GMR Institute of Technology
An Autonomous Institute Affiliated to JNTU-GV

GMRIT Training Tomorrow's Engineers Today

1.1.3 (A) Syllabus copy of the courses highlighting Focus on Employability/Entrepreneurship/ Skill development along with their course outcomes

Department of Electrical and Electronics Engineering

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Institute Vision

- To be among the most preferred institutions for engineering and technological education in the country
- An institution that will bring out the best from its students, faculty and staff – to learn, to achieve, to compete and to grow – among the very best
- An institution where ethics, excellence and excitement will be the work religion, while research, innovation and impact, the work culture

Institute Mission

- To turnout disciplined and competent engineers with sound work and life ethics
- To implement outcome based education in an IT-enabled environment
- To encourage all-round rigor and instill a spirit of enquiry and critical thinking among students, faculty and staff
- To develop teaching, research and consulting environment in collaboration with industry and other institutions

Department Vision

To be a preferred department of learning for students and teachers alike, with a commitment towards academics & research, serving the students in an atmosphere of innovation, critical thinking and making them industry ready.

Department Mission

M1. To provide adaptable education in a collaborative and innovative environment in skilling the graduates to solve real world problems in the field of Electrical & Electronics Engineering.

M2. To prepare the students as critical thinking professionals with multidisciplinary research orientation and Innovation.

M3. To instill ethical values and nurture the graduates who will be able to contribute to the society.

Program Educational Objectives (PEOs)

1. Employ logical and analytical skills in solving complex real-world engineering problems in the areas of Electrical & Electronics Engineering and allied fields.
2. Adaptable to emerging technologies with enhanced professional skills and ability towards continuous learning, facilitating higher studies and research.
3. Demonstrate professional ethics, leadership qualities and promote inclusive and collaborative growth with human values towards societal interest.

Program Outcomes (POs):

Engineering graduate will be able to:

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

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

PO 3: 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. (Design/development of solutions)

PO 4: 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. (Conduct investigations of complex problems)

PO 5: 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. (Modern tool usage)

PO 6: 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. (The engineer and society)

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

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

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

PO 10: 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. (Communication)

PO 11: 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. (Project management and finance)

PO 12: 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. (Life-long learning)

Program Specific Outcomes (PSOs):

Engineering graduate will be able to:

PSO#1: Apply principles of electrical and electronics engineering to design and develop reliable, efficient systems, circuits, and devices for diverse applications.

PSO#2: Utilize modern tools and emerging technologies, including electrical mobility, smart grids, and renewable energy systems, to foster energy-efficient and sustainable solutions.

Department of Electrical & Electronics Engineering

Minimum Credits to be earned: 160 (for Regular Students)
127 (for Lateral Entry Students)

S.No	Course Code	Course Name	POs	Contact Hours			
				L	T	P	C
First Semester							
1	21HSX01	Communicative English	1,6,10,11,12	2	-	-	2
2	21MAX01	Engineering Mathematics I	1,2,3,12,PSO1,PSO2	3	-	-	3
3	21PYX01/ 21CYX01	Engineering Physics / Engineering Chemistry	1 ,2,3,6,7,12/ 1 ,2,3,6,7,12	3/3	-	-	3/3
4	21BEX01/ 21BEX06	Basics of Engineering /IT Workshop	1 ,2,3,6,7,12 PSO1,PSO2/3,4,5,6,7,8,9,10,11,12	3/ -	-	-/ 3	3/1.5
5	21BEX02	Problem Solving and Programming Skills	1,2,3,6,12	3	-	-	3
6	21BEX03	Problem Solving and Programming Skills Lab	1,2,3,4,5,9,11,12	-	-	3	1.5
7	21BEX04/ 21BEX05	Engineering Drawing / Engineering Workshop	1,2,3,4,5,9,10,11,12/1,2,3,4,9,10,11,12	-	-	3/3	1.5/1.5
8	21PYX02/ 21CYX02	Engineering Physics Lab / Engineering Chemistry Lab	1,2,3,4,5,9,11,12/1,2,3,4,5,7,9,11,12	-	-	3/3	1.5/1.5
9	21HSX02	Communicative English Lab	1.4.5.9,10,11,12	-	-	3/-	1.5/-
			Total	**14/11**	**-**	**12/12**	**20/17**
Second Semester							
1		Language Elective	6,9,10,11,12	2	-	-	2
2	21MAX02	Engineering Mathematics II	1,2,3,12, PSO1,PSO2	3	-	-	3
3	21CYX01/ 21PYX01	Engineering Chemistry / Engineering Physics	1 ,2,3,6,7,12/ 1 ,2,3,6,7,12	3/3	-	-	3/3
4	21BEX01/ 21BEX06	Basics of Engineering / IT Workshop	1 ,2,3,6,7,12 PSO1,PSO2/3,4,5,6,7,8,9,10,11,12	-/3	-	3/-	1.5/3
5	21BEX07	Python Programming	1,2,3,12	3	-	-	3
6	21BEX08	Python Programming Lab	2,3,4,5,12	-	-	3	1.5
7	21BEX05/ 21BEX04	Engineering Workshop / Engineering Drawing	1,2,3,4,5,9,10,11,12/1,2,3,4,9,10,11,12	-	-	3/3	1.5/1.5
8	21CYX02/ 21PYX02	Engineering Chemistry Lab / Engineering Physics Lab	1,2,3,4,5,9,11,12/1,2,3,4,5,7,9,11,12	-	-	3/3	1.5/1.5
9	21HSX02	Communicative English Lab	1.4.5.9,10,11,12	-	-	-/3	-/1.5
			Total	**11/14**	**-**	**12/12**	**17/20**
Third Semester							
1	21MA302	Engineering Mathematics III	1,2,3,4,5,9,11,12,PSO1,PSO2	3	-	2	4
2	21EE302	DC Machines and Transformers	1,2,3,6,12,PSO1,PSO2	3	-	-	3
3	21EE303	Electrical Circuit Analysis	1,2,3,6,7,12,PSO1,PSO2	3	-	-	3
4	21EE304	Electromagnetic Field Theory	1,2,3,6,7,12,PSO1,PSO2	3	-	-	3
5	21EE305	Measurements and Instrumentation	1,2,3,6,12,PSO1,PSO2	3	-	-	3
6	21EE306	Semiconductor Devices and Circuits	1,2,3,4,5,6,12,PSO1,PSO2	3	-	2	4
7	21EE307	DC Machines Lab	1,2,3,4,5,9,11,12,PSO1,PSO2	-	-	3	1.5
8	21EE308	Electrical Circuits and Simulation Lab	1,2,3,4,5,9,11,12,PSO1,PSO2	-	-	3	1.5

9	21ESX01	Employability Skills I	1,2,3,4,5,9,10,11,12	-	-	2	-
10	21HSX11	CC & EC Activities I	9,10,12	-	-	1	-
			Total	**18**	**-**	**13**	**23**
Fourth Semester							
1	21EE401	AC Machines	1,2,3,6,12,PSO1,PSO2	3	-	-	3
2	21EE402	Linear and Digital Integrated Circuits	1,2,3,4,5,6,9,11,12,PSO1,PSO2	3	-	2	4
3	21EE403	Power Electronics	1,2,3,6,12,PSO1,PSO2	3	-	-	3
4	21EE404	Power Generation, Transmission and Distribution	1, 2,3,6,7,8,12, PSO1,PSO2	3	-	-	3
5	21EE405	Signals and Systems Theory	1,2,3,6,12,PSO1,PSO2	3	-	-	3
6	21EE406	AC Machines Lab	1,2,3,4,5,9,11,12,PSO1,PSO2	-	-	3	1.5
7	21EE407	Measurements and Instrumentation Lab	1,2,3,4,5,9,11,12,PSO1,PSO2	-	-	3	1.5
8	21ESX01	Employability Skills I	1,2,3,4,5,9,10,11,12	-	-	2	2
9	21HSX11	CC & EC Activities I	9,10,12	-	-	1	1
			Total	**15**	**-**	**11**	**22**
Fifth Semester							
1	21IT306	Fundamentals of Object Oriented Programming	1,2,3,4,5,6,9,12	3	-	2	4
2	21EE502	Control Systems	1,2,3,4,5,6,9,12,PSO1,PSO2	3	-	2	4
3	21EE503	Electrical Drives	1,2,3,6,12,PSO1,PSO2	3	-	-	3
4	21EE504	Power System Protection	1,2,3,6,7,8,12,PSO1,PSO2	3	-	-	3
5		Elective I (Professional Elective)		3	-	-	3
6		Elective II (Open Elective I)		3	-	-	3
7	21EE507	Power Electronics and Drives Lab	1,2,3,4,5,9,11,12,PSO1,PSO2	-	-	3	1.5
8	21TPX01	Term Paper	1,2,4,5,8,9,10,11,12,PSO2	-	-	3	1.5
9	21ESX02	Employability Skills II	1,2,3,4,5,9,10,11,12	-	-	2	-
10	21HSX12	CC & EC Activities II	9,10,12	-	-	1	-
11	21SIX01	Summer Internship I	1,2,3,6,7,8,9,10,11,12,PSO1,PSO2				1
			Total	**18**	**-**	**13**	**24**
Sixth Semester							
1	21HSX10	Engineering Economics and Project Management	1,2,3,4,5,6,7,8,9,10,11,12	3	-	-	3
2	21EE602	Power System Analysis and Control	1,2,3 ,6,7,8,12,PSO1,PSO2	3	-	-	3
3	21EE603	Utilization of Electrical Energy	1,2,3 ,6,7,12,PSO1,PSO2	3	-	-	3
4		Elective III (Professional Elective)		3	-	2	4
5		Elective IV (Open Elective II)		3	-	-	3
6	21EE606	Power Systems Lab	1,2,3 ,4,5,9,11,12,PSO1,PSO2	-	-	3	1.5
7	21MPX01	Mini Project	1 to12,PSO1,PSO2	-	-	3	1.5
8	21ESX02	Employability Skills II	1,2,3 ,4,5,9,10,11,12	-	-	2	2
9	21HSX12	CC & EC Activities II	9,10,12	-	-	1	1
10	21ATX01	Environmental Studies	1,3,6,7	-	-	-	-
11	21ATX02	Professional Ethics and Human Values	-----	-	-	-	-
12	21ATX---	Audit Course	-----	-	-	-	-
			Total	**15**	**-**	**11**	**22**
Seventh Semester							
1		Elective V (Professional Elective)		3	-	-	3

2		Elective VI (Professional Elective)		3	-	-	3
3		Elective VII (Open Elective III)		3	-	-	3
4	21SIX02	Summer Internship II	1 to 12,PSO1,PSO2	-	-	-	1
5	21PWX01	Project	1 to 12,PSO1,PSO2	-	-	16	8
			Total	**9**	**-**	**16**	**18**
Eighth Semester							
1		Elective VIII (Professional Elective)		-	-	-	3
2		Elective IX (Open Elective IV)		-	-	-	3
3	21FIX01	Full Semester Internship (FSI)	1 to 12,PSO1,PSO2	-	-	-	8
			Total	**-**	**-**	**-**	**14**

List of Electives

Language Electives							
No.	**Course Code**	**Course**	**POs**	**Contact Hours**			
				L	**T**	**P**	**C**
1	21HSX03	Advanced Communicative English	6,9,10,11,12	2	-	-	2
2	21HSX04	Communicative German		2	-	-	2
3	21HSX05	Communicative French		2	-	-	2
4	21HSX06	Communicative Japanese		2	-	-	2
5	21HSX07	Communicative Spanish		2	-	-	2
6	21HSX08	Communicative Korean		2	-	-	2
7	21HSX09	Communicative Hindi		2	-	-	2
Elective I							
Career Path I, II, III and Other Core Electives							
1	21EEC11	Electrical Vehicle Technologies	2,3,4,7,12,PSO1,PSO2	3	-	-	3
2	21EEC21	Green Energy Technologies	1,2,3,6,7,12,PSO1,PSO2	3	-	-	3
3	21EEC31	Micro and Smart Grid Technologies	2,3,6,7,12,PSO1,PSO2	3	-	-	3
4	21EE004	Electrical Machine Design	1,2,3,8,12,PSO1,PSO2	3	-	-	3
5	21EE005	High Voltage DC Transmission	1,2,3,6,7,12,PSO1,PSO2	3	-	-	3
6	21EE006	Special Electrical Machines	1,2,3,7,12,PSO1,PSO2	3	-	-	3
Elective III							
Career Path I, II, III and Other Core Electives							
1	21EEC12	Electric Vehicle Drive Train Systems	1,2,3 ,4,5,6,7,9,12,PSO1,PSO2	3	-	2	4
2	21EEC22	Power Electronic Applications to Green Energy Systems	1,2,3 ,4,5,6,7,9,12,PSO1,PSO2	3	-	2	4
3	21EEC32	Control and Instrumentation of Smart Grid Systems	1,2,3 ,4,5,6,7,12,PSO1,PSO2	3	-	2	4
4	21EE007	Advanced Control Systems	1,2,3 ,4,5,6,12,PSO1,PSO2	3	-	2	4
5	21EE008	Discrete Signal Processing	1,2,3 ,4,5,6,12,PSO1,PSO2	3	-	2	4
6	21EE009	Machine Modelling and Steady State Analysis	1,2,3 ,4,5,6,8,12,PSO1,PSO2	3	-	2	4
Elective V							
Career Path I, II, III and Other Core Electives							
1	21EEC13	Battery Management Systems	1,2,3,6,7,12, PSO1,PSO2	3	-	-	3
2	21EEC23	Hybrid Renewable Energy Systems Design	1,2,3,6,7,12, PSO1,PSO2	3	-	-	3
3	21EEC33	Communication and Security in Smart Grid	1,2,3,6,7,8,12, PSO1,PSO2	3	-	-	3
4	21EE010	Electrical Distribution Systems	1,2,3,6,7,8,12, PSO1,PSO2	3	-	-	3
5	21EC401	Analog and Digital Communications	1,2,3,6,7,12, PSO1,PSO2	3	-	-	3
6	21IT304	Database Management Systems	1,2,3,6,8,12	3	-	-	3
Elective VI							
1	21EE011	Energy Audit, Conservation and Managaement	1,2,3,6,7,8,12, PSO1,PSO2	3	-	-	3
2	21EE012	Microprocessors and Microcontroller Interfacing	1,2,3,6,12, PSO1,PSO2	3	-	-	3
3	21EE013	Programmable Logic Controllers	1,2,3,6,12, PSO1,PSO2	3	-	-	3
Elective VIII (Professional Elective)							
1	21EE014	Power System Deregulation	1,2,3,6,7,12, PSO1,PSO2	-	-	-	3
2	21EE015	Power System Dynamics & Control	1,2,3,8,12, PSO1,PSO2	-	-	-	3
3	21EE016	High Voltage Engineering	1,2,3,6,8,12, PSO1,PSO2	-	-	-	3
Elective II, IV, VII							
(List of Open Electives)							
No.	**Course Code**	**Course**	**POs**	**L**	**T**	**P**	**Credits**
1	21CE001	Disaster Management	2,7	3	-	-	3
2	21EE001	Electrical Installation, Safety and Auditing	1,2,3,6,7,8,12	3	-	-	3
3	21ME001	Fundamentals of Optimization Techniques	1,2,3,5	3	-	-	3
4	21EC001	Sensors for Engineering Applications	1	3	-	-	3
5	21CS001	Fundamentals of Artificial Intelligence	1,2,3	3	-	-	3
6	21CH001	Energy Conversion and Storage Devices	1,3,6,7	3	-	-	3
7	21IT001	Fundamentals of Multimedia	3,5,7	3	-	-	3

8	21BS001	Nano Materials and Technology	1,12	3	-	-	3
9	21DS001	Fundamentals of Data Science	1,2	3	-	-	3
10	21CE002	Air Pollution and Environmental Impact Assessment	6,7,12	3	-	-	3
11	21EE002	Renewable Energy Sources	1,2,3,6,7,12	3	-	-	3
12	21ME002	Principles of Entrepreneurship	1,5,8,11	3	-	-	3
13	21EC002	Electronics for Agriculture	1,2	3	-	-	3
14	21CS002	Fundamentals of Machine Learning	2,5	3	-	-	3
15	21CH002	Industrial Safety and Hazard Management	1,2,3,6,8	3	-	-	3
16	21IT002	Fundamentals of Cloud Computing	2,6,7,8,12	3	-	-	3
17	21BS002	Advanced Numerical Techniques	1,2	3	-	-	3
18	21BS003	Functional Materials and Applications	1,7	3	-	-	3
19	21CE003	Solid Waste Management	3,7,12	3	-	-	3
20	21EE003	Fundamentals of Electrical Vehicle Technology	1,2,3,6,7,12	3	-	-	3
21	21ME003	Industrial Engineering and Management	1,11	3	-	-	3
22	21EC003	Interfacing and Programming with Arduino	1,2	3	-	-	3
21	21CS003	Data Science for Engineering Applications	2,3,4	3	-	-	3
24	21CH003	Industrial Ecology for Sustainable Development	2,6,7	3	-	-	3
25	21IT003	Fundamentals of Mobile Computing	1,7	3	-	-	3
26	21BS004	Advanced Materials of Renewable Energy	1,7	3	-	-	3
27	21BS005	Applied Linear Algebra for Engineers	1,12	3	-	-	3
28	21CE019	Green Buildings	1,7,12	3	-	-	3
29	21EE017	Sustainable Energy	1,2,3,6,7,12	3	-	-	3
30	21ME019	Total Quality Management	1,11	3	-	-	3
31	21EC011	Communication Technologies	1,2	3	-	-	3
32	21CS020	Applications of Artificial Intelligence	2,3,6,7	3	-	-	3
33	21CH016	Green Technologies	2,6,7	3	-	-	3
34	21IT015	Human Computer Interaction	1,7	3	-	-	3
35	21BS006	Handling of Industrial waste and waste water	1,7	3	-	-	3
36	21OE001	Robotics and Automation	5,6,7	3	-	-	3
37	21OE002	Introduction to IoT	1,2	3	-	-	3
38	21OE003	Fundamentals of Image processing	1,2	3	-	-	3
39	21OE004	Fundamentals of Data Acquisition systems	1,2	3	-	-	3
40	21OE005	Airport Operations Management	2,4,11,12	3	-	-	3
41	21OE006	Fundamentals of Embedded Systems	1,2	3	-	-	3
42	21OE007	Remote Sensing and GIS	1,2,5,7,10	3	-	-	3
43	21OE008	Big Data Analytics	1,7	3	-	-	3
44	21OE009	Fundamentals of Cyber Security	3,6,8	3	-	-	3
45	21OE010	Smart Cities	7,12	3	-	-	3
46	21OE011	Nano Materials and Thin Film Technology	1,12				
47	21CSMC1	Cloud computing	2,3	3	-	-	3
48	21CSMC2	Ethical Hacking	1,2,3	3	-	-	3
49	21CSMC3	Fundamentals of Web Development	2,3,5	3	-	-	3
50	21OE012	Business Intelligence & Analytics	2,3,5	3	-	-	3
51	21OE013	Introduction To Industry 4.0 And Industrial IoT	2,3	3	-	-	3
52	21OE014	Natural Language Processing	2,3	3	-	-	3
Audit Course							
1	21AT001	Communication Etiquette in Workplaces	-	-	-	-	-
2	21AT002	Contemporary India: Economy, Policy and Society	-	-	-	-	-
3	21AT003	Design The Thinking	-	-	-	-	-
4	21AT004	Ethics and Integrity	-	-	-	-	-
5	21AT005	Indian Heritage and Culture	-	-	-	-	-
6	21AT006	Intellectual Property Rights and Patents	-	-	-	-	-
7	21AT007	Introduction to Journalism	-	-	-	-	-
8	21AT008	Mass Media Communication	-	-	-	-	-
9	21AT009	Science, Technology and Development	-	-	-	-	-
10	21AT010	Social Responsibility	-	-	-	-	-
11	21AT011	The Art of Photography and Film Making	-	-	-	-	-
12	21AT012	Gender Equality for Sustainbility	-	-	-	-	-

13	21AT013	Women in Leadership	-	-	-	-	-
14	21AT014	Introduction to Research Methodology	-	-	-	-	-
15	21AT015	Climate Chnages and Circular Economy					
B. Tech. (Honors)							
Domain I: AI in Electrical and Electronics Engineering							
01	21EEH11	Computational Intellegence in Electrical Engineering	1,2,3,6,12,PSO1,PSO2	4	-	-	4
02	21EEH12	Data analytics in Electrical Engineering	1,2,3,6,7,12,PSO1,PSO2	4	-	-	4
03	21EEH13	Internet of Things in Electrical Engineering	1,2,3,6,7,12,PSO1,PSO2	4	-	-	4
04	21EEH14	Introduction to Smart Cities	1,2,3,6,7,12,PSO1,PSO2	4	-	-	4
Domain II: Power Systems							
01	21EEH21	Design and Layout of Power Systems	1,2,3,6,7,12,PSO1,PSO2	4	-	-	4
02	21EEH22	Distributed Generation Technologies	1,2,3,6,7,11,12,PSO1,PSO2	4	-	-	4
03	21EEH23	Distribution System Planning and Automation	1,2,3,6,7,8,12,PSO1,PSO2	4	-	-	4
04	21EEH24	Power Quality	1,2,3,6,7,8,12,PSO1,PSO2	4	-	-	4
Domain III: Control Systems							
01	21EEH31	Adaptive Control Systems	1,2,3,12,PSO1,PSO2	4	-	-	4
02	21EEH32	Introduction to Autonomous Vehicles	1,2,3,6,12,PSO1,PSO2	4	-	-	4
03	21EEH33	Introduction to Robust Control Systems	1,2,3,6,12,PSO1,PSO2	4	-	-	4
04	21EEH34	Optimal Control Systems	1,2,3,6,12,PSO1,PSO2	4	-	-	4
Domain IV: Power Electronics and Drives							
01	21EEH41	Advanced Power Electronics	1,2,3,6,12,PSO1,PSO2	4	-	-	4
02	21EEH42	Flexible AC Transimission Systems	1,2,3,6,12,PSO1,PSO2	4	-	-	4
03	21EEH43	Power Electronic Control of DC Drives	1,2,3,6,12,PSO1,PSO2	4	-	-	4
04	21EEH44	Power Electronic Control of AC Drives	1,2,3,6,12,PSO1,PSO2	4	-	-	4
B. Tech. (Minors)							
Electrical and Electronics Engineering							
01	21EEM01	Electrical Machines	1,2	4	-	-	4
02	21EEM02	Power Systems	1,2,3,PSO1	4	-	-	4
03	21EEM03	Power Electronics and Drives	2,3,PSO1,PSO2	4	-	-	4
04	21EEM04	Electrical Measurements and Instrumentation	1,2,3	4	-	-	4

21IT306 Fundamentals of Object-Oriented Programming

3 0 2 4

Syllabus

Unit I **12+6 Hours**

Introduction to Java

Overview of Object-Oriented Programming principles, Importance of Java to the Internet, Byte code, Data types, arrays, control statements, Classes and Objects– constructors, methods, access control, this keyword, overloading methods and constructors, garbage collection

Features of object-oriented programming–Java History–Computer Programming Hierarchy–Role of Java Programmer in Industry

Practical Components

1. Read in a, b, c and use the quadratic formula. Write a Java program that prints all real solutions to the quadratic equation $ax^2 + bx + c = 0$. If the discriminate b2 -4ac is negative, display a message stating that there are no real solutions?
2. The Fibonacci sequence is defined by the following rule. The first 2 values in the sequence are 1, 1. Every subsequent value is the sum of the 2 values preceding it. Write a Java program that uses both recursive and non-recursive functions to print the nth value of the Fibonacci sequence.
3. Write a program to demonstrate String handling methods and tokenizing given string/text using String Tokenizer class with the following test cases

   Test case-1: "This, is, a, StringTokenizer"

   o/p: This
   ,
   is
   ,
   a
   ,
   StringTokenizer

   Test case-2: INPUT: Input string is: This is example for Java Tokenizer

   OUTPUT: The number of tokens in the string is: 6
4. Write a program to implement matrix operations using multidimensional arrays.

   INPUT: Matrix A:
   1 2 3
   4 5 6
   7 8 9

   Matrix B:
   9 8 7
   6 5 4
   3 2 1

   OUTPUT (ADDITION)
   Matrix A + Matrix B:
   10 10 10
   10 10 10
   10 10 10

   OUTPUT (MULTIPLICATION)
   Matrix A * Matrix B:
   30 24 18
   84 69 54
   138 114 90

Unit II **12+8 Hours**

Inheritance, Packages & Interface

Inheritance: Hierarchical abstractions, Base class and subclass, Benefits of inheritance, super keyword, final Keyword with inheritance, polymorphism, abstract classes

Packages: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, Member access rules. Interface: Defining an interface, differences between classes and interfaces, implementing interface, variables in interface and extending interfaces

Nested–Inner Class & Anonymous Classes–Generic Class Types

Practical Components

1. Write a program for creating one base class for student personal details and inherit those details into the sub class of student educational details to display complete student information.
2. You are tasked with creating a program that calculates and displays the areas of different geometric shapes. The program should exemplify the concept of runtime polymorphism using inheritance and method overriding.

   Test Case 1: Circle Area Calculation

   Input:
   Circle: Radius: 5.0
   Output:
   Area: 78.54

   Test Case 2: Multiple Shapes

   Input:
   Circle:Radius: 10.0
   Rectangle:Width: 5.0, Height: 7.0
   Output:
   Circle:Area: 314.16
   Rectangle:Area: 35.00
3. Write a program to create a package which has classes and methods to read Student admission details.

   Test Case 1: Valid Admission Details

   Input:
   Enter student name: Alice Johnson
   Enter student age: 22
   Enter course: Biology
   Output:
   Student Name: Alice Johnson
   Age: 22
   Course: Biology

   Test Case 2: Different Course

   Input:
   Enter student name: Bob Smith
   Enter student age: 19
   Enter course: Physics
   Output:
   Student Name: Bob Smith
   Age: 19
   Course: Physics
4. Write a Java program to create a Animal interface with a method called bark() that takes no arguments and returns void. Create a Dog class that implements Animal and overrides speak() to print "Dog is barking".

Unit III **12+8 Hours**

Exception Handling & Multithreading

Exception handling: Concepts and benefits of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, built-in and User Defined Exceptions.

Multithreading: Definition thread, thread life cycle, creating threads, synchronizing threads

Control Flow in Exceptions– JVM reaction to Exceptions– Inter Communication of Threads– Critical Factor in Thread–Deadlock

Practical Components

1. Create a Java program using multiple catch blocks to handle exceptions arising from array index out of bounds and division by zero, printing specific error messages for each exception.
2. Develop a program to define and handle User Defined Exceptions (make use of throw - throws).

   Test Case 1: Age above 18

   Input: int age = 20;

Output: Registration successful!
Test Case 2: Negative Age
Input: int age = -5;
Output: Exception: Age must be 18 or above for registration.

3. Design a Java program that showcases the concept of blocking a thread and illustrating how to control the execution flow and coordination between multiple threads in a controlled manner.
4. Introduction to Eclipse Environment.

Unit IV **12+10 Hours**

Java JDBC, Hibernate & Spring Framework

Java JDBC: Introduction, JDBC Driver, JDBC Connectivity steps, Connectivity with MySQL/Oracle. Hibernate Framework: Introduction, Object Relational Mapping tool, Java Persistence API, Hibernate Architecture
Spring Framework: Introduction, Spring Framework
Spring Application, Spring Boot.

Practical Components

1. Establish JDBC connection with Oracle
2. A) Develop a Java program that uses JDBC to establish a connection with a database, inserts data into a specified table, and verifies the successful insertion by displaying the inserted records from the table.
   B) Create a Java program utilizing JDBC to establish a database connection, perform updates and deletions on specified records within a table, and validate the changes by displaying the modified table data.
   Test Case 1: Update Record
   Input: Record ID to update, new values for the record's fields
   Action: Perform the update operation using JDBC
   Output: Display the updated record from the table
   Test Case 2: Delete Record
   Input: Record ID to delete
   Action: Perform the delete operation using JDBC
   Output: Display a message confirming the deletion, or display the modified table without the deleted record
3. Implement Hibernate Example without IDE
4. Develop a Hibernate example in Eclipse to save a "Student" entity to a MySQL database, utilizing Hibernate configuration, Java classes, and libraries, ensuring successful execution and record storage

Total: 48+32 Hours

21EE502 Control Systems

3 0 2 4

Unit I

Mathematical Models of Physical Systems

Concepts of Control Systems-Open Loop and closed loop control systems, Classification of control systems, Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems, Block diagram reduction Technique, Signal flow graphs

Effects of feedback

Practical Component

1. Plot the pole-zero configuration in s-plane for the given transfer function for open loop system and close-loop system
2. Simulation of a series R-L-C circuit
3. Simulation of a mass-spring-damper system
4. Series Parallel Feedback connection of Systems

12+8 Hours

Unit II

Time Domain Analysis

Standard test signals, Time response of first and second order systems, time domain specifications, characteristic Equation, Static error constants, Effects of P, PI, PD and PID controllers, Concept of stability, Routh-Hurwitz stability criterion, Difficulties and limitations in RH stability criterion, Root locus concept, construction of root loci

Effects of addition of poles and zeros on root locus plot

Practical Component

1. Step response characteristics for different values of damping factor and undamped natural frequency of any second-order system
2. Unit ramp, unit impulse, and unit acceleration responses of a second order System
3. Simulation of P, PD, PI, and PID controllers for a general second-order system
4. Construct Routh array for a given system and construct Root locus and find the gain K at any point on the root locus

12+8 Hours

Unit III

Frequency Domain Analysis

Frequency response characteristics, Frequency domain specifications, Time and frequency domain parameters correlations, Bode plot, transfer function from the Bode plot, Stability Analysis using Bode plot, Polar plot and Nyquist's stability criterion.

M & N circles

Practical Component

1. PID controller design for a DC motor in frequency domain
2. Polar Plot of a linear system
3. Stability analysis using Bode plot for second-order systems with varying zeta and for different values of gain K
4. Stability analysis using Nyquist stability criterion by determining its frequency characteristics

12+8 Hours

Unit IV

State Space Analysis

Concepts of state, state space modeling of physical systems, Representation of state space model in different canonical forms, Transfer function and state space model correlations, Solution of state equations, State Transition Matrix and it's Properties, Basic concept of Controllability and Observability.

Diagonalization

Practical Component

1. Convert transfer function to controllable, observable, diagonal, and Jordan canonical forms for a SISO system
2. State Controllability, State Observability, Output Controllability, Output Observability and pole-zero cancellation
3. Find the State transition matrix using Laplace Transforms
4. Controller design in the state space domain

12+8 Hours

Total: 48+32=80Hours

1. Illustrate the variation of root locus with respect to variations in K
2. Formulate the state space model in different canonical forms

21EE503 Electrical Drives

3 0 0 3

Unit I

Control of DC motors by Single Phase & Three Phase Converters

Introduction to Thyristor controlled Drives, Single Phase semi and Fully controlled converters connected to dc separately excited and dc series motors – continuous current operation – output voltage and current waveforms – Speed and Torque expressions – Speed – Torque Characteristics.

Three phase semi and fully controlled converters connected to dc separately excited and dc series motors – output voltage and current waveforms – Speed and Torque expressions – Speed – Torque characteristics.

Speed and Torque characteristics of dc motor, applications of converter fed dc motor.

12 Hours

Unit II

Electrical Braking and Chopper Fed Drives

Introduction to Four quadrant operation – Motoring operations, Electric Braking – Plugging, Dynamic and Regenerative braking operations. Four quadrant operation of DC motors by dual converters –Closed loop operation of DC motor, Single, Two and four quadrants chopper fed dc separately excited and series excited motors – Continuous current operation – Output voltage and current wave forms – Speed torque expressions – speed torque characteristics.

Four quadrant operation of DC motor by chopper, Closed Loop Operation of chopper dc drive.

12 Hours

Unit III

Control of Induction Motor from Stator Side

Variable voltage characteristics-Control of Induction Motor by AC Voltage Controllers-speed torque characteristics. Control of Induction Motor through Stator Frequency-Variable frequency characteristics-Variable frequency control of induction motor by Voltage source and current source inverters - PWM control – Comparison of VSI and CSI operations –Speed torque characteristics.

Closed loop operation of induction motor drives.

12 Hours

Unit IV

Control of Induction Motor from Rotor Side and Synchronous Motors

Static rotor resistance control, Slip power recovery – Static Scherbius drive – Static Kramer drive –their performance and speed torque characteristics, Separate control & self-control of synchronous motors.

Introduction to vector control

Advantages & applications of slip power recovery scheme.

12 Hours

Total: 48 Hours

21EE504 Power System Protection

3 0 0 3

Unit I

Circuit Breakers

Basics of Protection & its significance, Circuit Breakers: Elementary principles of arc interruption, Restriking and Recovery voltages - Restriking Phenomenon, Average and Max. RRRV- Current Chopping and Resistance Switching - CB ratings and Specifications, Auto-reclosures, Description and Operation of Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum Circuit Breakers and SF6 circuit breakers, MCB and MCCBs, Isolators.

Difference between a Fuse, an Isolator and a Circuit breaker.

12 Hours

Unit II

Electromagnetic Relays

Principle of operation and construction of attracted armature, Balanced beam, induction disc and induction cup relays. Instantaneous, DMT and IDMT relays.

Over current/ Under-voltage relays, Directional relays, Differential and percentage differential relays, Translay relay, Universal torque equation,

Distance relays- Impedance, Reactance and Mho relays.

Fundamental requirements of protective relays, Types of protection.

12 Hours

Unit III

Power system components protection

Generator Protection-Protection of generators against stator faults, rotor faults, restricted earth fault and inter-turn fault.

Transformer protection - Percentage differential protection, Buchholz relay protection.

Line protection -Over current, carrier current and three-zone distance relay protection using impedance relays, ZnO and rod gap Lightning arresters, grounding wires, Peterson coil.

Bus bar protection – Differential protection.

Voltage surge, lightning.

12 Hours

Unit IV

Static & Digital Relays

Static Relays-Introduction, Static relay components, Comparators – Amplitude and phase, Static over current relay, Static distance relay and Static poly-phase relay.

Digital Relays- Introduction, Digital logic communication, Microprocessor based over current, impedance, reactance & Mho relays, relay testing, static relays versus electromagnetic relays

Static relays versus electromagnetic relays.

12 Hours

Total: 48 Hours

21EEC11 Electrical Vehicle Technologies

3 0 0 3

Unit I

Introduction to Electric and Hybrid Electric Vehicles

Sustainable transportation, Brief history of electric vehicles (EV's), Hybrid electric vehicles, Fuel cell vehicles, Architectures of EV, Series HEV, Parallel HEVs, Diesel HEVs, PHEV & FCEV, Hybridization ratio, Interdisciplinary Nature of HEVs, Challenges and key technology of HEVs.

Recent EV models

12 Hours

Unit II

Vehicle Dynamics

General description of vehicle movement, Vehicle Resistance - Rolling Resistance, Grading Resistance, Aerodynamic Drag, Tire–Ground Adhesion and Maximum Tractive Effort- Power Train Tractive Effort and Vehicle Speed, Vehicle performance -Maximum Speed of a Vehicle, Gradeability, Operating fuel economy-Fuel Economy Characteristics of Internal Combustion Engines, Braking performance.

Techniques to improve vehicle fuel economy

12 Hours

Unit III

Power Electronics in HEVs

Power electronics converters used in a series HEV, Schematics of a power converter, Rectifiers used in HEV - Ideal Rectifier, Practical Rectifier, Buck Converter Used in HEVs -operating principle, Voltage source inverter, Current source inverter, Isolated bidirectional DC–DC converter, EV and PHEV battery chargers-charger architecture, Emerging power electronics devices, Thermal management of HEV power electronics

Circuit Packaging

12 Hours

Unit IV

Electric Machines and Drives in HEVs

Introduction to induction motor drives and control

Principle of operation and analysis of BLDC motor Drive, PMSM drive and SRM drive.

Doubly salient permanent magnet machines

12 Hours

Total: 48 Hours

21EEC21 Green Energy Technologies

3 0 0 3

Unit-I Wind Energy

Introduction to wind energy - Potential of wind electricity generation in India and its current growth rate Types of wind turbines - Power in the wind, temperature and altitude correction for air density - Impact of tower height - maximum rotor efficiency - Wind turbine generators, synchronous generators and asynchronous induction generator - Speed control for maximum power, Idealized wind turbine power curve, cut in wind speed, cut out wind speed, Rated wind speed, wind farms for bulk power supply

Indirect grid connection systems

12 Hours

Unit-II Solar PV Energy

Introduction of solar energy - Solar spectrum - Altitude angle of the sun at Solar noon, tilt angle of a PV module, Solar position at any time of day. Direct Beam Radiation, Diffuse Radiation, Reflected Radiation and Tracking system. Solar Radiation Measurements

Photovoltaic electrical characteristics - A generic photovoltaic cell, the simplest equivalent circuit for a photovoltaic cell, PV cell - cells, modules and arrays, voltage and current from a PV module - the PV *i–v* curve under standard test conditions - Impacts of temperature and insolation on *i–v* curves - Shading impacts on i–v curves, Impact of shading on PV cell -, importance of maximum power point tracking and its methods

Introduction to crystalline silicon technologies **12 Hours**

Unit-III Grid-connected PV systems

Grid-connected systems, interfacing with the utility, dc and ac rated power, derating a PV array to a PTC, ac rating, the "peak-hours" approach to estimating PV performance, Grid-connected system sizing - system trade-offs, amortizing costs - stand-alone PV systems, Islanding and anti-islanding systems estimating the load, the inverter and the system voltage,

Batteries, Importance of storage capacity in Grid connected system, sizing the PV array, hybrid PV systems and stand-alone system design..

Introduction to PV powered water pumping

12 Hours

Unit-IV Building integrated photovoltaics & International Regulations

Introduction to Building integrated Advantages and challenges of building integrated photovoltaic PV – Design of building envelope integration, PV integration options - Shading system ,Rain scree system , Curtain wall systems, Stick system curtain wall, Unitized system, Double-skin façade,- Shading systems, Principles of construction, Integration of PV modules.

Grid Requirements for PV - International Regulations, Response to Abnormal Grid Conditions, Power Quality, Anti-islanding Requirements

Array wiring

12 Hours

Total: 48 Hours

21EEC31 Micro and Smart Grid Technologies

3 0 0 3

Unit I

Microgrids: Concept, Modes of Operation and Control

Introduction, Structure, Modes of operation, Overall representation of the grid-connected microgrid, Microgrid bus, Microgrid representation in the islanded operation, Model control mechanism for connected distributed generators in a microgrid, Speed control of classical distributed generators, Control of inverter-based distributed generators, Control structure in grid-connected mode, Control structure in islanded model.

Global architecture representation **12 Hours**

Unit II

Microgrid Dynamics and Modeling

Introduction, Distribution network (Main Grid) and connection modeling, Distribution network modeling, Mechanical part and frequency regulation loop, Voltage regulation, Modeling of connection between the main grid and microgrid, Modeling of the medium voltage transmission lines

Adaptation between the per units and SI units **12 Hours**

Unit III

Introduction to Smart Grid

Definition of smart grid, Justification for smart grid, History of smart grid evolution, Characteristics and benefits of smart grid, Vision and realization, Comparison between smart grid and existing electrical grid system in India, Advanced metering infrastructure.

Basic components of smart grid **12 Hours**

Unit IV

Regulations of Smart Grid

Regulation and funding of smart grid, Regulation and economic models, Evolution of the value chain, Market regulation and standardization of smart grid

Market Models for Smart Grid

Demand response, Tariff design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, Cost benefit analysis of smart grid projects

Smart grid for smart cities **12 Hours**

Total:48 Hours

21EE004 Electrical Machine Design

3 0 0 3

Unit I

Introduction & DC Machines

Major considerations in Electrical Machine Design, Electrical Engineering Materials according to IS standards, Review of basic principles. DC Machines - Constructional details, output equation, choice of specific electric and magnetic loadings-separation of D and L for rotating machines, estimation of number of conductors/turns-coils-armature slots-conductor dimension-slot dimension, Choice of number of poles, length of air gap.

Choice of specific electric and magnetic loadings according to IS 1180-1989 & IS 2026-2011

12 Hours

Unit II

Transformers

Output equation, kVA output for single and three phase transformers, Window space factor, Overall dimensions, Transformer windings-coil design, determination of number of turns and length of mean turn of winding, leakage reactance of windings, design of Tank and cooling tubes, methods of cooling of transformers.

Various cooling techniques

12 Hours

Unit III

Induction Motors

Output equation of Induction motor, Main dimensions, design of stator winding and slots, Length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor.

Choice of specific electric and magnetic loadings according to IS 325-1996.

12 Hours

Unit IV

Synchronous Machines

Output equations, Main dimensions, Short circuit ratio, Length of air gap, shape of pole face, Armature design, length of mean turn, design of rotor, Design of damper winding, Design of field winding, Design of turbo alternators – Rotor design.

Choice of specific electric and magnetic loadings

12 Hours

21EE005 High Voltage DC Transmission

3 0 0 3

Unit I

Basic Concepts & Analysis of HVDC Converters

Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC Transmission, Application of DC Transmission System – Planning & Modern trends in DC Transmission.

Choice of Converter configuration – analysis of Graetz circuit – characteristics of 6 pulse converters – Cases of two 3 phase converters in star –star mode – their performance.

Characteristics of 12-pulse converters, characteristics of n-pulse converter

12 Hours

Unit II

Converter & Reactive Power Control in HVDC

Principal of DC Link Control – Converters Control Characteristics – Firing angle control – Current and extinction angle control – Effect of source inductance on the system; Starting and stopping of DC link; Power Control.

Reactive Power Requirements in steady state-Conventional control strategies-Alternate control strategies, AC Filters.

Shunt capacitors-synchronous condensers, Static VARS

12 Hours

Unit III

Power Flow Analysis, Converter Fault & Protection

Modeling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow – PU System for DC quantities-solution of AC-DC power flow-Simultaneous method-Sequential method.

Converter faults – protection against over current and over voltage in converter station – surge arresters – smoothing reactors – DC breakers.

corona effects on DC lines-Radio interference, Audible noise-space charge field

12 Hours

Unit IV

Harmonics & Filters

Generation of Harmonics –Characteristic harmonics, calculation of AC Harmonics, Non- Characteristic harmonics, adverse effects of harmonics – Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics. Types of AC filters, Design of Single tuned filters.

Design of High pass filters.

12 Hours

21EE006 Special Electrical Machines

3 0 0 3

Unit I

Stepper Motors

Classification of stepper motors – Hybrid and Variable Reluctance Motor (VRM) -Construction and principle of hybrid type synchronous stepper motor – Different configuration for switching the phase windings control circuits for stepper motors – Open loop and closed loop control of 2-phase hybrid stepping motor.

Construction and principle of operation of Variable Reluctance Motor (VRM) – Single stack and multiple stacks.

Open loop control of 3-phase VR Stepper Motor- Applications

12 Hours

Unit II

Switched Reluctance Motors

Construction – Comparison of conventional and switched reluctance motors – Design of stator and rotor pole arcs – Torque producing principle and torque expression – Different converter configurations for SRM – Drive and power circuits for SRM – Position sensing of rotor.

Applications of SRM

12 Hours

Unit III

Square wave Permanent Magnet Brushless DC Motor

Types of constructions – Surface mounted and interior type permanent magnet – Principle of operation of BLDC motor. Torque and EMF equations – Torque speed characteristics – Performance and efficiency- square wave brushless motors with 120^0 and 180^0 magnetic areas commutation.

Applications of BLDC motor

12 Hours

Unit IV

Sine wave Permanent Magnet Brushless DC Motor

Torque and EMF equations – Phasor Diagram – Circle diagram – Torque/speed characteristics – Comparison between square wave and sine wave permanent magnet motors

Other Special Machines

Construction–Principle of operation and Characteristics of universal motor, AC series motor, Hysteresis motor, Linear Induction motor, Reluctance motor- Applications.

Applications of PMSM

12 Hours

Total=48 Hours

21EE507 Power Electronics and Drives Lab

0 0 3 1.5

List of Experiments
(Any 10 Experiments)

1. Static V-I characteristics of SCR
2. Static characteristics of MOSFET & IGBT
3. Gate firing circuits for SCR
4. Single Phase AC Voltage Controller with R and RL Loads
5. Single Phase fully controlled bridge converter with R and RL loads
6. Forced Commutation circuits (Class A, Class B, Class C, Class D & Class E)
7. Single Phase Parallel inverter with R and RL loads
8. Single Phase cyclo-converter with R and RL loads
9. Single Phase Half controlled converter with R and RL load
10. Single Phase series inverter with R and RL loads.
11. Speed control of DC motor using Buck-Boost regulator
12. Design of Buck converter
13. Performance & speed control of DC shunt motor using 3-phase semi converter.
14. Performance & speed control of DC shunt motor using 3-phase full converter.
15. Four quadrant chopper fed DC drive.
16. dsPIC microcontroller-based speed control of three phase Induction Motor

List of Augmented Experiments[1]

1. Simulation of single-phase AC voltage controller for different loads using PSPICE/MATLAB
2. Simulation of a single phase fully controlled converter for RLE load using PSPICE/MATLAB
3. Simulation of converter fed DC Motor in closed loop speed control
4. Simulation of PWM inverter using MATLAB/Simulink
5. Simulation of Buck converter and its analysis using open loop and closed controllers
6. PWM pulse generation using low-cost PIC /Arduino controller for three phase inverters

[1]Students shall opt any one of the Augmented Experiments in addition to the regular experiments

21TPX01 Term Paper

0 0 3 1.5

Course Outcomes

1. Interpret the literature to link the earlier research with the contemporary technologies
2. Communicate effectively as an individual to present ideas clearly and coherently
3. Review the research findings and its correlation to the latest applications
4. Prepare documents and present the concepts clearly and coherently
5. Inculcate the spirit of enquiry for self-learning
6. Identify interdisciplinary oriented topics

COs – POs Mapping

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		3	2	3		3	2	3	2	2			3
CO2	2		3	3	3		2	3	3	2	3			2
CO3	3		3	2	3		3	2	3	2	2			3
CO4	3		3	2	3		3	3	3	2	2			3
CO5	2		3	3	3		2	2	3	2	3			2
CO6	2		3	1	3		3	3	3	2	2			3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21ESX02 Employability Skills II

0 0 2 0

Course Outcomes

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications
5. Solve engineering problems using software
6. Utilize simulation tools for testing

COs – POs Mapping

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1				2	3	3	3		
CO2	1	1	3	1	1				2	3	3	3		
CO3	1	1	3	1	1				2	2	3	3		
CO4	2	2	3	2	2				3	3	2	3		
CO5	3	2	3	2	2				3	2	2	3		
CO6	2	2	2	2	3				3	2	3	3		

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

PART-A

Soft Skills

Communication Skills, Confidence and Quantitative Aptitude

Introduction to Campus Placements: Stages of Campus Placement, Skills assessed in Campus Placements & How to get ready?

Motivational Talk on Positive Thinking: Beliefs, Thoughts, Actions, Habits & Results (Success)

Resume Preparation: Resume? Templates? Mistakes to be avoided in a Resume, Steps to be followed in preparing it.(with examples)

Group Discussions (Recap): GD? Stages of a GD, Skills assessed in a GD, Blunders to be avoided, How to excel in a GD? (through Practice Sessions)

Psychometric Tests: Definition, Types of Psychometric Tests: Numerical Computation, Data Interpretation, Verbal Comprehension, Verbal Critical Reasoning and Personality Questionnaires

Exercises related to Communication: Story Writing, TAT etc .

7 Hours

PART-B

Aptitude Skills

Quantitative Aptitude

Square &Cube roots, Partnership, Logarithms, Progressions, Mensuration, Data Sufficiency

8 Hours

PART-C

Domain Specific Knowledge

Programmable logic controllers -3

i. Implementation of Arithmetic instructions
ii. Implementation of X-NOR gate using basic logic gates in PLC
iii. Implementation of on-delay timer
iv. Implementation of off-delay timer
v. Implementation of direct on line (DOL) starter

15 Hours

Total: 30 Hours

21HSX12 CC&EC Activities II

0 0 1 0

Course Outcomes

1. Interpret and present the abstractive technical information through an activity
2. Think critically in providing solutions to the generic and common problems
3. Demonstrate the creative thinking in dealing with liberal arts
4. Instill team sprit through active engagement with the peer
5. Develop programs of common interest having social impact
6. Empower the under privileged through motivational activities

COs – POs Mapping

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									2	3		3		
CO2									2	3		2		
CO3									3	3		2		
CO4									3	2		2		
CO5									3	2		2		
CO6									3	2		3		

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

21SIX01 Summer Internship I

0 0 0 1

Course Outcomes

1. Demonstrate communication skills to meet the requirement of industry
2. Develop logical thinking and analytical skills to thrive in competitive examinations
3. Use mathematical concepts to solve technical quizzes
4. Develop technical skills to work out real time problems
5. Develop algorithms for different applications
6. Solve industry defined problems using appropriate programming skills

COs – POs Mapping

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	2	3	1	3	3	3	3	3	3	3
CO2	3	3	3	3	2	2	1	3	3	1	1	3	3	1
CO3	3	2	3	2	2	1	1	3	2	3	3	2	3	3
CO4	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	3	2	3	3	3	3	3	3

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

21HSX10 Engineering Economics and Project Management

3 0 0 3

Unit I

Introduction to Engineering Economics - Demand Forecasting & Cost Analysis

Concept of Engineering Economics – Types of efficiency – Managerial Economics Nature and Scope – Law of Demand – Types of Elasticity of demand.

Demand Forecasting & Cost Analysis: Demand Forecasting: Meaning, Factors Governing Demand Forecasting, Methods of Demand Forecasting (Survey and Statistical Methods) – Cost Analysis: Basic Cost Concepts, Break Even Analysis.

Factors affecting the elasticity of demand – Supply and law of Supply

11 Hours

Unit II

Market Structures - Financial Statements & Ratio Analysis

Different type of Markets Structures – Features – Price Out-put determination under Perfect Competition and Monopoly

Financial Statements & Ratio Analysis: Introduction to Financial Accounting – Double entry system – Journal – Ledger – Trail Balance – Final Accounts (with simple adjustments) – Financial Analysis through Ratios: Interpretation of Liquidity Ratios (Current Ratio and quick ratio), Activity Ratios (Inventory turnover ratio and Debtor Turnover ratio, Creditors Turnover Ratio, Capital Turnover Ratio), Solvency Ratios (Debt- Equity ratio, Interest Coverage ratio), and Profitability ratios (Gross Profit Ratio, Net Profit ratio, Operating Ratio, P/E Ratio and EPS).

Price output determination under Monopolistic markets, Accounting concepts and conventions

13 Hours

Unit III

Investment Decisions and Fundamentals of Management

Time Value of Money – Capital Budgeting: Meaning, Need and Techniques of Capital Budgeting

Introduction to Management: Nature – Importance – Classical Theories of Management: F.W.Taylor's and Henri Fayol's Theory – Functions and Levels of Management – Decision Making Process – Inventory Control, Objectives, Functions – Analysis of Inventory – EOQ.

Maslow & Douglas McGregor theories of Management, ABC Analysis

11 Hours

Unit IV

Project Management

Introduction – Project Life Cycle and its Phases – Project Selection Methods and Criteria – Technical Feasibility – Project Control and Scheduling through Networks – Probabilistic Models of Networks – Time-Cost Relationship (Crashing) – Human Aspects in Project Management: Form of Project Organization – Role & Traits of Project Manager.

Sources of Long-term and Short-term Project Finance

13 Hours

Total: 48 Hours

21EE602 Power System Analysis and Control

3 0 0 3

Unit – I

Per-unit Representation and Short Circuit Analysis

Per-unit System representation of a given power system network, Per-unit equivalent reactance diagram Symmetrical fault Analysis: Short Circuit Current and MVA Calculations. Symmetrical Component Theory: Symmetrical Component Transformation, Sequence Networks. Unsymmetrical Fault Analysis: LG, LL, LLG faults without fault impedance

Unsymmetrical Fault Analysis: LG, LL, LLG faults with fault impedance

12 Hours

Unit –II

Power Flow studies and stability

Power flow problem – significance, classification of buses, Formation of Y_{bus} using direct inspection method, Derivation of Static load flow equations, Load flow solutions using Gauss Seidel Method, Acceleration Factor, Newton Raphson Method in Rectangular and Polar Co-ordinates, Comparison of different load flow methods. (Only derivative approach)

Stability: Classification of power system stability, Swing equation, equal area criterion and its applications, methods to improve stability

Decoupled and Fast decoupled load flow method

12 Hours

Unit – III

Economic operation of power system

Input-output characteristics, heat-rate curve, incremental fuel cost, incremental production cost, optimal generation allocation with and without transmission line losses, loss coefficients, hydro-thermal scheduling-long term and short term, unit commitment-priority list method

Dynamic programming method

12 Hours

Unit – IV

Load Frequency Control

Necessity of keeping voltage and frequency constant, Modeling of Speed governing system, Turbine, Generator and load systems, complete block diagram of an isolated power system, Control area, Single area control -Steady state analysis, Dynamic response -uncontrolled and controlled cases.

Load frequency and economic dispatch control- Load frequency control of two area system – Steady state analysis, Dynamic response -uncontrolled and controlled cases, tie-line bias control.

Performance Index and optimal load frequency control

12 Hours

Total: 48 Hours

21EE603 Utilization of Electrical Energy

3 0 0 3

Unit I

Electric Drives, Heating and Welding

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, Particular applications of electric drives, Types of industrial loads, continuous, Intermittent and variable loads, load Equalization.

Advantages and methods of electric heating-resistance heating, induction heating and dielectric heating

Electric welding-resistance and arc welding, comparison between A.C. and D.C. Welding

Electric braking-Plugging, Rheostat braking, Regenerative braking

11 Hours

Unit II

Illumination

Introduction, terms used in illumination, laws of illumination, polar curves, sources of light. Basic principles of light control, CFL & LED lighting-phenomena, construction and working, flood lighting, Types and design of lighting, measurement of illumination- photometry, integrating sphere.

tungsten filament lamps and fluorescent tubes, IS 6665, 3646, 2440 codes

13 Hours

Unit III

Electrolytic Processes, Refrigeration and Air Conditioning

Need of electro-deposition, Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing, buffing, Equipment and accessories for electroplating, Factors affecting electro-deposition, Principle of galvanizing and its applications, Principles of anodising and its applications, Electroplating on non-conducting materials, Manufacture of chemicals by electrolytic & electrolysis process.

Principle of air conditioning, vapor pressure, refrigeration cycle, Description of Electrical circuit used in refrigerator, air-conditioner and water cooler

Eco-friendly refrigerants, BEE ratings, ISEER value

11 Hours

Unit IV

Electric Traction

System of Traction - Diesel & electric traction – Need for 25kV single phase AC traction in India, block diagrams of locomotives employing DC and AC drives, locomotive equipment – pantograph, transformer, rectifier, inverter, protective devices, Traction Mechanics: Mechanics of traction movement - speed-time curves for different services - trapezoidal and quadrilateral speed-time curves - tractive effort requirement at driving wheels and for propulsion of train - power - specific energy consumption –factors effecting specific energy consumption–Dead, accelerating and adhesive weights, Coefficient of adhesion

Track electrification - DC, AC & Composite systems

13 Hours

Total: 48 Hours

21EEC12 Electric Vehicle Drive Train Systems

Unit I

EV Drive Train

Introduction to Configurations and Performance of Electric Vehicles, Traction Motor characteristics, Tractive effort and Transmission Requirement, Vehicle Performance, Tractive Effort in Normal Driving, Energy Consumption.

Importance of Different Transportation Development Strategies to Future Oil Supply

Practical Component

1. Generate electrical characteristic curves of a series motor and a shunt motor.
2. Compute the cumulative tractive force necessary for an electric vehicle throughout a provided drive cycle.
3. Based on driving cycle and vehicle dynamics, analyse motor and battery power requirements for vehicle propulsion.
4. Calculate the total distance travelled in one drive cycle & Energy used per km.

10+8 Hours

Unit II

Propulsion System

Introduction to DC motor drives, Induction motor drives- V/F, Field Oriented Control, Permanent Magnetic Brush-Less DC Motor Drives and Permanent Magnetic Synchronous Motor Drives- Modeling, Analysis and Control.

Drive Train with Floating-Stator Motor

HEV to PHEV Conversions

Practical Component

1. Simulation of BLDC drive system
2. Simulation of PMSM drive system
3. Speed Control of BLDC using DSP-2407
4. Speed Control of PMSM using DSP-2407

13+8 Hours

Unit III

SHEV& PHEV Drive Train Design

SHEV & PHEV -operation Patterns, Control Strategies, Max. SOC of PPS & Engine Turn-On/Turn-Off, Drive Train Parameters.

Practical Component

1. Simulate the behaviour and performance of an electric vehicle.
2. Simulate the various modes of operations in a Series Hybrid Electric Vehicle.
3. Simulate the various modes of operations in a Parallel Hybrid Electric Vehicle.
4. Simulate and evaluate the thermostat control strategy for engine activation (on-off) in series hybrid and parallel hybrid electric vehicles

12+8 Hours

Unit IV

Fuel Cell HEV Drive Train Design

Operating Principles of Fuel Cells, Electrode Potential and Current–Voltage Curve, Fuel Cell System Characteristics, Fuel cell drive train Configuration, Control Strategy, Parametric Design.

Non-hydrogen Fuel Cells

Practical Component

1. Modelling and Simulation of Fuel cell
2. Controller design for Fuel Cell System
3. Simulate the various modes of operations in a Hybrid Fuel Cell Electric Vehicle
4. Write a program on fuel cell's power generation based on hydrogen flow rate

13+8 Hours

Total: 48+32=80 Hours

21EEC22 Power Electronic Applications to Green Energy Systems

Unit-I

DC-DC Converters 1 for solar energy system

The Role of Power Electronics in Renewable Energy Systems, General Scheme for a Solar PV System, Utility-scale PV Power Plants & stand-alone PV systems, Topologies of DC-DC converters, Unidirectional DC-DC converter, Bidirectional DC-DC converter, non-isolated bidirectional DC-DC converters, Isolated bidirectional DC-DC converters.

Double-input pulse width modulation DC-DC converter

Practical Component

1. Simulation of Uni-directional Buck DC-DC converter
2. Simulation of Uni-directional Boost DC-DC converter
3. Simulation of Uni-directional Buck-Boost DC-DC converter
4. Simulation of closed loop control in Uni-directional Boost DC-DC converter

12+8 Hours

Unit-II

DC-DC Converters 2 for solar energy system

Half-bridge LLC resonant converter, Benefits of resonant converters, Emerging DC-DC converter topologies, SEPIC converter, Luo converter, Soft-switching converter, Series charge controller, Shunt charge controller.

Integrated SEPIC-Cuk converter

Practical Component

1. Simulation of Bi-directional DC-DC converter
2. Simulation of Uni-directional SEPIC DC-DC converter
3. Simulation of Uni-directional LUO DC-DC converter
4. Simulation of Uni-directional CUK DC-DC converter

12+8 Hours

Unit-III

Multilevel converters and configurations for wind energy system

Multilevel converter topologies, Diode-clamped inverter, Capacitor-clamped inverter, Cascaded H-bridge inverter, Flying capacitor multilevel inverter.

Comparisons between the three-Level NPC and NPP Inverters

Practical Component

1. Simulation of 1-ϕ, 2 level H bridge Inverter
2. Simulation of 1-ϕ, 3 level H bridge Inverter
3. Simulation of 1-ϕ, diode clamped Multi level Inverter
4. Simulation of 3-ϕ, diode clamped Multi level Inverter

12+8 Hours

Unit-IV

Modulation techniques for multilevel converters in wind energy system

Modulation Methods for Multilevel Power Converters, Carrier-Based Modulation Techniques, Level-shifted PWM Method, Phase-shifted PWM Method, Hybrid PWM Methods, Space-vector based modulation methods, Grid-connected Multilevel Converters for the Integration of Renewable Energy Sources.

Converters for tidal energy systems

Practical Component

1. Simulation of 1-ϕ, flying capacitor Multi level Inverter
2. Simulation of 3-ϕ, flying capacitor Multi level Inverter
3. Simulation of 1-ϕ, cascaded H-bridge Multi level Inverter
4. Simulation of five-level Modular Multi-level inverter

12+8 Hours

Total: 48+32=80 Hours

21EEC32 Control and Instrumentation of Smart Grid Systems

3 0 2 4

Unit I

Concept Strategies for Smart Grid Systems

Control Strategies for AC and DC Systems – Micro-grid Control Hierarchy, Local Control, Secondary Control, Central/Emergency Control, Global Control, Droop Control, Droop Characteristic in Conventional Power Systems, DC Microgrid for a Residential Area, System Configuration and Operation.

Resistive Grid

Practical component:

1. Study the control in an AC microgrid system.
2. Study the control in a DC microgrid system.

12+8 Hours

Unit II

Voltage and frequency control in smart grid

Load frequency control, Voltage Stability Assessment, Concepts on the design of smart grid stabilizers to improve voltage stability, frequency & voltage regulations, and volt-VAR support, Operational aspects of smart grid system, active and reactive power response.

Ancillary Services

Practical Component:

1. Eigen value analysis of single machine infinite bus system.
2. Synchronous generator no load short circuit analysis.
3. Study of voltage stability and obtain PV and QV curves for two bus system.

12+8 Hours

Unit III

Introduction to Instrumentation System in Grid Scenario

Smart devices, Smart Sensors, Data Cataloguing, Data Recording, Data Processing, Application of smart sensors, Grid Management system (block diagram), Battery modeling system (block diagram), Study of accurate prediction using AI techniques.

Need of Smart Instruments: Low Power devices, wired or wireless technology and its Advantages.

Need of High Bandwidth Storage devices in SG

Practical Components:

1. Study of renewable energy data profile and finding the mean.
2. Study of data normalization procedure.
3. Plotting of Renewable energy data and find the maximum and minimum value.

12+8 Hours

Unit IV

Sensors, PMUs and WAMS

Smart Substation: Advanced Magnetic Sensor, Fiber Optic Sensor and its application- phasor measurement units (PMU) - Wide area measurement systems (WAMS)-Concept, architecture, data collection, advanced data processing in smart grids.

Smart Meters

Practical component:

1. Analysis of data conversion and data acquisition
2. Voltage Sensor/ Current sensor in power system during fault analysis
3. Find the resolution and measurements of Digital meter/Digital Instruments for the given specifications

12+8 Hours

Total: 48+32=80 Hours

21EE007 Advanced Control Systems

3 0 2 4

Unit – I

Fundamentals of Digital control systems and Z-transforms

Fundamentals of Digital Control System: Block diagram of digital control system, Advantages, disadvantages and applications of digital control system, Sampling operations, sampling theorem, Aliasing effect, Zero order hold.

Z–Transforms: Introduction, Properties and theorems of Z-transforms, Inverse Z-transforms, Z-Transform method for solving difference equations, Pulse transfer function, block diagram analysis of sampled-data systems, Pulse transfer function of ZOH.

Examples of digital control systems

Practical Component

1. Determination of Pole-Zero Plot using MATLAB/Scilab
2. Determination of pulse transfer function using MATLAB/Scilab

12 + 8 Hours

Unit – II

Stability Analysis

Mapping between s-plane and the z-plane, Stability Analysis of closed loop systems in the z-plane- Bilinear Transformation, Jury stability test, Lyapunov Stability

Concepts of Controllability and Observability, Tests for controllability and Observability, Duality between controllability and observability, Effect of Pole-zero Cancellation in Transfer Function.

Steady state error analysis of digital control system

Practical Component

1. Analysis of Stability of a given discrete time systems using MATLAB/Scilab
2. Tests for controllability and observability a given discrete time systems using MATLAB/Scilab

12 + 8 Hours

Unit – III

State feedback Controllers and Observers

Design of state feedback controller through pole placement- Ackerman's formula, Effect of dead-beat response

State Observers – Full order observer. Effect of dead-beat response

Reduced order observer

Practical Component

1. Design of full order and reduced order observers a given systems using MATLAB/Scilab
2. Design of state feedback controller through pole placement using MATLAB/Scilab

12 + 8 Hours

Unit – IV

Non-linear Systems

Features of linear and non-linear systems-Common physical non-linearities–Derivation of describing functions for common nonlinearities-Concept of phase portraits–Singular points–Limit cycles–Phase plane analysis of linear and non-linear systems–Isocline method.

Construction of phase portraits

Practical Component

1. Phase plane analysis of a given nonlinear system by analytical method using MATLAB/Scilab
2. Phase plane analysis of a given nonlinear system by Isocline method using MATLAB/Scilab

12 + 8 Hours

Total: 48+32=80 Hours

21EE008 Discrete Signal Processing

3 0 2 4

Unit I

Introduction to Discrete–Time signals and systems

Classification of discrete-time signals and sequences, properties of discrete time signals and systems, difference equations and their solutions – homogeneous and non-homogeneous equations, Linear and circular convolution, Sampling theorem and aliasing effect.

Concept of z-transforms, Region of Convergence, properties, Inverse z- transform and its application in solving the difference equations.

Analog-to-digital conversion and digital-to-analog conversion techniques

Practical Component

1. Determination of convolution of a given two discrete time signals using MATLAB/ Scilab
2. Determination of frequency response of a given discrete time system using MATLAB/ Scilab
3. Determination of Pole-Zero plot of a given discrete time system using MATLAB/ Scilab

12 +8 Hours

Unit II

Discrete–Time signals in Transform domain

Discrete Fourier Series (DFS), Discrete Fourier transform (DFT), Properties of DFT, Fast Fourier transform (FFT) – butterfly diagrams - Radix-2 decimation in time, Inverse FFT. Quantization effects in the computation of the DFT.

Short-time Fourier transform (s-transform)

Practical Component

1. Computation of DFT using DIT FFT algorithm for a given discrete time signals using MATLAB/ Scilab
2. Computation of IDFT using DIT FFT algorithm for a given discrete time signals using MATLAB/ Scilab

12 + 8 Hours

Unit III

IIR and FIR Digital Filters

IIR Filters: Properties of linear-phase IIR filters, Butterworth and Chebyshev filters, Impulse Invariant transformation, Bilinear transformation

FIR Filters: Characteristics of FIR Digital Filters, Gibbs phenomenon, windowing techniques – rectangular, Hamming, Hanning and Bartlett. Comparison of IIR & FIR filters.

Program to design FIR and IIR filters

Practical Component

1. Design of FIR filter from the given specifications for a particular using MATLAB/ Scilab
2. Design of IIR filter from the given specifications for a particular using MATLAB/ Scilab

12 + 8 Hours

Unit IV

Introduction to Multi-rate Signal Processing

Multi-rate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering.

Program to design adaptive filters

Practical Component

1. Illustration of up-sampling for a given discrete time signal using MATLAB/ Scilab
2. Illustration of down-sampling for a given discrete time signal using MATLAB/ Scilab
3. Design of adaptive filter for a given application using MATLAB/ Scilab

12 + 8 Hours

Total: 48+32=80 Hours

21EE009 Machine Modelling and Steady State Analysis

3 0 2 4

Unit-I

Basic Principles for Electric Machines

Magnetically coupled circuits, Nonlinear magnetic system, Electro-mechanically energy conversion, Energy in coupling fields, steady state and dynamic performance of an electromechanical system, machine windings and air gap mmf, winding inductances and voltage equations.

Inductance machine mmf

Practical Component

1. Simulation of magnetic coupled circuit
2. Simulation of dynamic performance of an electromechanical system

12+8 Hours

Unit-II

Analysis of DC-machine

Elementary DC machine, voltage and torque equations, dynamic characteristics of DC motors, Dynamic performance during starting and load change conditions, state equations.

Reference frame theory: Equations of transformation, conversion of stationary variables to arbitrary reference frame, Transformation between reference frames

Commonly used reference frames

Practical Component

1. Simulation of the dynamic behavior of permanent DC motor
2. Simulation of the dynamic behavior of shunt DC motor
3. Simulation of transformation of variables between reference frames

12+8 Hours

Unit-III

Analysis of Synchronous machine

Voltage equations in machine variables, Torque equation, Stator voltage equations in arbitrary reference-frame variables, Voltage equations in rotor reference-frame variables, rotor angle and angle between rotors, Analysis of steady state operation, Dynamic operation during sudden change in torque

Practical Component

1. Simulation of hydro turbine generator under dynamic conditions
2. Simulation of dynamic behavior of steam turbine generator during a step increase of input torque
3. Simulation of dynamic performance of hydro turbine generator during three phase fault

Approximate Transient Torque versus Rotor Angle Characteristics

12+8 Hours

Unit-IV

Analysis of Induction machine

Voltage equations in machine variables, Torque equation, equations of transformation for rotor circuits, voltage equations in arbitrary reference-frame variables, Analysis of steady state operation, Dynamic operation during sudden change in torque.

Per unit system.

Practical Component

1. Simulation of Torque–speed characteristics during free acceleration
2. Simulation of free acceleration characteristics of a 10-hp induction motor in a reference frame fixed in rotor
3. Simulation of free acceleration characteristics of a 10-hp induction motor in the synchronously rotating reference frame

12+8 Hours

Total: 48+32=80 Hours

21EE606 Power Systems lab

0 0 3 1.5

List of Experiments

Perform any 10 experiments from the given list

1) Simulation of performance characteristics of medium transmission lines
2) To study the characteristics of under voltage induction relay
3) To study the characteristics of attraction type relay
4) To study the characteristics of over current induction relay
5) To study the characteristics of directional over current relay
6) To study time vs. differential current characteristics of percentage biased differential relay
7) To study time vs. current characteristics of digital distance relay
8) To determination of breakdown strength of oil by variable distance Electrodes
9) To find the time vs. current characteristics of fuse
10) To study the characteristics of earth fault relay
11) To find the A, B, C, D parameters of the long transmission line
12) To find voltage regulation of the long transmission line under no-load and loaded condition
13) Application of compensation techniques to improve the performance of long transmission line

List of Augmented Experiments[1]

1. Development of over voltage protection
2. Development of under voltage protection
3. Development of over current relay
4. Development of a transmission line model

Text Books:

1. Ned Mohan *"Electric Power System"* John Wiley & Sons Inc, 2012
2. Badari Ram and D.N Vishwakarma, *"Power System Protection and Switchgear",* TMH Publications, 2nd Edition, 2011
3. I. J. Nagaraj and D. P. Kothari, *"Modern Power System Analysis"* Tata McGraw Hill, 3rd Edition, 2007
4. Sunil S Rao *"Switchgear and Protection"*, Khanna Publishers, 13th edition, 2017

[1]Students shall opt any one of the Augmented Experiments in addition to the regular experiments

21MPX01 Mini Project

0 0 3 1.5

Course Outcomes

1. Identify a contemporary engineering application to serve the society at large
2. Use engineering concepts and computational tools to get the desired solution
3. Justify the assembled/fabricated/developed products intended
4. Organize documents and present the project report articulating the applications of the concepts and ideas coherently
5. Demonstrate ethical and professional attributes during the project implementation
6. Execute the project in a collaborative environment

COs – POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	3	2	2	2	2	3	3	3	3
CO2	3	3	3	2	3	3	3	3	2	3	3	3	3	3
CO3	2	3	3	3	3	3	3	2	2	2	3	3	3	3
CO4	2	2	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	2	3	3	3	3	3	2	3	3	3	3
CO6	3	3	2	2	3	3	3	3	3	3	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

21ESX02 Employability Skills II **0 0 2 2**

Course Outcomes

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications
5. Solve engineering problems using software
6. Utilize simulation tools for testing

COs – POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1				2	3	3	3		
CO2	1	1	3	1	1				2	3	3	3		
CO3	1	1	3	1	1				2	2	3	3		
CO4	2	2	3	2	2				3	3	2	3		
CO5	3	2	3	2	2				3	2	2	3		
CO6	2	2	2	2	3				3	2	3	3		

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

PART-A

Soft Skills

Resume (Recap): Resume? Templates? Mistakes to be avoided in a Resume and Steps to be followed in preparing it.

Group Discussions (Recap) & Practice: GD? Stages of a GD, Skills assessed in a GD, Blunders to be avoided, How to excel in a GD? Practice sessions and sharing Feedback. (Screening sample Videos)

Interview Skills: Interview? Types of Interview, Dos & Don'ts, Skills assessed in an Interview, Mistakes to be avoided, How to equip oneself to excel? How to handle the Typical Interview Questions? (with Examples)

Mock Interviews: Practice sessions with Feedback.

Exercises related to Communication: Email Writing, Voice Versant., etc.

7 Hours

PART-B

Aptitude Skills

Time and Distance, Time and Distance, Problems on Trains, Problems on Trains, Blood relations, Ratio and Proportions, Calendars and Clocks

8 Hours

PART-C

Domain Specific Knowledge

Programmable logic controllers -4

i. Implementation of up-down counter
ii. DC motor direction control
iii. Implementation of PID controller
iv. Implementation of half wave rectifier using PLC
v. PLC implementation for an automation industry

15 Hours

Total: 30 Hours

Textbook (s)

1. Frederick D. Hackworth and John R. Hackworth, *Programmable Logic Controllers: Programming Methods and Applications*, Pearson India; 1st edition, 2003.
2. Frank Petruzella, *Programmable Logic Controllers*, Tata McGrawhill, 3rd Edition, 2011.

Reference (s)

1. Gary Dunning, Thomson Delmar, "*Programmable Logic Controller*", Cengage Learning, 3rd Edition, 2005.
2. W. Bolton, "*Programmable Logic Controllers*", Newnes – Elsevier, 2015.

21HSX12 CC&EC Activities II

0 0 1 1

Course Outcomes

1. Interpret and present the abstractive technical information through an activity
2. Think critically in providing solutions to the generic and common problems
3. Demonstrate the creative thinking in dealing with liberal arts
4. Instill team sprit through active engagement with the peer
5. Develop programs of common interest having social impact
6. Empower the under privileged through motivational activities

COs – POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									2	3		3		
CO2									2	3		2		
CO3									3	3		2		
CO4									3	2		2		
CO5									3	2		2		
CO6									3	2		3		

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Audit Course

0 0 0 0

Course Outcomes

1. Interpret the meaning of values and select their goals by self- Investigation based on personal values
2. Interpret the major events and issues related to a period in Indian history
3. Assess the benefits and limitations of science and its application in technological developments towards human welfare
4. Check the awareness regarding basic human rights and to uphold the dignity of every individual
5. Assess the individual and group behaviour, and understand the implications of organizational behaviour on the process of management
6. Determine the appropriateness of various leadership styles and conflict management strategies used in organizations

COs – POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	2	3	1	2		2		
CO2						3	2	1	1	1		1		
CO3						2	3	1	1	1		2		
CO4						3	2	3	1	2		2		
CO5						2	2	1	3	2		1		
O1						2	2	3	1	2		2		

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

21EEC13 Battery Management Systems

3 1 0 3

Unit I

Introduction to Battery Management System

Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging.

Analysis of different battery technologies

12+4 Hours

Unit II

Battery Management System Requirement

Battery-pack topology, BMS design requirements, Battery-pack sensing: Voltage, Temperature, Current; State of charge estimation, Energy estimation, and Power estimation.

Importance of battery management

10+4 Hours

Unit III

Battery-State and Health Estimation

Battery State of Charge (SOC) estimation, some approaches to estimate SOC. Need for health estimates, Negative-electrode aging, Positive-electrode aging, Cell Balancing: Causes of imbalance, Not causes of imbalance, Balancer design choices, Circuits for balancing.

State of health analysis of different batteries

10+3 Hours

Unit IV

Battery charging standards and safety Issues

Battery charging standards and algorithms, Power limits, Cold temperature performance, Lithium-Ion battery safety issues, Battery aging, Energy balancing with multi-battery system.

Energy balancing with different battery technologies

13+4 Hours

Total: 45+15=60 Hours

21EEC23 Hybrid Renewable Energy Systems Design

3 1 0 3

Unit:I

Fundamentals of Hybrid Energy Systems

Design and planning of hybrid system, Different Combinations of Hybrid Systems- PV System with Battery Storage, Hybrid Wind/Photovoltaic System, PV-diesel-battery system, Holistic planning approach.

Present Indian energy scenario of conventional and RE sources

11+4 Hours

Unit:II

Power Electronics Applications in Hybrid Energy Systems

AC and DC bus connected HES, DC-side integration of HES- Cascaded DC-connection, Series DC connection, Parallel DC connection, DC-side integrated hybrid energy storage systems, Three-port converters. AC side integration of HES.

Multi-level converter for hybrid energy systems.

11+4 Hours

Unit:III

Design of Hybrid Renewable Energy Systems

Photovoltaic plant planning for hybrid micro grids, Technical considerations for hybrid micro grids, Photovoltaic system design, Wind power plant planning and modeling, Design of wind System- Wind energy production estimate, Design of Hybrid Photovoltaic/Wind System/Fuel Cells (ADD SOME SUB TOPICS)

Environmental impacts of solar and wind energy system.

11+4 Hours

Unit:IV

Energy Storage System and Control

Need for ESS, Types of ESS configuration: passive configuration, semi active configuration, series active configuration, parallel active configuration, Control Strategies for hybrid energy storage system configurations, Control of microgrid configuration based on solar-photo voltaic-wind turbine and hybrid energy storage system.

Case studies of Wind-PV Maximum Power Point Tracking (MPPT)

12+3 Hours

Total: 45+15=60 Hours

21EEC33 Communication and Security in Smart Grid

3 1 0 3

Unit I

Wireless Communications in Smart Grids

Introduction, Overview of Data link Control and Media access control, wireless personal area networks, wireless local area networks, wireless metropolitan area networks, cellular networks, satellite communications - frequency bands and propagation effects

Fixed Satellite Systems

11 + 4 Hours

Unit II

Wire line Communications in Smart Grids

Introduction - phone line technology, coaxial cable technologies, power line technology - plc scenarios, channel, and noise aspects, power line communication (PLC) electromagnetic compatibility regulations, narrowband PLC and broadband PLC.

Optical Communications in Smart Grids

12 + 3 Hours

Unit III

Security Models for supervisory control and data acquisition (SCADA) and Smart Grid

National Institute of Standards and Technology Framework - NISTIR 7628 Smart grid cyber security architecture, European Union Mandate - EU M/490 and the Smart Grid Coordination Group (SGCG) reference architecture for the smart grid, mapping security requirements to smart grid environments, applying the "3×3" cyber security model to smart grids.

Zone separation in a Smart Grid

10 + 4 Hours

Unit IV

Smart Grid Security Standardization

Smart Grid Security Requirements. Security Relevant Regulation and Standardization Activities - ISO/IEC, IEEE and CIGRE, Trends in Energy Automation Security. Smart Grid Authentication and Key Management - Authentication and Authorization Issues in the Smart Grid

Malware Protection

12 + 4 Hours

Total: 45+15=60 Hours

21EE010 Electrical Distribution Systems

3 1 0 3

Unit – I

General Concepts & Distribution feeders

Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, contribution factor, loss factor - Relationship between the load factor and loss factor. Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics. Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, Feeder loading; basic design practice of the secondary distribution system.

Load Forecasting

12+3 Hours

Unit – II

Substations & System Analysis

Location of Substations: Rating of distribution substation, service area with n primary feeders. Benefits Derived through optimal location of substations. Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks.

Three phase balanced primary lines.

11+4 Hours

Unit – III

Protection & Coordination

Objectives of distribution system protection, types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of Fuses, Circuit Reclosures, line sectionalizes, and circuit Breakers. General coordination procedure, Coordination of Protective Devices.

Location of Sectionalizer

11+4 Hours

Unit – IV

Compensation for power factor Improvement & Voltage control

Shunt and series capacitors, effect of shunt capacitors (Fixed and switched), Power factor correction, capacitor allocation - Economic justification - Procedure to determine the best capacitor location. Voltage Control: Static Var compensator, Static Synchronous Compensator, Thyristor Controlled Series Compensator, Thyristor Controlled Reactor.

Effect of AVB/AVR, line drop compensation.

11+4 Hours

Total: 45+15=60 Hours

21EC401 Analog and Digital Communications

3 1 0 3

Unit I

Amplitude Modulation and Frequency Modulation

Introduction to communication system, Need for modulation, Frequency Division Multiplexing, Amplitude Modulation, power relations in AM waves, Generation of AM waves: square law Modulator, Principle of Detection of AM Wave: Envelope detector. DSB Modulation: Double side band suppressed carrier modulators, Generation of DSBSC Waves, Coherent detection of DSB-SC Modulated waves.
SSB Modulated Wave, Vestigial side band modulation: Generation of VSB Modulated wave.
Frequency Modulation: FM Wave, Narrow band FM, Wide band FM, Generation of FM Waves, Direct FM, Detection of FM Waves: Balanced Frequency discriminator.
Switching modulator, COSTAS loop

12+4 hours

Unit II

Noise, Analog Transmitters and Receivers

Noise in DSB & SSB System Noise in AM System, Noise in Angle Modulation System, Threshold effect in Angle Modulation System, Pre-emphasis & de-emphasis AM Transmitter, FM Transmitter - Variable reactance FM Transmitter, Super heterodyne receiver, Comparison of FM and AM Receiver.
Phase modulated FM transmitter, Phase locked loop

11+3 hours

Unit III

Pulse modulation

PAM, PWM, PPM, Model of Digital Communication Systems, Digital Representation of Analog Signal, Certain issues in Digital Transmission, Advantages of Digital Communication Systems , Pulse Code Modulation: PCM Generation and Reconstruction, Quantization noise, Non uniform Quantization and Companding, Time Division Multiplexing, DPCM, DM and Adaptive DM.
Classification of line encoding techniques, TDM Frame Structures

11+4 hours

Unit IV

Digital Modulations

Introduction, ASK, FSK Modulator, Coherent ASK Detector, Non-Coherent ASK Detector, FSK, Bandwidth and Frequency Spectrum of FSK, Non coherent FSK Detector, Coherent FSK Detector, BPSK, Differential PSK DEPSK, QPSK, MPSK, MSK, Probability of Error, Correlation Receiver, Matched filter Receiver.
Telemetry, OQPSK

11+4 hours
Total: 45+15 hours

21IT304 Database Management Systems

3 1 0 3

Unit I

Introduction to DBMS and ER Model

DBMS Vs. File System, instance and schema, Data abstraction, Data independence, database users and database administrator, Database system structure, Introduction to Data Models (E-R Model, Relational Model, Hierarchical Model, Network Model, Object Oriented Data Model), Database Design Process, Entities, Attributes, Entity Sets, Relationships, Relationship Sets, Additional features of ER Model.

Applications of DBMS, Object Relational Data Model

11+4 Hours

Unit II

Introduction to Relational Model and Basic SQL Queries

Relational Algebra Operations: Selection, Projection, Rename, Set Operators, Joins, Division, Examples of Relational Algebra Queries, Relational Calculus: Tuple Relational Calculus.

Integrity Constraints over Relations, Introduction to Views.

SQL Queries: Basic Structure, Set Operations, Aggregate Functions, Null values, Sub Queries, Group By And Having Clauses, Outer Joins.

Domain Relational Calculus, Query Optimization

11+4 Hours

Unit III

Normalization and Transaction Management

Introduction To Schema Refinement - Problems Caused By Redundancy - Decomposition - Problems Related To Decomposition - Functional Dependency - Closure of a Set of Fds - Attribute Closure - First - Second - Third Normal Forms – BCNF - Multi Valued Dependencies – Fourth Normal Form, Join Dependency, Fifth Normal Form

Transactions: Acid Properties of Transaction - Transaction States - Schedule: Serial Schedule - Concurrent Schedules - Anomalies Associated with Concurrent Schedules (RW - WR - and WW Conflicts) -Serializability - Conflict Serializability - and View Serializability.

EF Codd Rules, Domain Dependency

11+4 Hours

Unit IV

Locking, Recovery Systems, Indexing, Different Types of Data

Introduction to Lock Management-Lock Based Concurrency Control: 2pl-Strict 2pl-Concurrency without Locking: Timestamp–Based Concurrency Control, Optimistic Concurrency Control.

Introduction to Aries - the Log - the Write-Ahead Log Protocol-Check Pointing Indexing: Types of Single-Level Ordered Indexes, Multilevel Indexes Different Types of Data: Structured, Semi-Structured and Unstructured Data

Heap File, Hash File Organizations

12 + 3 Hours

Total: 45+15 Hours

21EE011 Energy Audit, Conservation and Management

3 1 0 3

UNIT-I

Introduction

Energy situation – world and India, energy consumption, conservation-need in thermal utility, Codes, standards and Legislation

Energy economic analysis--The time value of money concept, developing cash flow models, payback analysis, depreciation, taxes and tax credit – numerical problems

Energy Policy based on management

12+4 Hours

UNIT-II

Energy auditing

Introduction, Elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results, case study.

Electrical system optimization--The power triangle, motor horse power, power flow concept.

Concept of electric machines-AC& DC

10+4 Hours

UNIT-III

Electrical equipment and power factor

Electrical equipment and power factor correction and location of capacitors, energy efficient motors, lighting basics, electrical tariff, Concept of ABT.

Flexibilization in thermal power plant.

10+3 Hours

UNIT – IV

Demand side management

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

13+4 Hours

21EE012 Microprocessors and Microcontroller Interfacing

3 1 0 3

Unit I

8086 Microprocessors and Assembly Language Programming

Introduction to microcomputer, evolution of processors and semiconductor memories (RAM, ROM, EPROM, EEPROM), Architecture of 8086 microprocessor, Register organization of 8086, Pipelining concept, Memory segmentation, Addressing Modes.

Instruction Set and Programming: Instruction set of 8086 microprocessor: Data transfer instructions, Arithmetic instructions, Logical Instructions, String instructions, Stack related instructions, Branching instructions, Assembler directives.

Data transfer instructions of 8085 microprocessor, Architecture of 8085 microprocessor

11+ 4 Hours

Unit II

8086 Operational Modes and Memory Interfacing

Minimum and Maximum mode operations of 8086 with timing diagrams, Procedures and macros, Stack Structure of 8086, Static RAM Interfacing, Interfacing of 8255 Programmable Peripheral Interface with 8086 microprocessor.

Dynamic RAM, Direct memory access

11 + 4 Hours

Unit III

8051 Microcontroller

Comparison between microprocessor and microcontroller, 8051 family microcontroller, RAM architecture of 8051, Integrated Development Environment (IDE), Pin description of 8051 microcontroller, Machine cycle. Addressing Modes, Instruction set of 8051: Data transfer instructions, Arithmetic instructions, Logical Instructions, Stack related instructions, Branching instructions. Programing and Applications of Timers, Interrupts, Universal Asynchronous Receiver Transmitter (UART).

External memory interfacing with 8051 microcontroller, various constituents of hex file

11 + 4 Hours

Unit IV

Interfacing with 8051 microcontroller with External Peripherals

Interfacing with 8051 microcontroller with: Keypad matrix, LCD, Seven segment displays, L293D Motor driver, Stepper motor, Analog to Digital Converter (804), Digital to Analog Converter (808), introduction to CISC architecture, RISC architecture and Features of ARM processor.

Interfacing of temperature sensor (LM 35) with 8051, interfacing of relay with 8051

12+ 3 Hours

21EE013 Programmable Logic Controllers

3 1 0 3

Unit – I

Introduction to PLC & Working of PLC

The concept of PLC, Building blocks of PLC, I/O module structure, Memory structures, Functions of various blocks, Advantages of PLCs over electromagnetic relays, list of top PLC manufacturers, Basic operation and principles of PLC.

PLC Programming: programming equipment, programming languages, Input instructions, outputs, operational procedures.

Drill press operation.

10 + 4 Hours

Unit – II

Ladder Logic & File Structure

Ladder Logic: Introduction, Basic Components & Their Symbols, Fundamentals of Ladder Diagrams – A PLC illustrated with relays, programming concepts, ladder logic inputs, ladder logic outputs. Ladder Logic Functions – Data handling functions, logical functions, List functions, input and output functions.

File Structure & Addressing Formats: Introduction, Output & Input Data Files, Status File, Bit Data File, Timer Data File, Counter Data File Elements, Control Data File, Integer Data File & Float Data File.

Boolean Logic & Relay Logic functions

12 +4 Hours

Unit – III

Instruction Sets

Introduction, bit instructions, timer instructions, counter instructions, reset instructions, data handling instructions, comparison instructions, sequencer instructions

Reset (RES) Instruction & Sequencer Compare Instruction

12 + 4 Hours

Unit – IV

PLC Applications

Introduction, Switching ON-OFF Light, Liquid Level Control, Process Control, Main Door Control, Vehicle Parking Control, Bottling Plant, Drink Dispenser, Motor in forward and reverse direction

Traffic Light Control

11 + 3 Hours

Total: 45+15=60 Hours

21SIX02 Summer Internship II

0 0 0 1.5

Course Outcomes

1. Demonstrate communication skills to meet the requirement of industry
2. Develop logical thinking and analytical skills to thrive in competitive examinations
3. Use mathematical concepts to solve technical quizzes
4. Develop technical skills to work out real time problems
5. Develop algorithms for different applications
6. Solve industry defined problems using appropriate programming skills

COs – POs Mapping

COs	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	1	2	3	1	3	3	3	1	3	3	1
CO2	3	3	3	3	2	2	1	3	3	1	1	3	3	2
CO3	3	2	3	2	2	1	1	3	2	3	1	2	3	1
CO4	3	3	3	3	3	3	2	3	3	3	1	3	3	2
CO5	3	3	3	3	3	3	3	3	3	3	2	3	3	2
CO6	3	3	3	3	3	3	3	2	3	3	3	3	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21PWX01 Project

0 0 16 8

Course Outcomes

1. Identify a contemporary engineering application to serve the society at large
2. Use engineering concepts and computational tools to get the desired solution
3. Justify the assembled/fabricated/developed products intended
4. Organize documents and present the project report articulating the applications of the concepts and ideas coherently
5. Demonstrate ethical and professional attributes during the project implementation
6. Execute the project in a collaborative environment

COs – POs Mapping

COs	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	3	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	2	3	2	3	3	2	3	3
CO4	3	3	3	3	2	2	3	3	2	3	3	2	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21EE014 Power System Deregulation

0 0 0 3

UNIT- I

Introduction to Power System Deregulation

Basic concept and definitions, privatization, restructuring, transmission open access, wheeling, deregulation, components of deregulated system, advantages of competitive system

Regulation VS deregulation

12+3 Hours

UNIT- II

Power System Restructuring

Difference between integrated power system and restructured power system. Explanation with suitable practical examples. Deregulation of Power Sector: Separation of ownership and operation, Deregulated models, pool model, pool and bilateral trades model, Multilateral trade model.

Day ahead and hour ahead markets

11+4 Hours

UNIT- III

Competitive Electricity Market

Independent System Operator activities in pool market, Wholesale electricity market characteristics, central auction, single auction power pool, double auction power pool, market clearing and pricing, Market Power and its Mitigation Techniques, Bilateral trading, Ancillary services, Transmission Pricing-postage stamp, MW-mile.

Location based Marginal Pricing LMPs

11+4 Hours

UNIT- IV

Transmission Open Access Issues

Open Access Same Time Information System-structure, functionality, implementation, posting of information, uses, Congestion Management-Congestion management in normal operation, total transfer capability, Available transfer capability, Transmission Reliability Margin, Capacity Benefit Margin, Existing Transmission Commitments.

Tracing of power

11+4 Hours

Total: 45+15 = 60 Hours

21EEC23 Power System Dynamics & Control

0 0 0 3

Unit- I

Modeling of Synchronous Machine: Power system stability states of operation and system security – system dynamics – problems system model analysis of steady State stability and transient stability – simplified representation of Excitation control-Synchronous machine – park's Transformation-analysis of steady state performance per – unit quantities-Equivalent circuits of synchronous machine determination of parameters of equivalent circuits.

per – unit quantities

11+4 Hours

Unit- II

Excitation System: Excitation system modeling-excitation systems block Diagram – system representation by state equations- Dynamics of a synchronous generator connected to infinite bus – system model Synchronous machine model-stator equations rotor equations – Synchronous machine model with field circuit – one equivalent damper winding on q axis (model 1.1).

Calculation of Initial conditions

11+4 Hours

Unit-III

Analysis of Single Machine System: Small signal analysis with block diagram – Representation Characteristic equation and application of Routh Hurwitz criterion- synchronizing and damping torque analysis-small signal model – State equations.

Routh Hurwitz criterion

11+4 Hours

Unit-IV

Application of Power System Stabilizers: Basic concepts in applying PSS – Control signals – Structure and tuning of PSS – Washout circuit – Dynamic compensator analysis of single machine infinite bus system with and without PSS.

Power Transfer capacity of single machine system

12+3 Hours

21EE016 High Voltage Engineering

0 0 0 3

UNIT I

Introduction to High Voltage Technology and Applications

Electric Field Stresses, Gas / Vacuum as Insulator, Liquid Dielectrics, Solids and Composites, Surge voltages, their distribution and control, Applications of insulating materials in transformers, rotating machines, cable power capacitors and bushings.

Applications of circuit breakers

12+3 Hours

UNIT-II

Break Down In Gaseous, Liquids and Solid Dielectrics

Breakdown in Gases: Gases as insulating media, collision process, Ionization process, Townsend's criteria of Breakdown in gases, Paschen's law. Breakdown in Liquids: Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids. Breakdown in Solids: Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice.

Solid dielectrics used in practice

11+4 Hours

UNIT-III

Generation, Measurement and Testing of High Voltages and Currents

Generation of High Direct Current Voltages, Generation of High alternating voltages, Tripping and control of impulse generators. Measurement: Measurement of High Direct Current voltages, Measurement of High alternating Voltages, Measurement of High DC Currents, alternating Measurement of Dielectric.

Measurement of loss factor

11+4 Hour

UNIT – IV

Testing, Over Voltage Phenomenon and Insulation Co-Ordination

Testing: Testing of Insulators and bushings, Testing of Isolators and circuit breakers, testing of cables, Testing of Transformers. Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage.

Testing of Surge Arresters

11+4 Hours

Total: 45+15 Hours

21F1X01 Full Semester Internship

0 0 0 9

Course Outcomes

1. Use the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. Select appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
4. Use ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
5. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
6. 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

COs – POs Mapping

COs	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	2	2	2	2	2	2	2	3	3
CO2	3	3	3	3	3	2	2	2	2	2	2	2	3	3
CO3	3	3	3	2	3	3	3	2	2	2	3	2	3	3
CO4	2	2	2	3	3	3	3	2	2	2	3	2	2	3
CO5	2	2	3	3	3	3	3	2	2	3	3	3	3	3
CO6	3	3	3	3	3	3	3	2	2	3	3	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

The Vision of GMRIT

- To be among the most preferred institutions for engineering and technological education in the country
- An institution that will bring out the best from its students, faculty and staff – to learn, to achieve, to compete and to grow – among the very best
- An institution where ethics, excellence and excitement will be the work religion, while research, innovation and impact, the work culture

The Mission of GMRIT

- To turnout disciplined and competent engineers with sound work and life ethics
- To implement outcome based education in an IT-enabled environment
- To encourage all-round rigor and instill a spirit of enquiry and critical thinking among students, faculty and staff
- To develop teaching, research and consulting environment in collaboration with industry and other institutions

Department Vision

To be a most preferred Electrical & Electronics Engineering department of learning for students and teachers alike, with dual commitment to research and serving students in an atmosphere of innovation and critical thinking.

Department Mission

- To provide high-quality education in Electrical & Electronics Engineering, to prepare the graduates for a rewarding career in Electrical & Electronics Engineering and related industries, in tune with evolving needs of the industry.
- To prepare the students to become thinking professional and good citizens who would apply their knowledge critically and innovatively to solve professional and societal problems.

Program Educational Objectives (PEOs)

- **PEO1:** Graduates with ability to solve core engineering problems through continuous self-paced learning in tune with changing technologies
- **PEO2:** Reinforce engineering skills, critical thinking and problem-solving skills in professional engineering practices and deal with socio-economical, technical and business challenges
- **PEO3:** Nurture professionalism with soft skills, managerial & leadership skills and ethical values.

Program Outcomes (POs):

Engineering graduate will be able to:

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

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

PO 3: 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. (Design/development of solutions)

PO 4: 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. (Conduct investigations of complex problems)

PO 5: 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. (Modern tool usage)

PO 6: 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. (The engineer and society)

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

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

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

PO 10: 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. (Communication)

PO 11: 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. (Project management and finance)

PO 12: 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. (Life-long learning)

Program Specific Outcomes (PSOs):

Engineering graduate will be able to:

PSO#1: Utilize statistics, transformation methods, discrete mathematics and application of differential equations in analysing and design of electrical/electronic systems. (Program Specific)

PSO#2: Analyze, design and implement control of electrical systems in any problem/application of electrical/electronic (s) engineering. (Program Specific)

Department of Electrical & Electronics Engineering

Minimum Credits to be earned: 160 (for Regular Students)
127 (for Lateral Entry Students)

S.No	Course Code	Course Name	POs	Contact Hours			
				L	T	P	C
First Semester							
1	23CYX01	Chemistry	1,12	3	0	0	3
2	23MAX01	Linear Algebra& Calculus	1	3	0	0	3
3	23BEX01	Basic Electrical and Electronics Engineering	1,2,PSO1	3	0	0	3
4	23BEX03	Introduction to Programming	1,2,12	3	0	0	3
5	23BEX04	Engineering Graphics	1,5,10	2	0	2	3
6	23CYX03	Chemistry Lab	1,4	0	0	2	1
7	23BEX05	Electrical & Electronics Engineering Workshop	1,4,5	0	0	3	1.5
8	23BEX07	Computer Programming Lab	4	0	0	3	1.5
9	23HSX12	CCA (NSS/NCC/Community Service)		0	0	1	0.5
			Total	**14**		**11**	**19.5**
Second Semester							
1	23MAX02	Differential Equations and Vector Calculus	1	3	0	0	3
2	23PYX02	Engineering Physics	1,2,12	3	0	0	3
3	23HSX01	Communicative English	10,12	2	0	0	2
4	23BEX02	Basic Civil & Mechanical Engineering	1,2,3,6,7,8,12	3	0	0	3
5	23EE201	Electrical Circuit Analysis-I	1,2,PSO1	3	0	0	3
6	23HSX02	Communicative English Lab	10,12	0	0	2	1
7	23PYX02	Engineering Physics Lab	4,9,11	0	0	2	1
8	23BEX08	IT workshop	1,2,3,4,9,12	0	0	2	1
9	23BEX06	Engineering Workshop	1,9,12	0	0	3	1.5
10	23EE202	Electrical Circuits Lab	5	0	0	3	1.5
11	23HSX11	Health and Wellness, Yoga and Sports		0	0	1	0.5
			Total	**14**	**-**	**13**	**20.5**
Third Semester							
1	23MA302	Engineering Mathematics III	1,4,5	3	-	2	4
2	23EE302	DC Machines and Transformers	1,2	3	-	-	3
3	23EE303	Electrical Circuit Analysis-II	1,2,PSO1	3	-	-	3
4	23EE304	Electromagnetic Field Theory	1,2	3	-	-	3
5	23EE305	Measurements and Instrumentation	1,2,3	3	-	-	3
6	23EE306	Semiconductor Devices and Circuits	1,2, 3, 4,5	3	-	2	4
7	23EE307	DC Machines Lab	4	-	-	3	1.5
8	23EE308	Python Programming lab	4,5	-	-	3	1.5
9	23ESX01	Employability Skills I	1,2,5,8,10,12	-	-	2	-
			Total	**18**	**-**	**12**	**23**
Fourth Semester							
1	23EE401	AC Machines	1,2	3	-	-	3
2	23EE402	Linear and Digital Integrated Circuits	1,2,4	3	-	2	4
3	23EE403	Power Electronics	2,3,PSO1,PSO2	3	-	-	3
4	23EE404	Power Generation, Transmission and Distribution	1, 2,6	3	-	-	3
5	23EE405	Signals and Systems Theory	3,5,PSO1	3	-	-	3
6	23EE406	AC Machines Lab	4	-	-	3	1.5
7	23EE407	Measurements and Instrumentation Lab	4	-	-	3	1.5
8	23ESX01	Employability Skills I	1,2,5,8,10,12	-	-	2	2
			Total	**15**	**-**	**10**	**21**

Fifth Semester							
1	23IT306	Object Oriented Programming through Java	1,2,3,4,5	3	-	2	4
2	23EE502	Control Systems	2,3,4,5,PSO1,PSO2	3	-	2	4
3	23EE503	Electrical Drives	2,3,PSO2	3	-	-	3
4	23EE504	Power System Protection	2,3,PSO2	3	-	-	3
5		Elective I (Professional Elective)		3	-	-	3
6		Elective II (Open Elective I)		3	-	-	3
7	23EE507	Power Electronics and Drives Lab	4,5	-	-	3	1.5
8	23TPX01	Term Paper	1,4,10,12	-	-	3	1.5
9	23ESX02	Employability Skills II	1,2,5,8,10,12	-	-	2	-
10	23SIX01	Summer Internship I	1,2,8,10,12				1
			Total	**18**	**-**	**12**	**24**
Sixth Semester							
1	23HSX10	Engineering Economics and Project Management	11,12	3	-	-	3
2	23EE602	Power System Analysis and Control	2,3,PSO1,PSO2	3	-	-	3
3	23EE603	Utilization of Electrical Energy	3,6,7,8	3	-	-	3
4		Elective III (Professional Elective)		3	-	2	4
5		Elective IV (Open Elective II)		3	-	-	3
6	23EE606	Power Systems Lab	4,5	-	-	3	1.5
7	23MPX01	Mini Project	1 to12,PSO1,PSO2	-	-	3	1.5
8	23ESX02	Employability Skills II	1,2,5,8,10,12	-	-	2	2
9	23ATX01	Environmental Studies	1,3,6,7	-	-	-	-
10	23ATX02	Professional Ethics and Human Values	-----	-	-	-	-
11	23ATX03	Indian Knowledge Systems	12	-	-	-	-
			Total	**15**	**-**	**10**	**21**
Seventh Semester							
1		Elective V (Professional Elective)		3	-	-	3
2		Elective VI (Professional Elective)		3	-	-	3
3		Elective VII (Open Elective III)		3	-	-	3
4	23SIX02	Summer Internship II	1,2,5,6,10,12	-	-	-	1
5	23PWX01	Project	1 to 12,PSO1,PSO2	-	-	16	8
			Total	**9**	**-**	**16**	**18**
Eighth Semester							
1		Elective VIII (Professional Elective)		-	-	-	3
2		Elective IX (Open Elective IV)		-	-	-	2
3	23FIX01	Full Semester Internship (FSI)	1,2,5,8,9,10,PSO1, PSO2	-	-	-	8
			Total	**-**	**-**	**-**	**13**

List of Electives

Language Electives							
No.	**Course Code**	**Course**	**Pos**	**Contact Hours**			
				L	**T**	**P**	**C**
1	23HSX03	Advanced Communicative English	10,12	2	-	-	2
2	23HSX04	Communicative German		2	-	-	2
3	23HSX05	Communicative French		2	-	-	2
4	23HSX06	Communicative Japanese		2	-	-	2
5	23HSX07	Communicative Spanish		2	-	-	2
6	23HSX08	Communicative Korean		2	-	-	2
7	23HSX09	Communicative Hindi		2	-	-	2
Elective I							
Career Path I, II, III and Other Core Electives							
1	23EEC11	Electrical Vehicle Technologies	2,3,12,PSO2	3	-	-	3
2	23EEC21	Green Energy Technologies	2,3,12	3	-	-	3
3	23EEC31	Micro and Smart Grid Technologies	2,3,12,PSO2	3	-	-	3
4	23EE017	Electrical Machine Design	2,3	3	-	-	3
5	23EE018	High Voltage DC Transmission	2,3,PSO2	3	-	-	3
6	23EE019	Special Electrical Machines	2,3,PSO2	3	-	-	3
7		MOOCs		-	-	-	3
Elective II: Open Elective I							
1	23CE001	Disaster Management	2,7	3	-	-	3
2	23EE001	Electrical Installation, Safety and Auditing	2,3,6,8	3	-	-	3
3	23ME001	Fundamentals of Optimization Techniques	1,2	3	-	-	3
4	23EC001	Sensors for Engineering Applications	1	3	-	-	3
5	23CS001	Fundamentals of Artificail Intellegence	1,2,3	3	-	-	3
6	23CH001	Energy Conversion and Storage Devices	1,3,6,7	3	-	-	3
7	23IT001	Fundamentals of Multimedia	1,5,7	3	-	-	3
8	23BS001	Nano Materials and Technology	1,12	3	-	-	3
9	23O0211	Fundamentals of VLSI Design	1,4,5	3	-	-	3
Elective III							
Career Path I, II, III and Other Core Electives							
1	23EEC12	Electric Vehicle Drive Train Systems	2,3,12,PSO2	3	-	2	4
2	23EEC22	Power Electronic Applications to Green Energy Systems	2,3,5,12,PSO2	3	-	2	4
3	23EEC32	Control and Instrumentation of Smart Grid Systems	3,4,5,12,PSO2	3	-	2	4
4	23EE020	Advanced Control Systems	2,3,4,5,PSO1,PSO2	3	-	2	4
5	23EE021	Discrete Signal Processing	2,3,4,5,PSO1,PSO2	3	-	2	4
6	23EE009	Machine Modelling and Steady State Analysis	2,3,4,5	3	-	2	4
Elective IV : Open Eletive II							
1	23CE002	Air Pollution and Environmental Impact Assessment	6,7,12	3	-	-	3
2	23EE002	Renewable Energy Sources	2,7	3	-	-	3
3	23ME002	Principles of Entrepreneurship	1,11	3	-	-	3
4	23EC002	Electronics for Agriculture	1,2	3	-	-	3
5	23CS002	Fundamental of Machine Learning	2,3	3	-	-	3
6	23CH002	Industrial Safety and Hazard Management	1,2,3,6,8	3	-	-	3
7	23IT002	Fundamentals of Cloud Computing	1,7	3	-	-	
8	23BS002	Advanced Numerical Techniques	1,2	3	-	-	3
9	23BS003	Functional Materials and Applications	1,4	3	-	-	3
10	23O0212	Digital Design with Verilog	1,4,5	3	-	-	3
Elective V							
Career Path I, II, III and Other Core Electives							
1	23EEC13	Battery Management Systems	2, 12, PSO1,PSO2	3	-	-	3
2	23EEC23	Hybrid Renewable Energy Systems Design	2,12, PSO1,PSO2	3	-	-	3
3	23EEC33	Communication and Security in Smart Grid	2,12, PSO1,PSO2	3	-	-	3
4	23EE010	Electrical Distribution Systems	2,3,PSO2	3	-	-	3
5	23EC401	Analog and Digital Communications	1,2	3	-	-	3
6	23IT304	Database Management Systems	1,2,3,12	3	-	-	3
7		MOOCs		-	-	-	3

Elective VI							
1	23EE011	Energy Audit, Conservation and Managaement	2,3,12,PSO2	3	-	-	3
2	23EE012	Microprocessors and Microcontroller Interfacing	2,3,10,PSO2	3	-	-	3
3	23EE013	Programmable Logic Controllers	2,3,PSO2	3	-	-	3
		MOOCs		-	-	-	3
Elective VII:Open Elective III							
1	23CE003	Solid Waste Management	3,7,12	3	-	-	3
2	23EE003	Fundamentals of Electrical Vehicle Technology	2,3,12	3	-	-	3
3	23ME003	Industrial Engineering and Management	1,11	3	-	-	3
4	23EC003	Interfacing and Programming with Arduino	1,2	3	-	-	3
5	23CS003	Data Science for Engineering Applications	2,3,4	3	-	-	3
6	23CH003	Industrial Ecology for Sustainable Development	2,6,7	3	-	-	3
7	23IT003	Fundamentals of Mobile Computing	1,7	3	-	-	3
8	23BS004	Advanced Materials of Renewable Energy	1,7	3	-	-	3
9	23BS005	Applied Linear Algebra for Engineers	1,12	3	-	-	3
10	23O0213	Verification Using System Verilog	1,4,5	3	-	-	3
Elective VIII (Professional Elective)							
1	23EE014	Power System Deregulation	2,3,PSO2	-	-	-	3
2	23EE015	Power System Dynamics & Control	2,3,PSO2	-	-	-	3
3	23EE016	High Voltage Engineering	2,3,PSO2	-	-	-	3
4		MOOCs		-	-	-	3
Elective IX (Open Elective IV)							
1	23CE019	Green Buildings	1,7,12	-	-	-	2
2	23EE008	Sustainable Energy	1,2,12	-	-	-	2
3	23ME019	Total Quality Management	1,11	-	-	-	2
4	23EC011	Communication Technologies	1,2	-	-	-	2
5	23CS021	Applications of Artificial Intelligence	2,3,6,7	-	-	-	2
6	23CH016	Green Technologies	1,6,7	-	-	-	2
7	23IT015	Human Computer Interaction	1,7	-	-	-	2
8	23BS006	Handling of Industrial waste and waste water	1,7	-	-	-	2
9	23O0214	VLSI Design Flow: RTL to GDS	1,4,5	-	-	-	2
Audit Course							
1	23AT001	Communication Etiquette in Workplaces	-	-	-	-	-
2	23AT002	Contemporary India: Economy, Policy and Society	-	-	-	-	-
3	23AT003	Design The Thinking	-	-	-	-	-
4	23AT004	Ethics and Integrity	-	-	-	-	-
5	23AT005	Indian Heritage and Culture	-	-	-	-	-
6	23AT006	Intellectual Property Rights and Patents	-	-	-	-	-
7	23AT007	Introduction to Journalism	-	-	-	-	-
8	23AT008	Mass Media Communication	-	-	-	-	-
9	23AT009	Science, Technology and Development	-	-	-	-	-
10	23AT010	Social Responsibility	-	-	-	-	-
11	23AT011	The Art of Photography and Film Making	-	-	-	-	-
12	23AT012	Gender Equality for Sustainbility	-	-	-	-	-
13	23AT013	Women in Leadership	-	-	-	-	-
14	23AT014	Introduction to Research Methodology	-	-	-	-	-
15	23AT015	Climate Chnages and Circular Economy					
B. Tech. (Honors)							
Domain I: AI in Electrical and Electronics Engineering							
01	23EEH11	Computational Intellegence in Electrical Engineering	1,2,12,PSO2	4	-	-	4
02	23EEH12	Data analytics in Electrical Engineering	1,2,12	4	-	-	4
03	23EEH13	Internet of Things in Electrical Engineering	1,2,12, PSO1	4	-	-	4
04	23EEH14	Introduction to Smart Cities	1,2,12, PSO2	4	-	-	4
Domain II: Power Systems							
01	23EEH21	Design and Layout of Power Systems	1,2,3,8	4	-	-	4
02	23EEH22	Distributed Generation Technologies	1,2,6,7,8, PSO2	4	-	-	4
03	23EEH23	Distribution System Planning and Automation	2,3,6, PSO2	4	-	-	4
04	23EEH24	Power Quality	2,3,8, PSO2	4	-	-	4
Domain III: Control Systems							
01	23EEH31	Adaptive Control Systems	2,3,PSO1,PSO2	4	-	-	4
02	23EEH32	Introduction to Autonomous Vehicles	2,3, PSO2	4	-	-	4

03	23EEH33	Introduction to Robust Control Systems	2,3, PSO1,PSO2	4	-	-	4
04	21EEH34	Optimal Control Systems	2,3, PSO1,PSO2	4	-	-	4
Domain IV: Power Electronics and Drives							
01	23EEH41	Advanced Power Electronics	2,3, PSO1,PSO2	4	-	-	4
02	23EEH42	Flexible AC Transimission Systems	2,3, PSO1	4	-	-	4
03	23EEH43	Power Electronic Control of DC Drives	2,3,PSO2	4	-	-	4
04	23EEH44	Power Electronic Control of AC Drives	2,3,PSO2	4	-	-	4
B. Tech. (Minors)							
Energy Science & Technology							
01	23CHM11	Foundation of Energy Science and Technology	1,2,3,5,7,12	4	-	-	4
02	23CHM12	Energy Generation from Waste	1,2,3,4,5	4	-	-	4
03	23CHM13	Energy Storage Systems	1,2,3,6,7	4	-	-	4
04	23CHM14	Hydrogen Energy and Fuel Cells	1,2,3,7	4	-	-	4
Nano Science & Technology							
01	23CHM21	Introduction and Characterization of Nano Materials	1,2,3,7	4	-	-	4
02	23CHM22	Carbon Nanostructures and Applications	1,3,4,5	4	-	-	4
03	23CHM23	Energy, Environment & Biomedical Nanotechnology	1,2,3,7	4	-	-	4
04	23CHM24	Industrial Applications of Nano Technology	2,3,5,7	4	-	-	4
Environmental Engineering							
01	23CEM11	Watershed Management	6,7	4	-	-	4
02	23CEM12	Industrial Pollution Control and Engineering	3,6,7,12	4	-	-	4
03	23CEM13	Solid and Hazardous Waste Management	1,3,6,7	4	-	-	4
04	23CEM14	Ecology and Environmental Assessment	1,3,6,7	4	-	-	4
Artificial Intelligence & Machine Learning							
01	23CSM11	Fundamentals of AI & Machine Learning	1,12	4	-	-	4
02	23CSM12	Feature Engineering for Machine Learning	1,2,3	4	-	-	4
03	23CSM13	Exploratory Data Analytics	1,4	4	-	-	4
04	23CSM14	Deep Learning	1,2,4	4	-	-	4
Cyber Security							
01	23CSM21	Fundamentals of Security	1,2	4	-	-	4
02	23CSM22	Management of Information Security	3,6,7	4	-	-	4
03	23CSM23	Cyber Security	1,3,4	4	-	-	4
04	23CSM24	Cloud Security	2,3	4	-	-	4
Data Science & Analytics							
01	23CSM31	Data Cleaning	2,3,4	4	-	-	4
02	23CSM32	Data Engineering	1,2,3,4	4	-	-	4
03	23CSM33	Text Analytics	1,2,4	4	-	-	4
04	23CSM34	Social Network and Semantic Analysis	2,4	4	-	-	4
Computer Systems Programming							
01	23CSM41	Programming Fundamentals	1,2,3	4	-	-	4
02	23CSM41	Data Structures & Algorithms	1,2,3,4	4	-	-	4
03	23CSM41	Fundamentals of Databases	1,4	4	-	-	4
04	23CSM41	Fundamentals of Computer Networks & Operating Systems	1,2,3	4	-	-	4
Digital IC Design							
01	23ECM11	Fundamentals of VLSI Design	1,2,3	4	-	-	4
02	23ECM12	Digital Design using HDL	1,2,3	4	-	-	4
03	23ECM13	FPGA Technology	1,2	4	-	-	4
04	23ECM14	Analog and Mixed Signal Design	1,2	4	-	-	4
Industrial Automation							
01	23ECM21	Microcontrollers and Interfacing	1,2,3	4	-	-	4
02	23ECM22	Sensors and Data Acquisition System	1,2	4	-	-	4
03	23ECM23	Fundamentals of Labview	1,2	4	-	-	4
04	23ECM24	Medical Robotics	1,2,3	4	-	-	4
Communications and Networking							
01	23ECM31	Principles of Communications	1,2	4	-	-	4
02	23ECM32	Coding Theory and Practice	1,2	4	-	-	4
03	23ECM33	Ad-hoc and Wireless Sensor Networks	1,2,3	4	-	-	4
04	23ECM34	Fundamentals of Multimedia Networking	1,2,3	4	-	-	4

Avionics							
01	23ECM41	Principles of Aerodynamics	1,2	4	-	-	4
02	23ECM42	Aircraft Electrical Systems	1,2	4	-	-	4
03	23ECM43	Aircraft Instrument Systems	1,2	4	-	-	4
04	23ECM44	Aircraft Communication and Navigational Systems	1,2	4	-	-	4
Geographic Information System							
01	23ECM51	Sensors and Sensing Technology	1,2	4	-	-	4
02	23ECM52	Geographic Information Systems	1,2	4	-	-	4
03	23ECM53	Digital Image Processing	1,2	4	-	-	4
04	23ECM54	Lidar Systems	1,2	4	-	-	4
Cloud Application Development							
01	23ITM11	Introduction to Cloud Computing	6,7,12	4	-	-	4
02	23ITM12	Introduction to Web Development with HTML, CSS, JavaScript	1,2,3,9,12	4	-	-	4
03	23ITM13	Developing Cloud Native Applications	5,8,10	4	-	-	4
04	23ITM14	Introduction to Cloud Computing	6,7,12	4	-	-	4
Robotics and Automation							
01	23MEM11	Introduction to Robotics	1,2,3	4	-	-	4
02	23MEM12	Drives and Sensors	1,2,3,4	4	-	-	4
03	23MEM13	Control Systems for Robotics	1,2,3,4	4	-	-	4
04	23MEM14	Machine Learning for Robotics	2,5	4	-	-	4
Industrial Systems Engineering							
01	23MEM21	Industrial Management	1,10,11,12	4	-	-	4
02	23MEM22	Fundamentals of Operations Research	1,2,3,5	4	-	-	4
03	23MEM23	Enterprise Resource Planning	1,2,3,5,11,12	4	-	-	4
04	23MEM24	Production Planning and Control	1,2,3,5,11,12	4	-	-	4

23MA302 Engineering Mathematics III

(Programmes: EEE, MECH, CHEM)

3 0 2 4

Unit I

Solution of Algebraic and Transcendental Equations

Introduction, Bisection Method, Method of False Position, Newton-Raphson Method

Curve fitting-Fitting a straight line, Second degree curve, exponential curve, power curve by method of least squares

Geometrical interpretation - Bisection Method, Method of False Position, Newton-Raphson Method

Practical components

1. The Bisection method
2. Newton-Raphson Method
3. Linear Regression (Fitting of a straight line)

12 +8 Hours

Unit II

Interpolation, Numerical Integration and Numerical solution of Ordinary differential equations

Introduction, Finite differences, Newton's- forward and backward differences, Symbolic relations

Numerical Integration-Trapezoidal rule, Simpson's 1/3 Rule

Numerical Solution of Ordinary Differential equations: Solution by Taylor's series, Euler's, Modified Euler's Method, Runge-Kutta Methods

Milne's Predictor-Corrector Method

Practical components

1. Trapezoidal rule
2. Simpson's 1/3 Rule
3. Solution of Initial Value Problem using Taylor's series method
4. Solution of Initial Value Problem using Runge-Kutta Method of order four

12 +8 Hours

Unit III

Probability and Random variables

Probability, axioms of probability, Conditional probability, Baye's theorem

Random variables-Discrete and continuous Distributions and properties, Mathematical expectation, MGFs

Addition, Multiplication theorems of probability

Practical components

1. Baye's Rule

12 + 8 Hours

Unit IV

Probability Distributions, Correlation and Regression

Binomial, Poisson and Normal distribution – related properties

Correlation- Pearson's correlation coefficient and Spearman's Rank correlation coefficient, linear Regression (construction of Regression lines)

Correlation of grouped data, curvilinear regression

Practical components

1. Normal Distribution
2. Correlation related problems

12 + 8 Hours

Total: 48+32=80 Hours

23EE302 DC Machines and Transformers

3 0 0 3

Unit I

DC Generators

DC Machine-constructional features - principle of operation, EMF equation, methods of excitation – circuit model, armature reaction - effects of armature reaction - cross magnetizing and de-magnetizing AT/pole, commutation, power flow equation - losses - constant & variable losses, build-up of EMF - OCC and load characteristics of shunt, series and compound generators, parallel operation of DC shunt generators, applications of DC generators

Purpose of equalizer rings and dummy coils

12 Hours

Unit II

DC Motors

DC Motors - principle of operation, types of DC Motors, torque equation, characteristics and application of shunt, series and compound motors, speed control of DC Motors - armature voltage and field flux control methods, three-point starter, Brake test, Swinburne's test, Hopkinson's test

Four-point starters and Retardation test

12 Hours

Unit III

Single Phase Transformers

Single phase transformers – types, constructional details, Ideal Transformer, EMF equation, operation at no-load and load, practical Transformer, phasor diagrams, equivalent circuit, losses and efficiency, regulation, OC and SC tests, all day efficiency, applications, parallel operation of transformers with equal voltage ratios.

Parallel operation of transformers with unequal voltage ratios

12 Hours

Unit IV

Auto-Transformers and Three Phase Transformers

Auto-transformers: Constructional details, copper saving, VA rating, conversion of two winding transformer to an autotransformer, applications.

Three phase transformers: Construction, principle of operation, three phase transformer connections - Y/Y, Y/Δ, Δ /Y, Δ/Δ, Open Δ and Scott connections.

Tap changing transformers

12 Hours

Total: 48 Hours

23EE303 Electrical Circuit Analysis-II

3 0 0 3

Unit I

Three Phase Circuits

Three Phase Circuits: Advantages of 3-phase system over 1-phase systems, 3-phase balanced system connections-star connection, delta connection and their comparison, Unbalanced 3-phase connections-delta connection, 3-wire star connection, 4-wire star connection, measurement of power in 3-phase circuits using 2-wattmeter method for balanced load

10 Hours

Unit II

Laplace transforms – Definition and Laplace transforms of standard functions– Shifting theorem – Transforms of derivatives and integrals, Inverse Laplace transforms and applications.

Transient Analysis- Transient response of R-L, R-C and R-L-C series circuits for DC and sinusoidal excitations – Initial conditions - Solution using differential equation and Laplace transform approach.

14 Hours

Unit III

Two-port networks

Open circuit, short circuit, transmission, Inverse transmission, hybrid and inverse hybrid parameters and their inter relations, interconnection of two port networks, T and Π representation of two-port networks.

12 Hours

Unit IV

Network Functions: Driving point impedance and admittance, Transfer impedance and admittance, current and voltage transfer ratio, Network functions of ladder and non-ladder networks, Poles and zeros of a network function

Network Topology: Terminology used in network topology, network graph and tree, basic cut-set and basic tie-set matrices for planar networks, concept of duality and dual networks.

12 Hours

Total: 48 Hours

23EE304 Electromagnetic Field Theory

3 0 0 3

Unit I

Introduction to coordinate systems and fields

Cartesian coordinates, Cylindrical coordinates, Spherical coordinates and their relationship, Electrostatic fields, Coulomb's law and field intensity, Differential length, area and volume, line, surface and volume integrals, Electric field due to charge distribution, Electric flux density, Electric Potential.

Electric field due to discrete charge distribution

12 Hours

Unit II

Electrostatics

Gauss' Law and it's applications, del operator, gradient of a scalar, Electric dipole and flux lines, Behavior of conductors, convection and conduction currents, polarization in dielectrics, dielectric constants, continuity equation and relaxation time, Ohm's law in point form, Electrostatic boundary conditions, capacitance, energy stored in capacitors, energy density in electrostatic fields, Poisson's and Laplace's equations, general procedures for solving Poisson's or Laplace's equations, Maxwell's equation in static electric field.

Properties of materials in electric field

12Hours

Unit III

Magnetostatics

Magneto-static fields, Biot-Savart's Law and it's applications, Curl of a vector, Ampere's circuit law, application of Ampere's law, Stoke's theorem, magnetic flux density, scalar and vector magnetic potentials, Forces due to magnetic field, Lorentz's force equation, magnetic dipole, magnetic torque and moment, magnetization in materials, magnetic boundary conditions, inductors and inductances, magnetic energy. Maxwell's equation in steady magnetic field

Properties of materials in magnetic field

12 Hours

Unit IV

Time-Varying Electromagnetic Fields

Magnetic Circuits-Basic terminology, Faraday's Law, Concept of self and mutual inductance, dot convention, co-efficient of coupling, analysis of series and parallel magnetic circuits, transformer and motional electromotive forces, displacement current, Maxwell's equation in point and integral forms for time varying fields.

Modified Maxwell's equation.

12 Hours

Total: 48 Hours

23EE305 Measurements and Instrumentation

3 0 0 3

Unit I

Measuring Instruments

Classification of measuring instruments, different torques in an instrument, ammeters and voltmeters – PMMC, moving iron type instruments – expression for the deflecting torque and control torque – errors and compensations, extension of instrument range using shunts and multipliers, CT and PT – ratio and phase angle errors, digital voltmeters- successive approximation, ramp, dual slope integration continuous balance type, digital frequency meter

Electrostatic voltmeter

12 Hours

Unit II

Measurement of Power and Energy

Single phase dynamometer wattmeter, LPF wattmeter, expression for deflecting and control torques, measurement of 3-phase power, single phase induction type energy meter – driving and braking torques – errors and compensations, testing by phantom loading, three phase energy meter.

Extension of range of wattmeter using Instrument transformers.

12 Hours

Unit III

Potentiometer and Bridges

Principle and operation of DC Crompton's potentiometer – standardization – measurement of unknown resistance, current, voltage – applications, methods of measuring low, medium and high resistance –Wheat stone's bridge, Kelvin's double bridge, Loss of charge method, Measurement of inductance - Maxwell's bridge, Hay's bridge, Anderson's bridge, Measurement of capacitance – Desauty bridge – Schering Bridge.

Sensitivity of Wheat stone's bridge, Megger

12 Hours

Unit IV

Sensors and Transducers

Sensors and their classifications – Hall effect – Ultrasonic – Heat Flux – Fluid level measurement, Modern sensors-bio-sensors, glucose electrodes.

Classification of transducers – Resistive, Capacitive and Inductive transducers- active and passive transducers- Piezoelectric transducers – strain gauges, Phototransistor, LVDT, Photovoltaic Cell– thermocouple.

RVDT, RTD, Calibration of CRO

12 Hours

Total: 48 Hours

23EE306 Semiconductor Devices and Circuits

3 0 2 4

Unit I **12+8 Hours**

PN Junction Devices

Introduction to Semiconductors, Energy band diagrams; PN junction diode– Effect of temperature on the diode characteristics, Diode current equation, diffusion and transition capacitance; Clipping Circuits – one level and two-level Clippers; Clamping Circuits – Working of Clamping Circuit, Practical Clamping Circuit, Biased Clamping Circuits, Clamping Circuit Theorem - Tunnel Diode characteristics.

LED and Photo diodes

Practical Component

1. PN Junction diode characteristics
2. Zener diode characteristics
3. Full wave center tapped rectifier with and without filter.
4. Bridge type Full wave rectifier

12+8 Hours

Unit II

Bipolar Junction Transistor

BJT- construction, types, operation, current components, CE, CB and CC configurations, BJT as an amplifier, BJT biasing - Criteria for fixing operating point, Fixed bias, Collector to base bias, self-bias, stabilization techniques, Compensation techniques- compensation against variation in V_{BE} and I_{co}, thermal run away, thermal stability.

Unijunction transistor

Practical Component

1. Transistor CE characteristics (Input and Output)
2. Transistor CB characteristics (Input and Output)
3. Design of fixed bias circuit
4. Design of self-bias circuit

12+8 Hours

Unit III

Field Effect Transistor

FET – types, construction, operation and characteristics – JFET parameters, FET as an amplifier, FET biasing – Fixed bias circuit, voltage divider bias circuit, self-bias circuit, MOSFET- types, construction operation and characteristics – MOSFET biasing

FET as a Voltage Variable Resistor, Zener barrier

Practical Component

1. JFET characteristics
2. MOSFET characteristics
3. Fixed bias circuit
4. Voltage divider bias circuit

12+8 Hours

Unit IV

Amplifiers

Generalized analysis of transistor amplifier model using h-parameters, Approximate analysis of CE, CC and CB configuration, Single stage amplifiers – CE, CC and CB amplifiers, small signal analysis of single stage BJT amplifiers – CE amplifier with fixed bias, CE amplifier - emitter resistor, Un-bypassed emitter resistor, voltage divider bias-generalized analysis of FET small signal model.

Analysis of CS and CD amplifiers

Practical Component

1. Characteristics of CE Amplifier
2. Characteristics of CS Amplifier
3. Frequency response of CE amplifier
4. Frequency response of CS amplifier

11+7 HoursTotal: 48 + 32=80 Hours **69**

23EE307 DC Machines Lab

0 0 3 1.5

List of Experiments

1. Magnetization characteristics of DC shunt generator
2. Internal characteristics of DC shunt generator
3. External characteristics of DC shunt generator
4. Load test on DC series generator
5. Internal characteristics on DC compound generator
6. External characteristics on DC compound generator
7. Hopkinson's test on DC shunt machines
8. Swinburne's test
9. Speed control of DC shunt motor by controlling the armature current
10. Speed control of DC shunt motor by controlling the Field current
11. Brake test on DC shunt motor
12. Separation of losses in DC shunt motor
13. Brake test on DC compound motor
14. Brake test on DC series motor
15. Field test on DC Series Machines
16. Retardation test on DC Shunt Motor

List of Augmented Experiments[1]

1. Simulation of brake Test on a DC shunt motor
2. Simulation of Swinburne's test
3. Simulation of separation of losses in A DC shunt motor
4. Simulation of open circuit characteristics of a DC shunt generator
5. Simulation of speed control of a DC shunt motor

Reading Material (s)

1. P. S. Bimbra, "*Electrical Machinery*", Khanna Publishers, 7th Edition, Color Reprint 2014.
2. I.J. Nagrath& D.P. Kothari, "*Electric Machines*", Tata McGraw Hill, 5th Edition, 2017.
3. S. K. Sahdev, "*Electrical Machines*", Cambridge University Press, 1st Edition, 2017

[1] Students shall opt any one of the augmented experiments in addition to the regular experiments

23EE308 Python Programming Lab

0 0 3 1.5

List of Experiments

1. (a)Installation of Python and setting up environmental variables.
   (b)Write a Python program to perform the following operations on two integers a and b
   (i)Arithmetic operations (ii) Logical operations
   (c)Write a python Program to find the ASCII value of a Character and vice versa (use ord and chr methods).
   (d)Write a python Program to convert a given decimal number into binary, octal and hexadecimal (use bin, oct and hex methods).
2. (a) Write a Python program to check the given year is a leap year or not using if statement.
   (b) Write a Python Program to perform following operations on List
   (i)Create an Empty list (ii) Append the elements into list (iii)Find the length, minimum, maximum.
3. (a)Write a Python program to use python generators to print all the prime numbers upto the given value 'n'.
   (b) Write a Python program for a given list of numbers print all the numbers one by one-using iterators in python.
4. (a)Write a Python program to flatten a nested list.
   (b)Write a Python program to find the transpose of the matrix using list.
5. Write a Python program in a given list of numbers create another list of even numbers using list comprehension.
6. Write a Python Program to remove punctuations from a string.
7. (a)Write a Python program to find the cube of a given number using lambda()/anonymous function.
   (b)Write a Python program to filter only even numbers from a given list using filter method.
8. (a)Write a Python program to find the squares of the list of numbers using map function.
   (b)Write a Python program to print all the combinations for the given list of numbers using itertools.
9. Define a class and write a method which accepts multiple parameters/arguments and find the sum of given parameters.
10. Write a Python program to search a key element in the list using linear search approach.
11. Write a python program to Convert the given list to numpy array.
12. Write a Python program Create a pandas data frame with two dimensional list.
13. Write a Python program to Create a data frame from dict of numpy array.

List of Augmented Experiments[2]

1. Read n strings as input and print the frequency of characters in all the string but keep the below cases inmind
   a. If string contains any digit raise user defined exception "string has digit in it"
   b. If string contains any space raise user defined exception "string has space in it"
   c. If string contains any special characters raise a user defined exception "string contains specialcharacters"
2. Implementation of Selection Sort using Python.
3. Implementation of Insertion Sort using Python.
4. Develop a gaming application Tic Tac Toe.
5. Develop a gaming application Chess.
6. Develop an editor in Python.
7. Develop a program to test the typing speed using Python.
8. Develop a program for Number Guessing.
9. Develop Website using Python.
10. Develop a Game Spin a Yan.
11. Develop a Phone Book using Python.
12. Develop Python Story /Paragraph Generator using Keywords entered(min 10 keywords to be entered)

Reading Material (s)

1. Fundamentals of Python Programming ,Richard L. Halterman 2019 71

[2] Students shall opt any one of the augmented experiments in addition to the regular experiments

2. Kenneth A. Lambert. “Fundamentals of Python: First Programs”, 2nd Edition, Publisher: Cengage Learning 2018
3. Python Programming: A Modern Approach, VamsiKurama, Pearson 2017.
4. Python Programming Lab manual – Department of EEE-GMRIT, Rajam.

23ESX01 Employability Skills I

0 0 2 0

Course Outcomes

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications
5. Solve engineering problems using software
6. Utilize simulation tools for testing

COs – POs Mapping

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		1	1	1	1			2	3		3	1	
CO2	1		1	1	1	1			2	3		3	1	
CO3	1		1	1	1	1			2	2		3	1	
CO4	2		2	2	2	2			3	1		3	1	
CO5	3		2	2	2	2			3	1		3	2	
CO6	2		2	2	3	3			3	1		3	3	

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

PART-A

Soft Skills

Communication Skills & Confidence: How Communication Skills affect Confidence? How to communicate Effectively. (with Examples)

Listening: Listening? , Listening Vs Hearing, Possible reasons for why people do not Listen at times, Active Listening Vs Passive Listening, How Listening can affect our relationships? How Listening helps in Campus Placements also? (with Examples)

Goal Setting: SMART Technique to Goal Setting, Putting First things First, SWOT Analysis and Time Management

Attitude & Gratitude: Attitude Vs Skills Vs Knowledge, Attitude Vs Behavior, How to develop Positive Attitude? Developing the attitude of Gratitude.

Public Speaking: JAM, J2M, Presentations by Students on General Topics.

7 Hours

PART-B

Aptitude Skills

Quantitative Aptitude:

Number system, L.C.M and H.C.F, Problems on Ages, Averages, Time and work, Pipes and cisterns

8 Hours

PART-C

Domain Specific Knowledge

Programmable logic controllers -1

a) Implementation of basic logic gates
b) Implementation of simple relay
c) Implementation of direct on-line starter
d) Implementation of on and off delay timer
e) Implementation of series and parallel switches

15 Hours

Total: 30 Hours

Text Book (s)

1. Frederick D. Hackworth and John R. Hackworth, *Programmable Logic Controllers: Programming Methods and Applications*, Pearson India; 1st edition, 2003.
2. Frank Petruzella, *Programmable Logic Controllers*, Tata McGrawhill, 3rd Edition, 2011.

Reference (s)

1. Gary Dunning, Thomson Delmar, "*Programmable Logic Controller*", Cengage Learning, 3rd Edition, 2005.
2. W. Bolton, "*Programmable Logic Controllers*", Newnes – Elsevier, 2015.

23EE401 AC Machines

3 0 0 3

Unit I

Three-phase Induction Machines

Three-phase induction motors-constructional details of cage and wound rotor machines-production of rotating magnetic field - principle of operation, rotor e.m.f and rotor frequency, rotor reactance, rotor current and p.f at standstill and during operation, torque equation- expressions for maximum torque and starting torque, torque-slip characteristics, equivalent circuit, power stages, circle diagram, Applications

Crawling and cogging

12 Hours

Unit II

Speed Control and Starting Methods

Speed control-change of frequency, pole changing methods, rotor resistance control and cascade connection, voltage injection into rotor circuit, starting methods.

Single phase Induction motors: principle of operation, Double revolving field theory, equivalent circuit, Starting methods and applications.

Universal motor and BLDC motor.

12 Hours

Unit III

Synchronous Generators

Constructional features of wound rotor and salient pole machines – Armature windings –Distribution, pitch and winding factors, E.M.F equation, harmonics in generated e.m.f. – suppression of harmonics, armature reaction, phasor diagram, Regulation by synchronous impedance method, M.M.F. method, Z.P.F. method- two reaction theory-determination of X_d and X_q (slip test), phasor diagram, regulation of salient pole alternator. Synchronization of alternators with infinite bus, Parallel operation - Effect of change in excitation and mechanical power input

Synchronizing power and torque, Applications of Synchronous Generators

12 Hours

Unit IV

Synchronous Motors

Principle of operation, Phasor diagram, methods of starting, variation of current and power factor with excitation, losses and efficiency, synchronous condenser, power factor improvement, hunting and its suppression, Applications

Excitation circle and power circle, comparison of synchronous and induction motors.

12 Hours

Total: 48 Hours

23EE402 Linear and Digital Integrated Circuits

3 0 2 4

Unit-I

Op-Amp and characteristics

Introduction to Op-Amp, Ideal Op-Amp characteristics, DC characteristics, AC characteristics, Voltage -series feedback and voltage -shunt feedback, Frequency response of Op-Amp - Basic applications: inverting, noninverting and differential amplifier circuits, Adder-subtractor circuits, Differentiation and integrator circuits

Precision rectifiers

Practical Component

1. Voltage gain of non-inverting and inverting amplifier with feedback
2. OP AMP Applications–Adder and Subtractor.
3. Differentiator
4. Integrator

12+8 Hours

Unit II

Application of Op-Amps

Instrumentation amplifiers, First-order and Second order active filters, V to I and I to V converters, Comparators and Astable multi-vibrators, Triangular waveform generator, Clippers and Clampers, Peak detector, Weighted resistor type and R-2R ladder type D/A converters, Flash type A/D converter.

Schmitt Trigger

Practical Component

1. Active Filters–LPF, HPF (first order only)
2. Triangular wave Generator using 741OP AMP
3. Analog to Digital Converter using OP AMP
4. Digital to Analog Converter using OP AMP

12+8 Hours

Unit III

Boolean function minimization and combinational logic circuits

Review of Number System, Minimization of Boolean functions up to four variables using Karnaugh Map - PoS and SoP, with don't care conditions, Minimization of Boolean functions using tabular method, Combinational logic circuits - half adder, full adder, half-subtractor, full-subtractor, comparator, encoder, priority encoder, decoder, multiplexer, de-multiplexer, realization of switching functions using combinational logic circuits.

Code converters

Practical Component

1. Half adder and full adder
2. Half subtractor and full subtractor
3. 4X1 multiplexer and 1X4 demultiplexer
4. 8X3 encoder and 3X8 decoder

12+8 Hours

Unit IV

Sequential Logic circuits

Introduction to flip-flops, Registers - buffer register, controlled buffer register, shift registers, bi-directional shift register, universal shift register, Asynchronous & Synchronous counters - up, down, up down, ring counters, Johnson counters, Mealy and Moore state machines - conversion, reduction of state tables and state assignment.

Sequence Generator, Sequence detector

Practical Component

1. Shift registers
2. Synchronous counter
3. Asynchronous counter
4. Johnson / Ring counter

12+8 Hours

Total: 48+ 32=80 Hours

75

23EE403 Power Electronics

3 0 0 3

Unit I

Power Semiconductor Devices

Introduction to power electronics devices - Construction, operation, and characteristics of thyristor family (SCR & GTO), BJT, MOSFET, IGBT - Turn on and turn off methods of SCR - Two transistor analogy of SCR - SCR firing and protection circuits - Series and parallel operations of SCR - Introduction to wide-bandgap semiconductor devices (SiC & GaN).

Role of Gate Drive Circuits in Power Electronics

12 Hours

Unit II

Phase Controlled Converters (AC-DC Converters)

Introduction to phase-controlled converter – Operation of 2-pulse, 3-pulse, and 6-pulse converter with R, RL, and RLE loads – Derivation of average load voltage and average load current – Effect of source inductance on single-phase controlled converter – Introduction to dual converter.

Improved Power Quality AC-DC Converters

12 Hours

Unit III

AC–AC Converters

Introduction to AC-AC converter - AC voltage controllers - Operation of single-phase AC voltage regulator - Derivation of RMS load voltage and RMS load current – Cyclo-converters – Operation of single-phase to single-phase.

Three phase AC voltage controller

12 Hours

Unit IV

Choppers & Inverters

Introduction to choppers – Operation of buck, boost, and buck-boost dc-dc converters - Derivation of average load voltage and average load current - Time ratio control and current limit control strategies – Introduction to high frequency isolated dc-dc converters.

Introduction to voltage source inverters – Operation of single-phase half and full bridge inverters – Operation of three-phase inverters with 180-degree and 120-degree conduction mode - Pulse width modulation techniques (Single, Multiple, and Sinusoidal) - Introduction to current source inverters.

Introduction to Space Vector Modulation

12 Hours

Total: 48 Hours

23EE404 Power Generation, Transmission and Distribution

3 0 0 3

Unit I

Power Generating Stations

Hydel Power Stations- classification-construction and working of hydroelectric power station, thermal power Stations-single line diagram highlighting major components and working, nuclear power stations- nuclear fission and chain reaction-working of nuclear reactors-BWR, PWR

Breeder reactors

10 Hours

Unit II

Transmission Line parameters and performance

Transmission Line Parameters: Transmission line components, GMR and GMD, Numerical problems on resistance, inductance and capacitance for single phase and three phase single circuit symmetrical and asymmetrical configurations (no derivation), Performance of Short, Medium and Long Transmission Lines: model description with phasor diagram for Short, Nominal-T, Nominal-π and long transmission lines respectively. ABCD parameter interpretation and calculation of transmission efficiency and voltage regulation

Ferrant, Skin and Proximity effects, surge impedance loading, , Corona loss and its effects

14 Hours

Unit III

Underground cables and Mechanical design of overhead lines

Underground Cables: Construction, Types of Cables ,Calculation of Insulation resistance and stress in insulation, Capacitance of single and 3-core belted cables, Grading of cables -capacitance grading and Inter-sheath grading.

Insulators-types-calculation of string efficiency

Sag and Tension calculations with equal & unequal heights of towers- effect of wind & ice loading,

Grading of Insulators

12 Hours

Unit IV

DC & AC distribution systems

Distribution System-Components, connection schemes, classification and comparison; Voltage Drop Calculations in DC Distributors for the following cases: Radial DC Distributor fed one end and at both the ends (equal/unequal Voltages) and Ring Main Distributor.

Voltage Drop Calculations in AC Distribution System- Distributors for the following cases: Power Factors referred to receiving end voltage and with respect to respective load voltages.

and numerical problems, Tariff-Types and numerical problems

Economics-terminology, 11kV Substation layout

12 Hours

Total: 48 Hours

23EE405 Signals and Systems Theory

3 0 0 3

Unit I

Mathematical Description and Analysis of Signals

Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: time-shifting, time-scaling, amplitude shifting, amplitude-scaling. Complex exponential and sinusoidal signals, power and energy signals, impulse function, step function, signum function and ramp function, convolution sum , convolution integral.

Orthogonal signals

(12 Hours)

Unit II

Fourier series and Fourier transforms

Fourier series representation of continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Relation between Trigonometric and Exponential Fourier series, Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms.

Fourier transforms involving impulse function and Signum function.

(12 Hours)

Unit III

Laplace transforms

Introduction, Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Inverse Laplace transform, Relation between L.T's, and F.T. of a signal.

Laplace transforms involving impulse function and Signum function.

(12 Hours)

Unit IV

Z-Transforms

Introduction, Concept of Z-Transform of a discrete sequence. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, Inverse Z-transform, properties of Z-transforms. Distinction between Laplace, Fourier and Z transforms.

Sampling theorem

(12 Hours)

(Total: 48 Hours)

23EE406 AC Machines Lab

0 0 3 1.5

List of Experiments

1. Regulation of a three -phase alternator by synchronous impedance method & m.m.f. method
2. No-load & Blocked rotor tests on three phase Induction motor
3. Brake test on three phase Induction Motor
4. O.C. & S.C. Tests on Single phase Transformer
5. Separation of core losses of a single-phase transformer
6. Sumpner's test on a pair of single-phase transformers
7. Equivalent Circuit of a single-phase induction motor
8. Regulation of three-phase alternator by Z.P.F. method
9. Synchronization of three phase alternator to the Bus bars
10. V and Inverted V curves of a three-phase synchronous motor
11. Determination of X_d and X_q of a salient pole synchronous machine
12. Parallel operation of single-phase transformers

List of Augmented Experiments[1]

1. Estimation of heat developed by primary and secondary windings of a transformer
2. Determination of regulation of synchronous machine by using ASA method
3. Determination of sequence impedances of salient pole synchronous machine
4. Fault analysis of Alternator
5. Synchronization of alternator by using dark & bright lamp method
6. Determination of All day efficiency of transformer
7. Design and development of equivalent circuit of an auto transformer
8. Comparison of volume of copper in two winding transformer and auto transformer
9. Design and development of equivalent circuit of an auto transformer by using MATLAB
10. Maintenance of power transformer
11. Variation in the active and reactive power of an alternator connected to an infinite bus by (a) Varying excitation, (b) varying Mechanical-power input
12. Determine the insulation resistance of a transformer at no load and at full load condition

[1] Students shall opt any one of the augmented experiments in addition to the regular experiments

23EE407 Measurements and Instrumentation Lab

0 0 3 1.5

List of Experiments

Any 10 experiments out of which at least 5 experiments from group-A and 5 experiments from group-B.

Group-A: Measurements

1. Measurement of resistance by Kelvin's Double Bridge
2. Measurement of inductance by Maxwell's Bridge
3. Measurement of capacitance by Schering Bridge
4. Measurement of choke coil parameters by using 3-ammeter
5. Measurement of choke coil parameters by using 3-Voltmeter method
6. Measurement of dielectric strength of transformer oil
7. Calibration of single-phase energy meter
8. Calibration of dynamo type wattmeter by using Phantom loading

Group B: Sensors & Transducers

1. Measure the Linear displacement into Electrical signal using LVDT.
2. Strain measurement and Calibration by using Resistance strain gauge
3. Characteristics of photo transistor, photo diode and LDR
4. Characteristics of solar cell.
5. Response of Thermocouple
6. Measurement of Pressure by using Transducers
7. Capacitive Level sensor for liquid level measurement
8. Measurement of moisture using Hygrometer

List of Augmented Experiments[2]

1. Development of level measurement system using proximity sensor
2. Development of automatic door opening system using sensors
3. Development of illumination control system using sensors
4. Development of soil resistance measurement system

Reading Material (s)

1. E.W. Golding, and F.C. Widdis, "*Electrical Measurements and Measuring Instruments*", Reem Publications Pvt. Ltd.,3rd Edition, 2011.
2. A.K. Sawhney, "*Electrical & Electronic Measurements & Instrumentation*", Dhanpat Rai & Co. Pvt. Ltd., 19th Edition, 2011.
3. D.V.S. Murthy, "*Transducers and Instrumentation*", Prentice Hall of India, 2nd edition, 2008.

[1] Students shall opt any one of the augmented experiment in addition to the regular experiments

23ESX01 Employability Skills I

0 0 2 2

Course Outcomes

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications
5. Solve engineering problems using software
6. Utilize simulation tools for testing

COs – POs Mapping

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		1	1	1	1			2	3		3	1	
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CO3	1		1	1	1	1			2	2		3	1	
CO4	2		2	2	2	2			3	1		3	1	
CO5	3		2	2	2	2			3	1		3	2	
CO6	2		2	2	3	3			3	1		3	3	

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

PART-A

Soft Skills

Building Confidence: Fear? Steps to Overcoming the Fear of Public Speaking?

Self Esteem: Definition? Types of Self Esteem, Causes of Low Self Esteem, Merits of Positive Self Esteem and Steps to build a positive Self Esteem.

Group Discussions (Practice): GD? GD Vs Debate, Overview of a GD , Skills assessed in a GD, Dos & Don'ts, & Conducting practice sessions (Simple Topics).

Motivational Talk: Team Work: Team Vs Group? Stages in Team Building, Mistakes to avoid and Lessons to Learn (Through Stories or Can be a Case Specific)

8 Hours

PART-B

Aptitude Skills

Quantitative Aptitude:

Percentages, Profit and loss, Mixtures and Allegations, Simple Interest, Compound Interest

7 Hours

PART-C

Domain Specific Knowledge

Programmable logic controllers -2

a) Implementation of binary to BCD converter
b) Implementation of combinational circuits
c) Implementation of sequential circuits
d) Basic PLC design for dc motor control
e) Basic PLC design for induction motor control

15 Hours

Total: 30 Hours