTRODUCTION	8 Hours

Basic functions of PLCs, Mechanical relays versus PLC, Different types of PLC's – AllenBradley – Micrologix: ML1000, ML1100, SLC500, Compact Logix, Mitsubishi FX series, HMI's, Processor and I/O cards.

At the end of the Module 1, students will be able to:

1. To understand about basic functions of PLCs. (BL-2)
2. To distinguish between PLCs and Mechanical relays. (BL-2)
3. To know about Processor and I/O cards. (BL-2)

MODULE -2	Logic diagrams	8 Hours

Introduction to Easy Veep software, Link between mechanical, electrical and programming documentation, Logic diagrams, Flip-Flop Logic, M8000, M8001 internal bits interpretation, Binary code, data table, manipulation.

At the end of the Module 2, students will be able to:

1. To know about Easy Veep software .(BL-1)
2. To know about Logic diagrams. (BL-2)

MODULE-3	PLC software and applications	8 Hours

PLC software and applications, Boolean algebra – understanding binary code, ADD and SUB functions, UP and Down Counters, Introduction to k1Y0, MOV function, CPR and ZCP functions, SHWT and SHRD instructions, Introduction to Absolutely Drum Instruction.

At the end of the Module 3, students will be able to:

1. To know about basic features of PLCs. (BL-2)
2. To know about various instructions of PLC. (BL-2)

MODULE-4	PLC Hardware	10 Hours

Allen Bradley PLC: Introduction to Rockwell Software, Hardware focus, Hardware considerations (Field wiring, Master Control Relay, VFD), Basic programming and applications, Cascade control – subroutine, Different programs.

At the end of the Module 4, students will be able to:

1. To know about various PLC versions. (BL-2)
2. To understand about Cascade control and subroutines. (BL-1)

MODULE-5	PLC IC applications	10 Hours

Programming instructions: Instructions and binary interpretation, Bit Instruction, Timers and counters, Comparison instructions, Programming Instructions - Math instructions, Move and Logical Instructions, Discussions of programming, communications for PLC-Robotic arm, Exercise of setup and monitoring.

At the end of the Module 6, students will be able to:

1. To know about various Programming instructions. (BL-1)
2. To understand Math instructions in PLCs. (BL-2)
3. To understand about Communications with PLC using set up and monitoring. (BL-2)

Total hours:	**44 hours**

Term work:

Term work contains minimum two group assignments followed by seminars and quiz's

Content beyond syllabus:

1. Hybridization of different energy storage devices
2. Mechanics of Electric Vehicles

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Introduction to PLC	CO1	https://www.youtube.com/watch?v=PbAGl_mv5XI
2	PLC logic circuits	CO2	https://www.youtube.com/watch?v=X3xGqdb0DAA
3	PLC software applications	CO3	https://www.youtube.com/results?search_query=PLC+software+

	4	PLC Hardware applications	CO4	https://www.youtube.com/results?search_query=plc+hardware+components
	5	PLC IC applications	CO5	https://www.youtube.com/watch?v=JvTCgq5vss0

Text Book(s):

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
3. Electric Vehicle Technology Explained-James Larminie, John Lowry-John Wiley & Sons Ltd,-2003
4. Electric & Hybrid Vehicles-Design Fundamentals-Iqbal Hussain, Second Edition, CRCPress,2011

Reference Book(s):

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.
3. Iqbal Husain, "Electric and Hybrid Electric Vehicles", CRC Press, 2011.
4. Wei Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, WILEY, 2017

Online Resources / Web References:

1. https://b-ok.asia/book/1226776/eceb4b
2. https://b-ok.asia/book/3357286/21e776
3. http://ceb.ac.in/knowledge-center/E-BOOKS/Modern%20Electric,%20Hybrid%20Electric%20&%20Fuel%20Cell%20Vehicles%20-%20Mehrdad%20Ehsani.pdf
4. https://b-ok.asia/book/3516646/6fe038
5. https://nptel.ac.in/courses/108/103/108103009/
6. https://www.youtube.com/watch?v=V004WUdpHeA&list=PLlYm0-AHZdZRLYSylFinxkspWmcgNvbtl
7. https://www.youtube.com/watch?v=11e_d3Q9jEc

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4018	HYBRID ELECTRICAL VEHICLES							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: To Learn about Power Electronic devices, Semiconductor drives, Energy storage systems(Battery, Fuel Cell, Super Capacitor etc).

Course Objectives:

1. To understand Importance of Hybrid Electric Vehicles
2. To Know the various drive-train topologies
3. To Learn the operation and configurations of DC & AC Drives
4. To Know the importance of various Energy storage systems and Energy management strategies
5. To provide knowledge about supervisory control of EVs

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

CO 1	Understand the models to describe hybrid vehicles and their performance (BL-2)
CO 2	Classify various hybrid drive-train topologies(BL-1)
CO 3	Understand the various configurations of DC & AC Motor drives. (BL-2)
CO 4	Understand the different possible ways of energy storage and different strategies related to Energy management strategies. (BL-2)
CO 5	Understand the mode of operation and control Architecture. (BL-2)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2						2						2	3
CO2	2												2	2
CO3	3		1										1	2
CO4	2												1	
CO5	2												1	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	**INTRODUCTION TO ELECTRIC VEHICLES**	**8 Hours**

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

At the end of the Module 1, students will be able to:

1. Understand the importance of Electric vehicles over Conventional vehicles. (BL-2)
2. Understand the social and environmental importance of hybrid and electric vehicles. (BL-2)
3. Understand the impact of modern drive-trains on energy supplies. (BL-2)

MODULE -2	Hybrid Electric Drive-trains	8 Hours
Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis		
At the end of the Module 2, students will be able to: 1. Compare various hybrid drive-train topologies. (BL-1) 2. Explain power flow control in hybrid drive-train topologies. (BL-2) 3. Understand the Fuel efficiency analysis. (BL-2)		
MODULE-3	**Electric Propulsion unit**	**8 Hours**
Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives		
At the end of the Module 3, students will be able to: 1. Understand Configuration of DC Motor drives. (BL-2) 2. Understand Configuration of Induction Motor drives. (BL-2) 3. Understand Configuration of SRM drives. (BL-2)		
MODULE-4	**Energy Storage Systems and Energy Management**	**10 Hours**
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery, Fuel Cell, Super Capacitor based energy storage and its analysis. Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies.		
At the end of the Module 4, students will be able to: 1. Understand the requirements of Energy storage systems. (BL-2) 2. Know the Battery based Energy storage systems. (BL-1) 3. Understand the importance of energy management strategies. (BL-2)		
MODULE-5	**Hybrid Vehicle Control Strategy**	**10 Hours**
HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode.		
At the end of the Module 6, students will be able to: 1. Know the speed control techniques of HEV. (BL-1) 2. Distinguish the different modes of operation of control strategies. (BL-2)		
	Total hours:	**44 hours**

Term work:

Term work contains minimum two group assignments followed by seminars and quiz's

Content beyond syllabus:

1. Hybridization of different energy storage devices
2. Mechanics of Electric Vehicles

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Introduction to	CO1	https://nptel.ac.in/content/storage2/courses/108103009/

		Electric Vehicles		download/M1.pdf https://www.youtube.com/watch?v=KOLBGKMo3zQ
	2	Hybrid Electric Drive-trains	CO2	https://www.youtube.com/watch?v=oydKVcJqPQ0 https://nptel.ac.in/content/storage2/courses/108103009/download/M3.pdf
	3	DC & AC Motor drives	CO3	https://www.youtube.com/watch?v=1AT1yuQ9awM&list=PLFW6lRTa1g83sIfVY1p1xGqPGYUmXyahx
	4	Energy Storage Systems & Energy Management Strategies	CO4	https://www.youtube.com/watch?v=j7RaL_XKywk https://nptel.ac.in/content/storage2/courses/108103009/download/M10.pdf
	5	Hybrid Vehicle Control Strategy	CO5	https://nptel.ac.in/content/storage2/courses/108103009/download/M12.pdf

Text Book(s):

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
3. Electric Vehicle Technology Explained-James Larminie, John Lowry-John Wiley & Sons Ltd,-2003
4. Electric & Hybrid Vehicles-Design Fundamentals-Iqbal Hussain, Second Edition, CRCPress,2011

Reference Book(s):

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.
3. Iqbal Husain, "Electric and Hybrid Electric Vehicles", CRC Press, 2011.
4. Wei Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, WILEY, 2017

Online Resources / Web References:

1. https://b-ok.asia/book/1226776/eceb4b
2. https://b-ok.asia/book/3357286/21e776
3. http://ceb.ac.in/knowledge-center/E-BOOKS/Modern%20Electric,%20Hybrid%20Electric%20&%20Fuel%20Cell%20Vehicles%20-%20Mehrdad%20Ehsani.pdf
4. https://b-ok.asia/book/3516646/6fe038
5. https://nptel.ac.in/courses/108/103/108103009/
6. https://www.youtube.com/watch?v=V004WUdpHeA&list=PLlYm0-AHZdZRLYSylFinxkspWmcgNvbtl
7. https://www.youtube.com/watch?v=11e_d3Q9jEc

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4023	AUTOMOTIVE ELECTRICAL ENGINEERING							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	AEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To understand the various types of Batteries and their ratings
2. To understand the starting condition and its behavior
3. To understand the various charging systems in Automobiles
4. To learn different Lighting systems in Automobiles
5. To learn electronic engine management system in Automobiles
6. To understand the various electrical and non electrical sensors

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

CO 1	Compute the efficiency of Batteries through various test's
CO 2	Understand the working of different starter drive units and their maintenance and the concept of vehicle charging system with its auxiliaries
CO 3	Understand the dazzling of head light and its preventive methods
CO 4	Understand the electronic dashboard instruments & onboard diagnostic system
CO 5	Understand the various sensors used in Automobiles

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3		1				2						2	2
CO2	2	1	1											
CO3	2		1										1	
CO4	2	1	2										2	2
CO5	2	1	1										1	2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**10 Hours**

BATTERIES ACCESSORIES AND CHARGING SYSTEM

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging.

Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cutout. Voltage and current regulators, compensated voltage regulator, alternators.

At the end of the Module 1, students will be able to:

1. Explain the Principle and construction of lead acid battery
2. Identify the ratings of various Batteries
3. Understand the importance of voltage and current regulators in charging system

MODULE -2	**10 Hours**

STARTING SYSTEM

Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.

At the end of the Module 2, students will be able to:

1. Understand the importance of starter
2. Understand the principle and construction of starter motor
3. Explain the various types of starter switches

MODULE-3	10 Hours

LIGHTING

Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trafficator.

At the end of the Module 4, students will be able to:

1. Understand the arrangement of insulated and earth return system
2. Understand the working of wiper system and trafficator.

MODULE-4	10 Hours

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS

Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

At the end of the Module 5, students will be able to:

1. Understand the use of electronics in engine management system
2. Understand the concept of electromagnetic interference suppression
3. Understand the Automobile security and warning system

MODULE-5	10 Hours

SENSORS AND ACTUATORS

Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.

At the end of the Module 6, students will be able to:

1. Identify various types of sensors in Automobiles
2. Explain about air mass flow in engine application

Total hours:	50 hours

Term work:

Individual Assignments, followed by Quiz's

Content beyond syllabus:

1. Advanced charging system in Automobiles

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Construction of lead acid battery	CO1	https://circuitglobe.com/lead-acid-battery.html https://www.howacarworks.com/basics/how-the-charging-system-works
2	Principle and construction of starter motor	CO2	https://www.samarins.com/glossary/starter.html
3	Lighting system	CO3	https://what-when-how.com/automobile/lighting-circuit-automobile/
4	Automotive electronic engine management system	CO4	https://www.ukessays.com/essays/engineering/electronic-control-unit-and-engine-management-system-engineering-essay.php
5	Types of sensors	CO5	https://www.my-cardictionary.com/electronics/sensors.html

Text Book(s):

1. Tom Weather Jr and Cland C.Hunter, *"Automotive Computers and Control system"*, Prentice Hall Inc., New Jersey.
2. A. Bonnick, *"Automotive Computer Controlled Systems"*, 2011.
3. Young A. P & Griffiths L, *"Automobile Electrical and Electronic Equipments"* English Languages Book Society & New Press, 1990.

Reference Book(s):

1. Santini Al, *"Automotive Electricity and Electronics"*, Cengage Learning, 2012.
2. Tom Denton, *"Automotive Electrical and Electronic System"*, SAE International, 2004.
3. William B. Ribbens, *"Understanding Automotive Electronics"*, 6th Edition, Newnes, 2003.
4. BOSCH, *"Automotive Handbook"*, 8th Edition, BENTLEY ROBERT Incorporated, 2011.
5. Norm Chapman, *"Principles of Electricity and electronics for the Automotive Technician"*, Delmar Cengage Learning, 2008.
6. Judge A.W, *"Modern Electrical Equipment of Automobiles"*, Chapman & Hall, London, 1992.

Online Resources:

1. https://b-ok.asia/book/526451/802478
2. https://b-ok.asia/book/2161298/3ad7b5

Web Resources:

1. https://www.youtube.com/watch?v=hs7bABMtOMI&list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MlJau4F
2. https://www.youtube.com/watch?v=HHgPBMMZ26w

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4004	RENEWABLE ENERGY CONVERSION SYSTEMS							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	RECS	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nill

Course Objectives:

1. To create awareness about various Electric Energy Conversion Systems.
2. Learn the fundamental concepts about solar energy conversion systems and devices
3. To understand the solar thermal conversion systems for high temperature applications.
4. To learn Thermal and Bio-energy conversion systems
5. To Understand the various technologies that are used in WECS
6. To Understand the Fuel cell technology

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

CO 1	Understand various Electric Energy Conversion Systems (BTL-2)
CO 2	Analyze the solar thermal conversion system (Also for high temperature applications) (BTL-4)
CO 3	Analyze the Photovoltaic & Bio-Energy Conversion Systems (BTL-4)
CO 4	Illustrate the existing Wind Energy Conversion System (BTL-2)
CO 5	Extend the knowledge about working principle of various Fuel cell technology (BTL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1										1	
CO2	2	2											1	2
CO3	2	1											1	1
CO4	2	1	1											2
CO5	1	1	1										1	2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	ELECTRIC ENERGY CONVERSION SYSTEM	12 Hrs

Generation of electricity using different sources, Transmission and distribution losses, AC to DC and DC to AC conversions, Electric motors: Types, losses, efficiency, Lightning systems, Diesel generating systems.

At the end of the Module 1, students will be able to:

1. Understand various Electric Energy Conversion Systems.
2. Understand losses, efficiency related to Electric Energy Conversion Systems.

MODULE -2	SOLAR THERMAL CONVERSION SYSTEM	12 Hrs

Relevance of solar thermal power generation; Components of solar thermal power plant, Design and performance, characteristics of different solar concentrator types suitable for thermal power generation

HIGH TEMPERATURE APPLICATIONS: Types of solar thermal conversion system used in high temperature application, Tracking of solar concentrators; performance characterization of solar concentrators both line focus and point focus, Comparative analysis of the both mode focus system.

At the end of the Module 2, students will be able to:

1. Describe the existing solar Energy Conversion System
2. understand characteristics of different solar concentrators
3. Evaluate the solar thermal conversion systems for high temperature applications.
4. understand the working of various solar concentrators

MODULE-3	THERMAL ENERGY CONVERSION & BIO-ENERGY CONVERSION SYSTEMS	8 Hrs

Thermo-electric generator, Concepts and design considerations of MHD generators, Cycle analysis of MHD systems, Thermionic power conversion and plasma diodes, Thermo chemical Conversion. Bio-energy conversion, bio methanation technology.

At the end of the Module 4, students will be able to:

1. Understand the Photovoltaic & Bio-Energy Conversion Systems
2. Analyze Thermo chemical and Bio-energy conversion

MODULE-4	WIND ENERGY CONVERSION SYSTEM (WECS)	8 Hrs

Rotor Selection, Annual Energy Output, HAWT, VAWT, Rotor Design Considerations-Number of Blades, Blade Profile -2/3 Blades and Teetering, Coning- Upwind/Downwind, Power Regulation, Yaw System- Tower, Synchronous and Asynchronous Generators and Loads, Integration of Wind Energy Converters to Electrical Networks, Inverters.

At the end of the Module 5, students will be able to:

1. Describe the existing Wind Energy Conversion System.
2. understand the Rotor Design Considerations

MODULE-5	FUEL CELL TECHNOLOGY	8 Hrs

Overview of fuel cells, Fuel cell thermodynamics, fuel cell efficiency, Fuel cell characterization, Fuel cell modelling and system integration, Balance of plant, Hydrogen production from renewable sources and storage, life cycle analysis of fuel cells

At the end of the Module 6, students will be able to:

1. Understand the Fuel cell technology
2. Understand the Fuel cell modelling and system integration

Total hours: 48 hours

Term work:

Individual assignment, followed by Quiz and End semester examinations

Content beyond syllabus:

Advance energy conversion process

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Electric Energy Conversion Systems	CO1	https://www.britannica.com/technology/energy-conversio

2	solar energy conversion systems	CO2	https://www.appropedia.org/Solar_energy_conversion_system https://www.sciencedirect.com/topics/engineering/thermal-solar-energy-system-technology	
3	Thermal and Bio-energy conversion systems	CO3	http://www.fao.org/3/T1804E/t1804e06.htm	
4	Wind Energy Conversion Systems	CO4	https://www.appropedia.org/Wind_energy_conversion_system	
5	Fuel cell technology	CO5	https://www.hydrogenics.com/technology-resources/hydrogen-technology/fuel-cells/	

Text Book(s):

1. S. S. L. Chang, Energy Conversion, Prentice Hall, 1963
2. R. J. Rosa, Magneto hydrodynamic Energy Conversion, Springer, 1987.
3. V. S. Bagotsky, Fuel Cell Problems and Solutions, John Wiley & Sons, 2009

Reference Book(s):

1. Kettani, M.A., Direct energy conversion, Addison-Wesley, Reading, Mass, 1970
2. Hand book Batteries and Fuel Cells. Linden, McGraw Hill, 1984

Online Resources:

1. https://archive.org/details/energyconversion00chan
2. https://www.trine.edu/books/documents/de_text1.0.0.pdf

Web Resources:

1. https://www.youtube.com/watch?v=mpHZWYpKDJg
2. https://www.youtube.com/watch?v=GExTwRNkQBg

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4009	SOLAR AND FUEL CELL ENERGY SYSTEMS							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To make students understand the fundamental theory governing the photovoltaic devise and make them carry out preliminary system design.
2. To learn the fundamental knowledge about various fuel cell technologies.

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

CO 1	Understand the need of radiation of sun and discuss the various performance characteristics of solar radiation.(BL-2)
CO 2	Discuss the photovoltaic effect, PV Cell efficiency and its limits along with the concepts of fabrication technology for solar cell (BL-2)
CO 3	Predict the performance of solar photovoltaic device and analyze its performance. (BL-2)
CO 4	Carry out the application of photovoltaic system as power system. (BL-3)
CO 5	Analyze the performance of fuel cells under different operating conditions and also defend appropriate fuel cell technology for a given application. (BL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1			2	2						2	1
CO2	3	3	3			2	2				2		3	2
CO3	2	2	1			2	2				2		2	2
CO4	2	2				2	2	2			2		3	3
CO5	2	3	2			2	2				2		2	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	Solar Radiation	08 Hours

Sun as Energy Source, Solar Radiation at The Earth's Surface, Solar Radiation Geometry, Solar Time and Equation of Time, Sun Earth angles, Sun path diagram, Sunshine hours, Measurement of Solar Diffuse, Global and Direct Solar Radiation, Equipments, Estimation of Solar radiation on horizontal and tilted Surfaces, Global Solar radiation data, Indian Solar Radiation data analysis

At the end of the Module 1, students will be able to:

1.Understand the need of radiation of sun (BL-2)

2. Discuss the various performance characteristics of solar radiation.(BL-2)

MODULE -2	Solar Cells and its Fabrication	07 Hours

Solar Cells

Conversion of Solar energy into Electricity - Photovoltaic Effect, Equivalent Circuit of the Solar Cell, Analysis of PV Cells: Dark and illumination characteristics, Figure of merits of solar cell, Efficiency limits, Variation of efficiency with band-gap and temperature, Efficiency measurements, High efficiency cells, Recent developments in Solar Cells, Role of nano-technology in Solar cells

Fabrication Technology for Solar Cells

High efficiency multi-junction solar cell, Quantum well solar cell, Technology for the fabrication of thin film cells, Optical concentration, Effect of temperature on Cell performance, Thermo photovoltaic effect

At the end of the Module 2, students will be able to:

1. Discuss the photovoltaic effect, PV Cell efficiency and its limits (BL-2)
2. Discuss the concepts of fabrication technology for solar cell (BL-2)

MODULE-3	Solar Photovoltaic System	10 Hours

Solar Photovoltaic System Design
Solar cell array system analysis and performance prediction, Shadow analysis: Reliability, Solar cell array design concepts, PV system design, Design process and optimization: Detailed array design, Voltage regulation, Maximum tracking, Quick sizing method, Array protection.
Solar Photo Voltaic System Testing
Sun Simulator, Testing and performance assessment of Solar PV generator, Electronic Control and Regulation, Power Conditioning, Converters and inverter, Concentrating system, System design and configuration

At the end of the Module 3, students will be able to:
1. Predict the performance of solar photovoltaic device and analyze its performance. (BL-2)

MODULE-4	SPV Power Systems	12 Hours

Centralized and decentralized SPV systems, Stand alone, hybrid and, grid connected system, System installation, Operation and Maintenance, Application of PV for lighting, Water pumping. Refrigeration, Telecommunication, Cathodic Protection, Solar PV Power Plant-Status-Case Studies, Hybridization Engineering, Hybrid systems, Grid integration. Building Integrated PV Systems, PV market analysis and Economics of SPV systems.

At the end of the Module 4, students will be able to:
1. Carry out the application of photovoltaic system as power system. (BL-3)

MODULE-5	FUEL CELLS	12 Hours

History, Working principle of fuel cells, Fuel cell thermodynamics, fuel cell electrochemistry - Nernst equation, Electrochemical kinetics, Butler-Volmer equation, performance evaluation of fuel cells, Types of Fuel Cells: AFC, PAFC, SOFC, MCFC, DMFC, relative merits and demerits.
Fuel cell characterization In-situ and ex-situ characterization techniques, I-V curve, frequency response analyses; Fuel cell system integration
Application of Fuel Cells Fuel Cell usage for domestic power systems, large scale power generation, Automobile, environmental analysis. Future trends in fuel cells, portable fuel cells, laptops, mobiles, submarines.

At the end of the Module 6, students will be able to:
1. Analyze the performance of fuel cells under different operating conditions. (BL-4)
2. Select and defend appropriate fuel cell technology for a given application. (BL-4)

Total hours:	**48 hours**

Term work:
1. Field trip

Content beyond syllabus:
1. Introduction of hydrogen energy systems
2. Hydrogen production processes
3. Hydrogen storage and safety

Self-Study:

Contents to promote self-Learning:

SNO	MODULE	Reference
1	Indian Solar Radiation data analysis	https://www.nrel.gov/docs/fy21osti/78025.pdf
2	Role of nano-technology in Solar cells	https://www.intechopen.com/chapters/73145
3	Converters and inverter in solar energy	https://www.energy.gov/eere/solar/solar-integration-inverters-and-grid-services-basics
4	Economics of SPV systems	https://extensionpublications.unl.edu/assets/pdf/g2182.pdf
5	Types of Fuel cells with relative merits and demerits	https://www.energy.gov/eere/fuelcells/types-fuel-cells

Text Book(s):

1. Fundamentals of Solar Cells: PV Solar Energy Conversion by AL Fahrenbruch and RH Bube, Academic Press, New York.
2. Solar Photovoltaics. Fundamental Technologies and Application by Chetan Singh Solanki, PHI Publicaton.
3. Principles of Fuel Cells by Xianguo Li, Taylor & Francis.
4. Fuel cell Systems Explained by James Larminie and Andrew Dicks, John Wiley & Sons, Inc.
5. Fuel Cells: From Fundamentals to Applications by S Srinivasan, Springer.

Reference Book(s):

1. Principles of Solar Engineering by F Kreith and JF Kreider, McGraw-Hill.
2. Fuel Cell Fundamentals by O'Hayre, SW Cha, W Colella and FB Prinz, Wiley.
3. Fuel Cell Science and Technology by Basu, S. (Ed) Springer, N.Y.

Online Resources:

1. https://www.nrel.gov/docs/fy21osti/78025.pdf
2. https://www.intechopen.com/chapters/73145
3. https://www.energy.gov/eere/solar/solar-integration-inverters-and-grid-services-basics
4. https://extensionpublications.unl.edu/assets/pdf/g2182.pdf
5. https://www.energy.gov/eere/fuelcells/types-fuel-cells

Web References:

1. https://www.youtube.com/watch?v=--GfdbavEk8
2. https://www.youtube.com/watch?v=qFnAIxyPXuQ
3. https://www.youtube.com/watch?v=px239v5o6xU
4. https://www.youtube.com/watch?v=pH03Y5KwpjU
5. https://www.youtube.com/watch?v=6oeN9VDFLig

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EE4014	**WIND & BIOMASS ENERGY SYSTEM**							R2020
	Hours / Week			Total	Credit	Max Marks		
	L	T	P	hrs	C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100
Pre-requisite: Nil								

Course Objectives:

1. To acquire the knowledge on wind power generation
2. To Understand the concept of wind turbine design
3. To Discuss the Current trends in worldwide applications of wind power
4. To Understand the various methods Bio- Chemical Conversion systems
5. To Discuss the various applications of biomass

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

CO 1	Understand the present wind energy scenario (BL-2)
CO 2	Explain the various wind energy technologies. (BL-3)
CO 3	Identify various applications of wind energy .(BL-2)
CO 4	Explain the various biomass conversion technologies and testing of performance of biogas. (BL-2)
CO 5	Understand the Bio-Energy Systems with Efficient Applications. (BL-2)

CO-PO Mapping

CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	2	2									2	1
CO2	3	1	1	2									3	2
CO3	3	3	2	1									2	2
CO4	2	2	3	2									3	3
CO5	1	2	1		2								2	1
1: Low, 2-Medium, 3- High														

COURSE CONTENT

MODULE – 1	**Wind Power Generation**	**08 Hours**

Introduction – Basic principles of wind energy conversion power in the wind-Forces on blades and thrust on turbines – Wind energy conversion – site selection Considerations -Basic components of WECS – Classification- Advantages and disadvantages – Power, torque and speed characteristics.

At the end of the Module 1, students will be able to:

1.Understand the need of wind energy (BL-2)

2. Explain the various performance characteristics of wind energy.(BL-1)

3. Understand the Basic principles of wind energy conversion system (BL-2)

MODULE -2	**WECS design**	**07 Hours**

Design of wind turbine :Wind turbine design considerations; Methodology; Theoretical simulation of wind turbine characteristics; Test methods.

Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and combine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip loss Correction.

At the end of the Module 2, students will be able to:

1. Discuss Wind turbine design considerations & characteristics (BL-2)
2. Discuss the concepts of Aerodynamic theories (BL-2)
3. Understand the concept of Maximum power coefficient (BL-2)

MODULE-3	Wind Energy Applications & Measurements	10 Hours

Wind energy measurements: Wind speed, Wind direction, Data measurement and analysis, Performance evaluation of Wind energy system, Wind potential assessment

Wind energy application Wind pumps: Performance analysis, design concept and testing; Principle of WEG; Stand alone, grid connected and hybrid applications of WECS; Economics of wind energy. Utilization; Wind energy in India; Case studies.

At the end of the Module 3, students will be able to:

1. Explain the various measuring instruments used in wind systems (BL-2)
2. Understand the wind energy applications(BL-2)
3. Understand the Current trends in worldwide applications of wind energy (BL-2)

MODULE-4	Biomass conversion Technologies	12 Hours

Bio Energy: Introduction – Biomass conversion technologies – Bio gas generation – Factors affecting bio digestion or generation of gas – Classification of bio gas plants – advantages and disadvantages –Materials used for biogas plant – selection of site for biogas plant

Thermo-chemical conversions: Direct Combustion, Technology of Biomass gasification, Pyrolysis and Liquefaction, Bio- Chemical Conversion: anaerobic digestion, alcohol production from biomass,

Chemical conversion process: hydrolysis and hydrogenation

Biomass Gasifiers: History, Principle, Design of Biomass Gasifiers, updraft gasifier, down draft gasifier, zero carbon biomass gasification plants, Gasification of plastic-rich waste, applications for cooking, electricity generation, Gasifier Engines, Operation of spark ignition and compression ignition engine with wood gas, methanol, ethanol and biogas, Biomass integrated gasification/combined cycles systems.

At the end of the Module 4, students will be able to:

1. Discuss Biomass conversion technologies (BL-2)
2. Explain the concept of Bio- Chemical Conversion & Thermo-chemical conversions (BL-2)
3. Explain Direct & In-Direct Combustion methods (BL-2)
4. Discuss the historical perspective of biomass energy (BL-2)
5. Explain the Biomass Gasifiers (BL-2)
6. Discuss the concept of various Gasifier Engines (BL-2)

MODULE-5	Bio-Energy Systems with Efficient Applications	12 Hours

Traditional Stoves, Energy Efficient Cooking and Space heating Stoves, Metal Stoves Improved Gasifier Stoves, Pollution due to smoke emissions, Biogas Systems : Technology of Bio-gas production, Biogas Plants , Digester types, Digester design, Chemical kinetics and mathematical modeling of bio-methanation process, Dung, Vegetable Waste, Night Soil and Municipal Waste based Bio-gas plants, Bio gas as fuel for transportation, Lighting, Running Dual Fuel Engines, Electricity generation, Bio gas Bottling Plant Technology, Application of Bio gas slurry in agriculture , Design of Biogas for cold climates.

At the end of the Module 6, students will be able to:

1. Explain the Bio-Energy Systems with Efficient Applications (BL-2)
2. Identify various real time applications. (BL-3)
3. Discuss the various applications of bio- energy (BL-2)

Total hours:	**48 hours**

Term work:

1. Field trip

Content beyond syllabus:

1. Betz limit & Wind resource assessment

Self-Study:

Contents to promote self-Learning:

SNO	MODULE	Reference
1	Basic components of WECS	https://www.youtube.com/watch?v=uUzqfckAlbg
2	Prandlt's tip loss Correction	https://www.youtube.com/watch?v=F9J2BdprXOQ
3	Wind energy measurements	https://www.youtube.com/watch?v=-N-QJkY1GEM
4	Biomass conversion technologies Design of Biomass Gasifiers	https://www.youtube.com/watch?v=H1hrkC--dto https://www.youtube.com/watch?v=RrBOqjCtkk0
5	Night Soil and Municipal Waste based Bio-gas plants	https://www.youtube.com/watch?v=ehNEtJtaFR8

Text Book(s):

1. S.N.Bhadra,D.Kastha, S.Banerjee, " wind electrical systems" Oxford University Press
2. S.Rao & B.B.Parulekar, "Energy Technology", 4th edition, Khanna publishers, 2005.
3. "Energy conversion systems" by Rakosh das Begamudre, New age international publishers, New Delhi - 2000.

Reference Book(s):

1. "Renewable Energy sources & Conversion Technology" by N.K.Bansal, Manfred Kleemann, Michael Meliss. Tata Mcgraw Hill Publishers.
2. "The Electrical Energy Storage" by IEC Market Strategy Board.
3. Jim Eyer, Garth Corey, "Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report", Press, Feb 2010.

Online Resources:

1. https://www.lathamathavan.edu.in/lmgi/antiragging/WECS-%20EEE%20new.pdf
2.https://www.lathamathavan.edu.in/lmgi/antiragging/WECS-%20EEE%20new.pdf
3.https://engineering.purdue.edu/~dionysis/EE452/Lab9/Wind_Energy_Conversion.pdf
4. https://energystorage.org/why-energy-storage/technologies/
5. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118029008

Web References:

1. https://www.youtube.com/watch?v=mh51mAUexK4
2. https://www.youtube.com/watch?v=GExTwRNkQBg
3. https://www.youtube.com/watch?v=4a4XGu1mR5E
4. https://www.youtube.com/watch?v=xzY3CK43C98
5. https://www.youtube.com/watch?v=_OQtT4yhhWc

NARAYANA ENGINEERING COLLEGE::GUDUR								
20EE4019	UTILIZATION OF ELECTRICAL ENERGY							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	UCE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To Summarize various electric drives and traction motors with applications
2. To Understand the concepts of Mechanics of Train movement and associated calculations
3. To Explain the laws of illumination and their application for various lighting schemes
4. To understand the different methods of electric heating and electric welding
5. To identify how to utilize the solar radiation into electrical energy for different applications and to understand the basic principles of wind energy conversion

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

CO 1	Utilize the suitable electric drives for different applications(BL=3)
CO 2	Analyze the Speed-Time Curves of Different Services(BL=4)
CO 3	Identify the energy saving based on Illumination system (BL=3)
CO 4	Understand the utilization of electrical energy for heating and welding purposes(BL=2)
CO 5	Illustrate the effective usage of solar and wind energy for electrical applications(BL=2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2												1	3
CO2	3	2												3
CO3	3	2		2									2	2
CO4	2			1	1								1	2
CO5	2	2	1				2						1	3

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	ELECTRIC DRIVES AND TRACTION	12 Hrs

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear

At the end of the Module 1, students will be able to:

1. Select the various Electric drives and Traction motors(BL=1)
2. Understand the types of railway electrification and track equipment(BL=2)
3. Explain the various electrical braking methods(BL=2)

MODULE -2	MECHANICS OF ELECTRIC TRACTION	12 Hrs

Mechanics of Train Movement. Speed-Time Curves of Different Services – Trapezoidal and Quadrilateral Speed-Time Curves – Numerical Problems. Calculations of Tractive Effort, Power, Specific Energy Consumption, Adhesive Weight and Coefficient of Adhesion.

At the end of the Module 2, students will be able to:

1. Understand the Speed-Time Curves of Different Services(BL=2)
2. Explain the mechanics of train movement(BL=2)
3. Understand the factors effecting Specific Energy Consumption(BL=2)

MODULE-3	**ILLUMINATION**	08 Hrs

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapor lamps, fluorescent lamps –design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting – UPS- energy saving lamps, LED – working principle of air conditioning system

At the end of the Module 3, students will be able to:

1. Explain the various light sources (BL=2)
2. Understand the various lighting schemes(BL=2)
3. Illustrate the Energy conservation through LED usage(BL=2)

MODULE-4	**HEATING AND WELDING**	08 Hrs

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating -resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types -resistance welding - arc welding - power supply for arc welding - radiation welding

At the end of the Module 4, students will be able to:

1. Understand the various electrical heating methods(BL=2)
2. List the advantages of electric heating(BL=1)
3. Explain the electrical welding methods(BL=2)

MODULE-5	**SOLAR & WIND ENERGY CONVERSION SYSTEM**	08 Hrs

Solar Energy Conversion System: Introduction - solar constant – terrestrial solar radiation - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat – flat-plate collectors - transmissivity of cover system - energy balance equation and collector efficiency -concentrating collector - advantages and disadvantages of concentrating collectors

Wind Energy Conversion System: Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind machines - analysis of aerodynamic forces acting on the blade

At the end of the Module 5, students will be able to:

1. Understand the principles of the conversion of solar radiation into electrical energy(BL=2)
2. Explain the various solar energy collectors(BL=2)
3. Understand merits and demerits of concentrating collectors(BL=2)
4. Understand the principles of wind energy conversion(BL=2)
5. Illustrate the components of Wind Energy Conversion System(BL=2)
6. Understand the aerodynamic forces acting on the blade(BL=2)

Total hours:	**48 hours**

Term work:

1.Report on different DC drives used in electric traction system in India
2.Report on different AC drives used in electric traction system in India
3.study different Electrification systems in traction and submit the report
4.Field trip to electric locomotive limited ,Tirupati and submit report on protection system used in electric locomotive
5. Field trip to electric locomotive limited ,Tirupati and submit report on energy consumption for different electric locomotives
6.Study the different lighting schemes & its line diagrams in Damodharam sanjeevaiah thermal power plant
7.Visit Nelcast industries,Gudur and submit the report on different types electric furnaces and its Rating
8. Visit Nelcast industries,Gudur and submit the report on protective schemes used for electric furnaces
9.Report on complete solar power utilization in India
10.Report on complete wind power utilization in India

Content beyond syllabus:

1. Energy Efficient Technologies in Electrical Systems

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	Electric Drives And Traction	https://www.electronicshub.org/electric-traction-system/
2	Mechanics Of Electric Traction	https://www.engineeringenotes.com/electrical-engineering/electric-traction-electrical-engineering/train-movement-and-energy-consumption-electrical-engineering/37136
3	Illumination	https://nptel.ac.in/courses/108/105/108105060/
4	Heating And Welding	https://www.electrical4u.com/electric-heating/ **twi-global.com/technical-knowledge/faqs/what-is-arc-welding**
5	Solar & Wind Energy Conversion System	https://www.sciencedirect.com/topics/engineering/solar-collector https://www.awea.org/wind-101/basics-of-wind-energy https://www.slideshare.net/BansiKansagara/et-wind

Text Book(s):

1. Utilization of Electric Energy, E. Openshaw Taylor and V. V. L. Rao, Universities Press, 2009.
2. N.V. Suryanarayana, “Utilisation of Electric Power”, Wiley Eastern Limited, New Age International Limited, 1993
3. J.B.Gupta, “Utilisation Electric power and Electric Traction”, S.K.Kataria and sons, 2000.
4. G.D.Rai,” Non-Conventional Energy sources”, Khanna publications Ltd.,New Delhi 1997
5. D.P.Kothari, K.C.Singal, Rakesh Ranjan, “Renewable Energy Sources and Emerging Technologies”, PHI Learing Private Limited, 2013.

Reference Book(s):

1. Generation, distribution and utilization of electrical energy, C.L Wadhwa, Wiley Eastern Limited,1993
2. R.K.Rajput, Utilisation of Electric Power, Laxmi publications private Limited.,2007
3. H.Partab, Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi-2004.

Online Resources:

1. https://b-ok.asia/book/5441788/abf631
2. https://b-ok.asia/book/2871150/836618

Web Resources:

1.https://www.youtube.com/watch?v=fQrZMMWo1mA&list=PLbMVogVj5nJThs8VThC-DA8CZYsmaQypX&index=1
2. https://www.youtube.com/watch?v=5ZGh08q9K7E&list=PLEprwsbQ0B8ITTiaONpKN3Q-bEBJKTMlQ
3. https://www.youtube.com/watch?v=p3PkcLjNUhI
4.https://www.youtube.com/watch?v=TpvmJBeGUrg&list=PLyqSpQzTE6MKwjFQByBvRx464XpCgOEC&index=2
5. https://www.youtube.com/watch?v=GzMuLpsRY-8
6. https://www.youtube.com/watch?v=GExTwRNkQBg

NARAYANA ENGINEERING COLLEGE::GUDUR								
20EE4024	ENERGY AUDIT & DEMAND SIDE MANAGEMENT							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	EMS	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To learn about energy consumption and situation in India
2. To learn about Energy Management.
3. To learn about Energy Measuring Instruments.
4. To understand the Demand Side Management (DSM).
5. To understand the cost effectiveness for DSM.

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

CO 1	Understand the importance of energy audit and the basic ideas of conduction an energy audit (BTL-2)
CO 2	Analyze various techniques of energy management and conservation (BTL-4)
CO 3	Understand energy efficient methods and power factor improvement techniques (BTL-2)
CO 4	Analyze demand side management concepts through case study (BTL-4)
CO 5	Understand various Cost effectiveness test for demand side management programs (BTL-2)

CO-PO Mapping

CO	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		1	2		2			2	1			1	1
CO2	1	2	1	1		1	1		2		1		2	1
CO3		1		1		1							2	1
CO4	1	2				1			1				1	1
CO5	1	1	2			1			1				1	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	Basic principles of Energy Audit	12 Hrs

Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes-Energy audit of industries-energy saving potential, energy audit of process industry, thermal power station, building energy audit

At the end of the Module 1, students will be able to:

1. Understand the concept of energy audit
2. Understand the various Energy conservation schemes

MODULE -2	Energy management	12 Hrs

Energy management-I

Principles of energy management, organizing energy management program, initiating, planning , controlling, promoting, monitoring, reporting.

Energy management-II

Energy manger, Qualities and functions , language ,Questionnaire - check list for top management

At the end of the Module 2, students will be able to:

1. Conduct energy management, energy audit and energy conservation measures.
2. Understand the basic principles of energy management
3. Understand the need of energy management
4. Evaluate energy audit results
5. Illustrate electrical load management techniques

MODULE-3	ENERGY MANAGEMENT FOR LIGHTING AND ENERGY MOTORS	08 Hrs

Good Lighting System Design and Practice, Lighting Control, Lighting Energy Audit
Energy efficient motors , factors affecting efficiency, loss distribution , constructional details , characteristics - variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit

At the end of the Module 4, students will be able to:

1. understand the characteristics of energy efficient motors
2. Implement energy efficient methods and power factor improvement techniques

MODULE-4	INTRODUCTION TO DEMAND SIDE MANAGEMENT	08 Hrs

Introduction to DSM, Concept of DSM, Benefits of DSM, Different Techniques of DSM – Time of Day Pricing, Multi-Utility Power Exchange Model, Time of Day Models for Planning. Load Management, Load Priority Technique, Peak Clipping, Peak Shifting, Valley Filling, Strategic Conservation, Energy Efficient Equipment. Management and Organization of Energy Conservation Awareness Programs.

At the end of the Module 5, students will be able to:

1. Analyze demand side management concepts through case study
2. Understand the load management

MODULE-5	ECONOMICS AND COST EFFECTIVENESS TESTS OF DSM PROGRAMS	08 Hrs

Basic payback calculations, Depreciation, Net present value calculations. Taxes and Tax Credit – Numerical Problems. Importance of evaluation, measurement and verification of demand side management programs. Cost effectiveness test for demand side management programs - Ratepayer Impact Measure Test, Total Resource Cost, Participant Cost Test, Program Administrator Cost Test

At the end of the Module 6, students will be able to:

1. Analyze economic impacts of energy management and auditing
2. Understand various Cost effectiveness test for demand side management programs

Total hours:	**48 hours**

Term work:

Term work contains assignments ,seminars and quiz

Content beyond syllabus:

1. Energy Instruments For Audit

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Energy Audit	CO1	http://www.opexworks.com/KBase/Energy _Management/Energy_Audit_and _Management/Energy_Audit/Energy _Audit_Types_and_Methodology.htm
2	Overview of energy management	CO2	https://beeindia.gov.in/sites/default/files/1Ch3.pdf https://www.nrcan.gc.ca/sites/oee.nrcan.gc.ca /files/files/pdf/energy-audit-manual-and-tool.pdf
3	Energy management for motors	CO3	https://www.youtube.com/watch?v=T9Vmp3Qo8Mo
4	Demand side management	CO4	http://africa-toolkit.reeep.org/modules/Module14.pdf

	5	Cost effective test of DSM	CO5	https://www.youtube.com/watch?v=P4yfHQWYfLc

Text Book(s):

1. Industrial Energy Management Systems**,** Arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere Publishing Corporation, New York, 1994.

2. Fundamentals of Energy Engineering - Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey, 1984.

Reference Book(s):

1) Energy management by W.R. Murphy & G. Mckay Butter worth, Heinemann publications.
2) Energy management by Paul o" Callaghan, Mc-graw Hill Book company-1/e,1998
3) Energy efficient electric motors by John C. Andreas, Marcel Dekker Inc Ltd-2/e, 1995
4) Energy management hand book by W.C.Turner, john Wiley and sons
5). Energy management and good lighting practice: fuel efficiency- booklet12-EEO

Online Resources:

1. http://lab.fs.uni-lj.si/kes/erasmus/Energy%20Management%20Handbook.pdf
2. https://www.bsr.org/reports/bsr-energy-management-handbook.pdf

Web Resources:

1. https://freevideolectures.com/
2. https://www.academia.edu/33324894/Energy_Management_Handbook_7th_Ed_Doty_and_Turner_Fairmont_Press_2009--03-Oct-2009-.pdf?auto=download

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EE4005	ADVANCED POWER ELECTRONICS							R2020
	Hours / Week			Total	Credit	Max Marks		
	L	T	P	**hrs**	C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Power Electronics

Course Objectives:

1. To explain the concepts of power electronic switches
2. To demonstrate the applications and analysis of switches in DC-DC converter and various single phase converters
3. To analyze the operation of single phase, three phase and multipulse converters
4. To analyze the power quality improvement techniques
5. To analyze the allocations of FACTS devices

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

CO 1	Explain basic Concept of Switches and their controlling process (B-2)
CO 2	Demonstrate the device physics, Application and Analysis of Switches in DC-DC converters and Single Phase Converter (B-2)
CO 3	Analyze the operation Single Phase Converter, Three Phase Converter, Multipulse Converter and Effect of Source Inductance and PWM Rectifiers (B-4)
CO 4	Analyze the Power Quality Improvement Techniques in electrical systems (B-4)
CO 5	Analyze the applications of FACTS Devices in electrical system (B-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2											2	3
CO2	3	2											2	3
CO3	3	2											2	3
CO4	3	2	2										2	2
CO5	3	2	2										2	3

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**Advanced Solid State Devices**	**10 Hours**

MOSFETs, IGBT, GTO, IGCT etc. Power modules, intelligent power modules, gating circuits. Thermal design, protection. Digital signal processors used in their control.

At the end of the Module 1, students will be able to:

1. Recall the basic concepts of Switching characteristics **(BL-1)**

2. Understand the controlling techniques of switches **(BL-2)**

MODULE -2	**DC – DC and Single Phase converters**	**10 Hours**

Non-isolated dc-dc converters: Buck, boost, buck-boost, Cuk, SEPIC, Zeta in DCM and CCM. Isolated dc-dc converters: Flyback, forward, Cuk, SEPIC, Zeta, half bridge, push-pull and bridge in DCM and CCM. Single-phase, single-stage converters (SSSSC), power factor correction at ac mains in these converters. Their application in SMPS, UPS, welding and lighting systems.

At the end of the Module 2, students will be able to:

1. understand the concept of DC-DC conversion **(BL-2)**
2. explain the concept of single-pahse and single stage converters **(BL-2)**

MODULE-3	AC-DC Converters	10 Hours

Single-phase improved power quality ac-dc converters: Buck, boost, buck-boost, PWM VSC (Voltage source converters), multilevel VSCs, PWM CSC (Current voltage source converters). Three-phase improved power quality ac-dc converters: VSC, multilevel VSCs, multipulse VSCs, PWM CSC (Current voltage source converters). Multipulse ac-dc converters: Diode and thyristor based converters

At the end of the Module 3, students will be able to:

1. Understand the concept of power quality **(BL-2)**
2. Apply the various converters to improve the power quality **(BL-3)**
3. Analyze the various ac-dc converters **(BL-4)**

MODULE-4	Passive and Active Filters	10 Hours

Power quality mitigation devices: Passive filters, active filters, hybrid filters. DSTATCOM (Distribution static compensator), DVR (Dynamic voltage restorer) and UPQC (Universal power quality conditioner).

At the end of the Module 4, students will be able to:

1. Explain the concept of passive and active filters **(BL-2)**
2. Analyze different types of power quality mitigation devices **(BL-4)**

MODULE-5	FACTS Devices	08 Hours

FACTS devices: TCR (Thyristor Controlled Reactor), TSC (Thyristor Switched Capacitors). STATCOM (Static Synchronous Compensator). SSSC (Static Series Synchronous Compensator). UPFC (Unified Power Flow Controller), IPFC (Interline Power Flow Controller).

At the end of the Module 5, students will be able to:

1. Understand the concept of FACTS devices **(BL-2)**
2. Analyze the operation of different types of FACTS Devices **(BL-4)**

Total hours:	48 Hours

Term work:

Content beyond syllabus:

1. Advanced controlling techniques to improve Power Quality

Self-Study:

Contents to promote self-Learning:

S.NO	Module	Reference
1	**Advanced Solid State Devices**	https://youtu.be/XgY3HiBhHEE
2	**DC – DC and Single Phase converters**	https://www.youtube.com/watch?v=p5NZw5fUvgQ
3	**AC-DC Converters**	https://www.youtube.com/watch?v=JXJaRPXPwjQ
4	**Passive and Active Filters**	https://www.youtube.com/watch?v=EoPGgrMAAJo

	5	**FACTS Devices**	https://www.youtube.com/watch?v=GVxY3nE5mO8&list=PLLy_2iUCG87AVyRAN4QwVQrC8vSg1vWa6	

Text Book(s):

1. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India, 3rd ed., 2009.
3. Narain G. Hingorani, Laszlo Gyugyi, "Understanding FACTS", IEEE Press.

Reference Book(s):

1. Derek A. Paice "Power Electronic Converter Harmonics – Multipulse Methods for Clean Power", IEEE Press, 1996.
2. Muhammad H. Rashid , "Power Electronics Handbook", Elsevier, 3rd ed., 2011.
3. P.C.Sen, "Modern Power Electronics ", S. Chand and Co. Ltd., New Delhi, 2000.
4. Vijay K. Sood, "HVDC and FACTS Controllers Applications of Static Converters in Power Systems", Kluwer Academic Publishers, Boston, 2004.
5. L. Umanand, "Power Electronics Essentials and Applications", Wiley India Ltd., 2009

Online Resources / Web References:

1. https://www.youtube.com/watch?v=MeOYUx07SCk
2. https://www.youtube.com/watch?v=ErMz2MI5DQo
3. https://www.youtube.com/watch?v=ohwGWysVuXU
4. https://www.academia.edu/38805211/Advanced_Power_Electronics_Converters_PWM_Converters_Processing_AC_Voltages
5. https://www.electronicbo.com/2019/06/Advanced-Power-Electronics-Converters.html
6. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/
7. https://nptel.ac.in/courses/108/106/108106073/
8. https://www.youtube.com/watch?v=MeOYUx07SCk&list=PLUpFmz4G8ZyZx2fG5B_GRVIhTquypoAWZ
9. https://www.youtube.com/watch?v=ohwGWysVuXU
10. https://www.youtube.com/watch?v=0jevuayGmmU&list=PLLy_2iUCG87DzWK9cLYKxjH1LRACxdEKi

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EE4010	ADVANCED ELECTRICAL DRIVES							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To understand steady state operation and transient dynamics of a motor load system.
2. To acquire knowledge of fuzzy logic and neural network concepts in various drives

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

CO 1	Analyze the Power electronic converters for electrical drives.(BL-4)
CO 2	Analyze the field oriented control of machines.(BL-4)
CO 3	Understand the vector control of electrical drives.(BL-2)
CO 4	Understand the sensor less control of AC drives.(BL-2)
CO 5	Analyze the direct torque control of Induction Machines.(BL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3		2								1	2
CO2	2	2	3		2								1	2
CO3	2	2	2		2								1	2
CO4	2		3		2									2
CO5	2	2	2		2									2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1 (08 Hrs)

INTRODUCTION TO POWER CONVERTERS FOR ELECTRIC DRIVES

Switching converters and their applications to variable frequency drives - Power electronic converters for control of amplitude-AC variable frequency drives - Mathematical representation of switching functions- reduction of switching losses in practical switches. MATLAB simulation -study on ‘D0Q’ transformation in various frames of reference. Free acceleration characteristics of Induction motor from ‘D0Q’ model viewed from various reference frames

At the end of the Module 1, students will be able to:

1. Explain the switching converters ad their application.(BL-2)
2. Understand the Power electronic converters for control of drives.(BL-2)
3. Explain the characteristics of Induction motor from various reference frames. (BL-2)

MODULE -2 (10 Hrs)

FIELD ORIENTATED CONTROL

Field oriented control of induction machines - Theory – DC drive analogy.

At the end of the Module 2, students will be able to:

1. Understand the field orientated control and its application. (BL-2)
2. Analyze the Field oriented control of induction machines. (BL-4)
3. Analyze the Field oriented control of DC drive. (BL-4)

MODULE-3 (10 Hrs)

VECTOR CONTROL

Vector control concept- Direct or Feedback vector control - Indirect or Feed forward vector control – Flux vector estimation - Space vector modulation control-PWM current control-MATLAB simulation direct & indirect vector control induction motor- closed loop speed control of VVVF PMAC motor drive & FPGA based closed loop control of BLDC motor drive.

At the end of the Module 3, students will be able to:

1. Understand the vector control concept. (BL-2)
2. Understand the MATLAB simulation direct & indirect vector of control induction motor. (BL-2).
3. Explain FPGA based closed loop control of BLDC motor drive. (BL-2)

MODULE-4 (10 Hrs)

SENSORLESS CONTROL OF AC DRIVES

Introduction to sensor less control of AC drives – Advantages – speed estimation methods-State synthesis method – model reference adaptive system – observer based techniques -MATLAB simulation model reference adaptive system for speed estimation.

At the end of the Module 4, students will be able to:

1. Understand the sensor less control of AC drives.(BL-2)
2. Explain the state synthesis method. (BL-2)
3. Understand the MATLAB simulation model reference adaptive system for speed estimation. (BL-2)

MODULE-5 (10 Hrs)

DIRECT TORQUE CONTROL

Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy – optimum switching vector selection – reduction of torque ripple methods- adaptive control. MATLAB simulation-open loop control-DTC of induction motor drive-adaptive control.

At the end of the Module 5, students will be able to:

1. Understand the Direct torque control of Induction Machines. (BL-2)
2. Explain the Torque expression with stator and rotor fluxes.(BL-2)
3. Explain optimum switching vector selection.(BL-2)

Total hours: 48 hours

Content beyond syllabus:

1. GA based drives

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Reduction of switching losses in practical	CO1	https://www.youtube.com/watch?v=7kGPLVXvsPk

	switches		
2	Field oriented control of induction machines	CO2	https://www.youtube.com/watch?v=2jtk1_rcYYQ
3	FPGA based closed loop control of BLDC motor drive	CO3	https://www.youtube.com/watch?v=V0XP3N5c2GY
4	MATLAB simulation model reference adaptive system for speed estimation	CO4	https://www.youtube.com/watch?v=9W2CzT0wq3Q
5	DTC of induction motor drive	CO5	https://www.youtube.com/watch?v=mG7AxRkGrr8

Text Book(s):

1. Bimal.K. Bose, "Power Electronics and Variable frequency drives", Standard Publishers Distributors, New Delhi, 2000.
2. Dubey G.K., "Power Semiconductor controlled drives", Prentice Hall inc, A division of Simon and Schester England cliffs, New Jersey, 1989.

Reference Book(s):

1. Murphy J.M.D, Turnbull, F.G, "Thyristor control of AC motor", Pergamon press, Oxford, 1988.
2. Sheperal, Wand Hully, L.N. "Power Electronic and Motor control" Cambridge University Press Cambridge, 1987.
3. Dewan, S. Slemon B., Straughen, A. G.R., "Power Semiconductor drives", John Wiley and Sons, NewYork, 1984.

Online Resources:

1. https://doku.pub/documents/electric-drives-by-gk-dubey-59qge6y3vm0n
2. https://nptel.ac.in/courses/108/104/108104011/

Web Resources:

1. https://www.youtube.com/watch?v=6DctdwlDKhc&list=PLA5CA7D35114BA425
2. https://www.youtube.com/watch?v=WsDPqDqnpyw&list=PLuv3GM6gsE3UGP1cSOl1KuEXscGFdKXB

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EE4015	HVDC and FACTS							R2020
	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	HVDC	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Transmission and Distribution, Power Electronics and High voltage engineering

Course Objectives:

1. To introduce the extra high voltage AC and DC transmission
2. To introduce the HVDC transmission system with types, control and protection.
3. To discuss about the design factors of lines and cables.
4. To provide knowledge on FACTS controllers.
5. To introduce the reactive power control techniques.
6. To study the characteristics, modelling and operating schemes of different types of shunt and series switched reactive power generating devices.

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

CO 1	Find the applications of different types of HVDC links.(BL-2)
CO 2	Apply converters for HVDC transmission for control of converters.(BL-3)
CO 3	Understand the concept of filters to mitigate harmonics, concept of reactive power requirements.(BL-2)
CO 4	Understand the working principles of FACTS devices.(BL-2)
CO 5	Analyze the performance of Series, Shunt and combined FACTS controllers.(BL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2										3	2
CO2	3		3										2	2
CO3	2	2	2										2	2
CO4	2	3	2										3	2
CO5	2	2	3										3	2

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	**Introduction**	10Hrs

Comparison of AC and DC transmission systems, application of DC transmission, types of DC links, typical layout of a HVDC converter station, HVDC converts, pulse number, analysis of Gratez circuit with and without overlap, converter bridge characteristics, equivalent circuits or rectifier and inverter configurations of twelve pulse converters.

At the end of the Module 1, students will be able to:

1. Explain the comparison of HVDC and HV AC.(BL-2)
2. Understand the Application of the HVDC Transmission.(BL-2)
3. Understand the Characteristics of 6 pulse and 12 pulse converters.(BL-2)

MODULE -2	CONVERTER & HVDC SYSTEM CONTROL	10Hrs

Principle of DC link control –Converters control characteristics- system control hierarchy, firing angle control, current and excitation angle control, starting and stopping of DC link.

At the end of the Module 2, students will be able to:

1. Understand the principle of DC link control.(BL-2)
2. Understand the Firing Angle Control for the Converters.(BL-2)
3. Explain the starting and stopping of DC link. (BL-2)

MODULE-3	HARMONICS, FILTERS AND REACTIVE POWER CONTROL	10Hrs

Introduction, generation of Harmonics, AC and DC Filters. Reactive power requirements in steady state, sources of reactive power, static VAR systems.

POWER FLOW ANALYSIS IN AC/DC SYSTEMS: Modeling of DC/AC converts, controller equations solutions of AC/DC load flow- simultaneous method, sequential method.

At the end of the Module 3, students will be able to:

1. Understand the Basics generation of harmonics.(BL-2)
2. Explain the calculation of voltage & Current harmonics. (BL-2)
3. Explain the types of AC filters.(BL-2)

MODULE-4	INTRODUCTION TO FACTS	10Hrs

Flow of power in AC parallel paths and meshed systems, basic types of FACTS controllers, brief description and definitions of FACTS controllers.

STATIC SHUNT COMPENSATION: Objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators, SVC and STATCOM, comparison between SVC and STATCOM.

At the end of the Module 4, students will be able to:

1. Explain the basic principles, characteristics of different types of FACTS controllers. (BL-2)
2. Explain the new methods adopted in power system control. (BL-2)
3. Understand the static shunt compensation. (BL-2)

MODULE-5	STATIC SERIES COMPENSATORS	8Hrs

Objectives of series compensation, variable impedance type- thyristor switched series capacitors (TCSC), and switching converter type series compensators, static series synchronous compensator (SSSC)- power angle characteristics-basic operating control schemes.

At the end of the Module 5, students will be able to:

1. Understand the objectives of series compensation of power systems. (BL-2)
2. Understand the power angle characteristics. (BL-2)
3. Explain the basic operating control schemes. (BL-2)

Total hours:	48 hours

Term work:

1. Develop HVDC Transmission system using mat lab software
2. The steady-state and transient performance of a 12-pulse, 1000 MW (500 kV-2kA) 50/60 Hz HVDC transmission system.
3. FACTS and HVDC Technologies for the Development and Enhancement of Future Power Systems.
4. Use of HVDC and FACTS which can be applied in transmission and distribution systems
5. Simulation of various applications using FACTs devices.
6. AC-DC Power flow analysis using FACTS devices.
7. Stabilty of Power Transmission Capability of HVDC system using facts controllers.
8. Design of DC breakers modelling using MATLAB
9. Design of Power control in HVDC using MATLAB
10. Modelling and digital simulation of STATACOM using MATLAB

Content beyond syllabus:

1. Design of real-time industrial projects.
2. Application of various compensation techniques in power system.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	Introduction of DC power transmission	https://www.cet.edu.in/noticefiles/229_HVDC_NOTE.pdf
2	Analysis of HVDC converters	https://aits-tpt.edu.in/wp-content/uploads/2018/08/HVDC-2-Unit.pdf
3	Control of HVDC converter and systems	https://sari-energy.org/oldsite/PageFiles/What_We_Do/activities/HVDC_Training/Presentations/Day_2/3.HVDC_CONTROLS.pdf
4	Introduction To Facts	https://nptel.ac.in/courses/108/107/108107114/
5	Static Series Compensators	https://nptel.ac.in/courses/108/107/108107114/

Text Book(s):

1. Padiyar, K. R., "HVDC power transmission system", New Age International (P) Ltd., New Delhi, Second Edition, 2010.
2. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, 1990.
4. R.MohanMathur,RajivK.Varma,"Thyristor–Based Facts Controllers for Electrical Transmission Systems", IEEE press andJohnWiley&Sons,Inc,2002.
5.Narain G.Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors,Delhi-110006,2011.

Reference Book(s):

1. Direct Current Transmission, Vol. 1, E. W. Kimbark, Wiley, 1971
2. High Voltage Direct Current Transmission, Jos Arrillaga, IEE Power and Energy series 29, 2nd Edition, 1998
3. EHV-AC, HVDC Transmission & Distribution Engineering, S Rao, Khanna Publishers, 4 th Edition, 2008.
4.K.R.Padiyar,"FACTS Controllersin Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008
5. A.T.John,"FlexibleA.C.TransmissionSystems",InstitutionofElectricalandElectronic Engineers(IEEE), 1999.
6. V.K.Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,KluwerAcademic Publishers,2004.

Online Resources/ Web Resources:

1. https://nptel.ac.in/courses/108/104/108104013/
2. http://www.ee.uidaho.edu/ee/power/ee
3. https://www.powereng.com/our-services/power-delivery/hvdc-fact/
4. https://en.wikipedia.org/wiki/High-voltage_direct_current
5. https://www.ti.com/lit/an/sloa289a/sloa289a.pdf?ts=1592377419880&ref_url=https%253A%252F%2www.google.co.in%252F
7. https://pv-magazine-usa.com/2020/03/31/hvdc-transmission-helps-investors-but-may-not-help-solar/
8. http://www.renewableenergyfocus.com/view/3567/hvdc-transmission-from-energy-source-to-consumer/

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EE4020	ADVANCED POWER CONVERTERS							R2020
	Hours / Week			Total	Credit	Max Marks		
	L	T	P	**hrs**	C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Power Electronics

Course Objectives:

1. To analyze the dc-dc voltage regulators
2. To describe the operation of resonant converters
3. To describe the operation of multi level converters and multi pulse converters with switching strategies for high power
4. To understand Principle of Operation DC power supplies
5. To analyze the AC power supplies

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

CO 1	Evaluate different dc-dc voltage regulators**(BL-3)**
CO 2	Analyze resonant converters**(BL-3)**
CO 3	Evaluate various multi-level inverter configurations **(BL-3)**
CO 4	Select appropriate phase shifting converter for a multi-pulse converter**(BL-3)**
CO 5	Analyze the various DC power supplies **(BL-3)**

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2											2	3
CO2	3	2	2										3	3
CO3	1	1	1										2	3
CO4	2	2											2	2
CO5	1	3											2	3

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**Switching Voltage Regulators**	10**Hours**

Introduction; Linear power supply (voltage regulators); Switching voltage regulators; Review of basic dc-dc voltage regulator configurations -Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode; Other converter configurations like Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter; Design criteria for SMPS; Multi-output switch mode regulator.

At the end of the Module 1, students will be able to:

1. Recall the basic concepts of voltage regulators **(BL-1)**

2. Understand the other converter configurations **(BL-2)**

3. Evaluate the different dc voltage regulators**(BL-3)**

MODULE -2	**Resonant Converters**	**10 Hours**

Introduction, Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, zerovoltage switching dc-dc converters, zero current switching dc-dc converters, clamped voltage topologies.

At the end of the Module 2, students will be able to:

1. understand the concept of resonant conversion**(BL-2)**
2. compare & analyzethe zero voltage and current switching dc-dc converters**(BL-2)**

MODULE-3	**Multi-level converters**	**10 Hours**

Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded H-bridge multilevel Converters configurations; Features and relative comparison of these configurations applications, Introduction to carrier based PWM technique for multi-level converters.

At the end of the Module 3, students will be able to:

1. Understand the concept of multi-level **(BL-2)**
2. Evaluate various multi-level inverter configurations **(BL-3)**
3. Understandcarrier based PWM technique for multi-level converters**(BL-2)**

MODULE-4	**Multipulse Converters**	**08 Hours**

Concept of multi-pulse, Configurations for m-pulse (m=12,18,24 ….) converters, Different phase shifting transformer (Y-Δ1, Y-Δ2, Y-Z1 and Y-Z2) configurations for multi-pulse converters, Applications.

At the end of the Module 4, students will be able to:

1. Explain the concept of multi-pulse**(BL-3)**
2. Analyze different phase shifting transformer configurations for multi-pulse converters**(BL-4)**
3. Understand the applications of multipulse converters**(BL-2)**

MODULE-5	**DC & AC Power Supplies**	**10 Hours**

DC Power Supplies – Types – Switched Mode DC Power Supplies – Fly Back Converter –Forward Converter – Push-Pull Converter – Half Bridge Converter – Full Bridge Converter –Resonant DC Power Supplies – Bidirectional Power Supplies – Applications –AC Power Supplies – Types – Switched Mode Ac Power Supplies – Resonant AC Power Supplies – Bidirectional Ac Power Supplies – Multistage Conversions – Control Circuits – Power Line Disturbances – Power Conditioners – Uninterruptible Power Supplies – Applications

At the end of the Module 5, students will be able to:

1. Understand the switched mode dc power supplies**(BL-2)**
2. Analyze the types of dc power supplies **(BL-3)**
3. Analyze Bidirectional Power Supplies (BL-3)

Total hours:	**48 Hours**

Term work:

1. Evaluate the performance and operating modes of SLR/PLR dc-dc converter with the change in switching frequency.
2. Simulate/Design a circuit for a Buck Converter with ZVS/ZCS to regulate the output voltage Vo with a given input voltage Vin.
3. Carrier based Sine PWM control of a CHB multilevel inverter and study of harmonic spectrum.
4. Study the operation and performance of second order converters like Buck-Boost, Fly back, forward converters etc.
5. Study the operation and performance of fourth order converters like C'uk or Sepic converters
6. Study of harmonic spectrum for 12 and 18 pulse converters.
7. Design based Problems (DP)/Open Ended Problem: Course coordinator can assign the design based problem/open ended problem.
8. Major Equipment: Simulation software like MATLAB, PSIM, Scilab, Power Electronic Converters, CRO/DSO, meters, Current/Voltage Probes, Isolation transformer etc. as demanded by the course.

Content beyond syllabus:

1.Advanced multilevel converters

Self-Study:

Contents to promote self-Learning:

S.NO	Module	Reference
1	**Switching Voltage Regulators**	https://www.youtube.com/watch?v=Q0E-ZAsqzKE
2	**Resonant Converters**	https://www.youtube.com/watch?v=53avTO3BYnI
3	**Multi-level converters**	https://www.youtube.com/watch?v=J3iEhAtcwZs
4	**Multipulse Converters**	https://www.youtube.com/watch?v=cqT6oOh3ggc
5	**DC Power Supplies**	https://www.youtube.com/watch?v=flAETm0RreY
6	**AC Power Supplies**	https://www.youtube.com/watch?v=DwiBp-Oohvs

Text Book(s):

1. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India, 3rd ed., 2009.
3. Bin Wu, "High Power Converters and AC Drives", John Willey & sons, Inc., 2006.

Reference Book(s):

1. Derek A. Paice "Power Electronic Converter Harmonics – Multipulse Methods for Clean Power", IEEE Press, 1996.
2. Muhammad H. Rashid , "Power Electronics Handbook", Elsevier, 3rd ed., 2011.
3. P.C.Sen, "Modern Power Electronics ", S. Chand and Co. Ltd., New Delhi, 2000.
4. Vijay K. Sood, "HVDC and FACTS Controllers Applications of Static Converters in Power Systems", Kluwer Academic Publishers, Boston, 2004.
5. L. Umanand, "Power Electronics Essentials and Applications", Wiley India Ltd., 2009

Online Resources / Web References:

1. https://www.youtube.com/watch?v=MeOYUx07SCk
2. https://www.youtube.com/watch?v=ErMz2MI5DQo
3. https://www.youtube.com/watch?v=ohwGWysVuXU
4. https://www.academia.edu/38805211/Advanced_Power_Electronics_Converters_PWM_Converters_Processing_AC_Voltages
5. https://www.electronicbo.com/2019/06/Advanced-Power-Electronics-Converters.html
6. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/
7. https://nptel.ac.in/courses/108/106/108106073/
8. https://www.youtube.com/watch?v=MeOYUx07SCk&list=PLUpFmz4G8ZyZx2fG5B_GRVIhTquypoAWZ
9. https://www.youtube.com/watch?v=ohwGWysVuXU
10. https://www.youtube.com/watch?v=0jevuayGmmU&list=PLLy_2iUCG87DzWK9cLYKxjH1LRACxdEKi

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EE4025	ADVANCED POWER SEMICONDUCTOR DEVICES AND PROTECTION							R2020
	Hours / Week			Total	Credit	Max Marks		
	L	T	P	**hrs**	C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Review of introductory concepts of power semiconductor devices

Course Objectives:

OBJECTIVES:

1. To improve power semiconductor device structures for adjustable speed motor controlapplications.
2. To understand the static and dynamic characteristics of current controlled powersemiconductor devices
3. To understand the static and dynamic characteristics of voltage controlled powersemiconductor devices
4. To enable the students for the selection of devices for different power electronicsApplications
5. To understand the control and firing circuit for different devices.

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

CO 1	Analyze power switching devices **(BL-4)**
CO 2	Design of current controlled devices and their parameters**(BL-3)**
CO 3	Analyze the voltage controlled devices and their parameters **(BL-2)**
CO 4	Understand new power semiconductor devices**(BL-2)**
CO 5	Design of protecting circuit**(BL-3)**

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2											2	2
CO2	3	2	2										2	2
CO3	3	2											2	2
CO4	3	2											2	2
CO5	3	2	2										2	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	**POWER SWITCHING DEVICES**	10**Hours**

Power switching devices overview – Attributes of an ideal switch, application requirements,circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state andswitching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

At the end of the Module 1, students will be able to:

1. Understand the Power switching devices overview**(BL-2)**
2. Analyze the Device selection strategy **(BL-3)**
3. Analyze the Power diodes **(BL-3)**

MODULE -2	CURRENT CONTROLLED DEVICES	10 Hours
BJT's – Construction, static characteristics, switching characteristics; Negative temperaturecoefficient and second breakdown; - Thyristors – Physical and electrical principle underlyingoperating mode, Two transistor analogy – concept of latching; Gate and switchingcharacteristics; converter grade and inverter grade and other types; series and paralleloperation; comparison of BJT and Thyristor – steady state and dynamic models of BJT Thyristors- Basics of GTO, MCT, FCT, RCT		
At the end of the Module 2, students will be able to: **1.** Analyze the switching characteristicsofBJT**(BL-3)** **2.** Analyze the Two transistor analogy**(BL-3)** **3.** Understand the basics of thyristors**(BL-3)**		
MODULE-3	**VOLTAGE CONTROLLED DEVICES**	**10 Hours**
Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types,static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs -and IGCT		
At the end of the Module 3, students will be able to: **1.** Understand the principle of voltage controlled devices**(BL-2)** **2.** Analyze the switching characteristics of MOSFET & IGBT**(BL-3)**		
MODULE-4	**NEW SEMICONDUCTOR MATERIALS FOR DEVICES**	**10 Hours**
New semiconductor materials for devices – Intelligent power modules- Integratedgate commutated thyristor (IGCT) - Comparison of all power devices.		
At the end of the Module 4, students will be able to: **1.** Understand the Intelligent power modules**(BL-2)** **2.** Analyze the Integratedgate commutated thyristor**(BL-3)** **3.** Compare all power devices**(BL-2)**		
MODULE-5	**FIRING AND PROTECTING CIRCUITS**	**08 Hours**
Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET,IGBTs and base driving for power BJT. - Over voltage, over current and gate protections;Design of snubbers.Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling		
At the end of the Module 5, students will be able to: **1.** Understand the necessity of isolation**(BL-2)** **2.** Analyze the Gate drives circuit**(BL-3)** **3.** Understand the design of snubbers**(BL-2)**		
	Total hours:	**48 hours**

Term work:

1. Study of design of SiC MOSFETs
2. Tabulate the details of SCRs of different ratings
3. Derivation and explanation of transient thermal impedance of SCR
4. Study of thermal design of SCR with derivations
5. Study and explain paper on the state of the art and future trends of power semiconductors

Content beyond syllabus:

Protection against external & internal over voltages.

Self-Study:

Contents to promote self-Learning:

S.NO	Module	Reference
1	Power Switching Devices	https://www.youtube.com/watch?v=7XsuRUXF4wE
2	Current Controlled Devices	https://www.youtube.com/watch?v=5Jf_WWt-5vg
3	Voltage Controlled Devices	https://www.youtube.com/watch?v=lzwqcMvuYxU
4	New Semiconductor Materials For Devices	https://www.youtube.com/watch?v=88lo7MgCpNo
5	Firing And Protecting Circuits	https://www.youtube.com/watch?v=XyuY8OgMQL4

Text Book(s):

1. B.W Williams 'Power Electronics Circuit Devices and Applications'..
2. Rashid M.H., " Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004
3. MD Singh and K.B Khanchandani, "Power Electronics", Tata McGraw Hill, 2001.
4. Mohan, Undeland and Robins, "Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.
5. Joseph Vithayathil, Power Electronics: Principles and Applications, Delhi, Tata McGraw-Hill, 2010.

Reference Book(s):

1. Advanced power electronics converters by Euzeli dos santos, Edison R. da silva.
2. Fundamentals of Power Semiconductor Devices by B. JayanthBaliga, Springer Press, 2008.
3. Power Semiconductor Devices and Circuits, Jaecklin**, A.A.**
4. Fundamentals of Power Semiconductor Devices, **Baliga**, B. Jayant

Online Resources/ Web References:

1. https://www.amazon.in/Power-Electronics-Drives-Advanced-Applications-ebook/dp/B086H4Z9WY
2. https://www.pdfdrive.com/25-advanced-power-semiconductor-devices-apsd-e456994.html
3. https://www.ttiinc.com/content/ttiinc/en/resources/product-types/discretes.html?utm=1267&channel=ppc&gclid=CjwKCAjw1K75BRAEEiwAd41h1AEeMfdQ65z0DUsEWQSBV_cFEI5VwuQnFLxopFizjnXDYRY4iPtUoRoCkAEQAvD_BwE
4. http://site.iugaza.edu.ps/malramlawi/files/RASHID_Power_Electronics_Handbook.pdf
5. https://www.youtube.com/watch?v=h0Y9jDKqScQ&list=PLgMDNELGJ1CaNcuuQv9xN07ZWkXE-wCGP
6. https://www.youtube.com/watch?v=m-uY4fja_Jw&list=PLOzRYVm0a65dVYOA7_3-N67Xu1NIrLnR0
7. https://www.youtube.com/watch?v=-YgHdIqkbs0
8. https://www.youtube.com/watch?v=5-uQ4rLlWPE