Swaminarayan University

Teaching & Examination Scheme
Course – Faculty of Engineering (Degree)
Branch – Electrical Engineering

Semester – 6th

Subject Code	Subject Name	Category	L	T	P	Total Credit	E	M	I	V	Total Marks
BE100601	Contributor Personality Development Program	Personality Development (Elective)	2	0	0	2	60	40	20	30	150
BE100602	Integrated Personality Development Course		2	0	0	2	60	40	20	30	150
BE105601	Microprocessors and Microcontrollers	Professional Core	4	0	2	5	60	40	20	30	150
BE105602	Electrical Measurement and Measuring Instruments	Professional Core	4	0	2	5	60	40	20	30	150
BE105603	Energy Conservation	Professional Elective - 1	3	0	0	3	60	40	0	0	100
BE105604	Wind and Solar Energy		3	0	0	3	60	40	0	0	100
BE105605	Element of Electrical Design		3	0	0	3	60	40	0	0	100
BE105606	Electric Drives	Professional Elective - 2	3	0	2	4	60	40	20	30	150
BE105607	Inter Connected Power System		3	0	2	4	60	40	20	30	150
BE105608	HVDC Transmission Systems		3	0	2	4	60	40	20	30	150
BE105609	Electrical Materials	Open elective - 2	3	0	0	3	60	40	0	0	100
BE103609	Cyber Laws and Ethics		3	0	0	3	60	40	0	0	100

	Total		**19**	**0**	**6**	**22**					

L=Lecture, T=tutorial, P=Practical, E=Theory External, M=Theory Internal, I=Practical Internal, V=Practical External

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch:Electrical Engineering

Subject Code: BE100602

Subject Name : Integrated Personality Development Course

w.e.f.Academic Year:	2024-25
Semester:	6th
Category of the Course:	Elective

Prerequisite:	An open attitude toward personal growth, with basic self-awareness and willingness to reflect on values, behavior, and responsibilities.
Rationale:	The Integrated Personality Development Course (IPDC) aims to nurture students' overall growth by developing essential life skills, ethics, emotional intelligence, and self-awareness. It prepares students to face personal and professional challenges confidently, with a strong sense of responsibility, discipline, and positive attitude, enabling them to lead meaningful and successful lives.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
2	0	0	2	60	40	20	30	150

Detailed Syllabus –

Unit	Content		Hours	% Of Weight
1	**Remaking Yourself-**Begin with the End in Mind	Students will learn to visualize their future goals and will structuretheir lives through smart goals to give themselves direction and ultimately take them to where they want to go.	2	5
2	**Remaking Yourself-** Being Addiction-Free	Students will explore the detrimental effects of addictions on one's health, personal life, and family life. They will learn how to take control of their life by becoming addiction free.	2	10
3	**Selfless Service-** Case Study: DisasterRelief	Students will apply previous lessons of seva, to analyse the case study of the Bhuj earthquake relief work.	2	5

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4	**Soft Skills-** Teamwork & Harmony	Students will learn the six steps of teamwork and harmony that are essential for students' professional and daily life.	**2**	**10**
5	**My India My Pride-** Present Scenario	To implement the transformation of India from a developing country into a developed country it is necessary to have a value- based citizen. Students will see how the transformation to a greaterIndia relies on the vision and efforts of themselves as a youth.	**2**	**10**
6	**Learning from Legends-** Leading WithoutLeading	Students will explore a new approach to leadership, throughhumility.	**2**	**10**
7	**My India My Pride-** An Ideal Citizen - 1	Students will learn that to become value-based citizens, they must first develop good values in their lives. They start by exploring thevalues of responsibility and integrity.	**2**	**5**
8	**My India My Pride-** An Ideal Citizen - 2	Students will learn that by developing the values of loyalty, sincerity, and punctuality; they become indispensable and can leavea strong impression. They will start developing these values by trying to keep perfection in every small task and by looking at the bigger picture.	**2**	**5**
9	**Facing Failures** Timeless Wisdom forDaily Life	Students will learn the role wisdom plays in finding long-term stability. They will use ancient wisdom to solve their modern-daychallenges.	**2**	**5**
10	**From House to Home-** Forgive & Forget	Students will understand the importance and benefits that forgiveness plays in their personal and professional life. They willlearn to apply this knowledge in realistic situations.	**2**	**5**
11	**Remaking Yourself-** Stress Management	Students will learn to cope with current and future causes of stress.	**2**	**5**
12	**Remaking Yourself-** Better Health Better Future	A healthy body prevents disease and stress; increases positivity, productivity, and brainpower. Students will learn to maintain good health through regular exercise, healthy eating habits, and regular and sufficient sleep.	**2**	**5**

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13	**Learning from Legends -** Words of Wisdom	A panel of learned and experienced mentors will personally answerpractical questions that students face in their daily life.	**2**	**5**
14	**Soft Skills –** Financial Planning	Students will develop a variety of practical financial skills that prepare them to become financially stable throughout their futurecareers.	**2**	**5**
15	**Remaking Yourself** Impact of Company	Students will understand that the type of company that we keep, hasa crucial role in determining who we are and who we will become. They will develop the ability to create a positive environment around them.	**2**	**5**
Concluding	**Life After IPDC**	This concluding lecture encourages students to keep practicing these priceless lessons and prepares them for the next steps in their lives.	**2**	**5**
	Teaching Hours		**32**	**100**

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	**Apply value-based education to achieve success in academic, professional, and social life.**	**Applying**
CO2	**Develop effective habits that support personal growth, wellbeing, and productivity.**	**Applying**
CO3	**Demonstrate empathy, unity, forgiveness, and effective communication to strengthen family and social connections.**	**Understanding**
CO4	**Practice soft skills such as time management, teamwork, leadership, and communication to complement professional skills.**	**Applying**
CO5	**Recognize India's cultural heritage and global values to become responsible and considerate citizens.**	**Understanding**
CO6	**Reflect on lives of value-based role models to develop higher character and principled living.**	**Analyze**

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4	CO5	CO6
PO1 Engineering Knowledge	-	-	-	-	-	-
PO2 Problem Analysis	-	-	-	-	-	-
PO3 Design/Development of Solutions	-	-	-	-	-	

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PO4 Conduct Investigations of Complex Problems	-	-	-	-	-	-
PO5 Modern Tool Usage	2	2	-	3	-	-
PO6 The Engineer and Society	2	2	3	-	3	3
PO7 Environment and Sustainability	-	-	2	3	-	-
PO8 Ethics	2	2	3	-	3	3
PO9 Individual and Team Work	-	-	2	3	-	-
PO10 Communication	2	2	2	3	1	-
PO11 Project Management and Finance	-	-	-	2	-	-
PO12 Life-long Learning	3	3	3	2	2	2

CO\PSO MATRIX

CO \PSO	PSO1(Values and Ethics in Life)	PSO2(Personality and Professional Development)
CO1	3	3
CO2	2	3
CO3	3	3
CO4	2	3
CO5	3	2
CO6	3	2

Reference Books –

Module No.	Module	References
1	Facing Failure	1. Thomas Edison's factory burns down, New York Times Archives, Page 1, 10/12/1914 2. Lincoln Financial Foundation, Abraham Lincoln's "Failures": Critiques, Forgotten Books,2017 3. J.K. Rowling Harvard Commencement Speech | Harvard University Commencement,2008 4. Born Again on the Mountain: A Story of Losing Everything and Finding It Back, ArunimaSinha, Penguin, 2014 5. Failing Forward: Turning Mistakes Into Stepping Stones for Success, John C. Maxwell,Thomas Nelson, 2007 6. Steve Jobs: The Exclusive Biography Paperback, Walter Isaacson, Abacus, 2015

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		7. Failing Forward: Turning Mistakes Into Stepping Stones for Success, John C. Maxwell,Thomas Nelson, 2007
2	Learningfrom Legend	1. Chase Your Dreams: My Autobiography, Sachin Tendulkar, Hachette India, 2017 2. Playing It My Way: My Autobiography, Sachin Tendulkar, Hodder & Stoughton, 2014 3. The Wit and Wisdom of Ratan Tata, Ratan Tata, Hay House, 2018 4. The Tata Group: From Torchbearers to Trailblazers, Shashank Shah, Penguin Portfolio,2018 5. The Leader Who Had No Title, Robin Sharma, Jaico Publishing House, 2010 6. In the Joy of Others: A Life-Sketch of Pramukh Swami Maharaj, Mohanlal Patel and BAPSSadhus, Swaminarayan Aksharpith, 2013
3	My IndiaMy Pride	1. Rishis, Mystics, and Heroes of India, Sadhu Mukundcharandas, Swaminarayan Aksharpith,2011 2. Physics in Ancient India, Narayan Dongre, Shankar Nene, National Book Trust, 2016 3. The Rise of Civilization in India and Pakistan, Raymond Allchin, Bridget Allchin, Cambridge University Press, 1982 4. The Āryabhaṭīya of Āryabhaṭa: An Ancient Indian Work on Mathematics and Astronomy(1930), Walter Eugene Clark, University of Chicago Press, reprint, Kessinger Publishing, 2006
4	Remaking Yourself	1. Power of Habit, Charles Duhigg, Random House Trade Paperbacks, 2014 2. Change Your Habit, Change Your Life, Tom Corley, North Loop Books, 2016 3. The Seven Habits of Highly Effective People, Stephen Covey, Simon & Schuster, 2013 4. Seven Habits of Highly Effective Teens, Sean Covey, Simon & Schuster, 2012 5. Atomic Habits, James Clear, Random House, 2018 6. How a handful of tech companies control billions of minds every day, Tristan Harris, TEDTalk, 2017
5	From Houseto Home	1. “What Makes a Good Life? Lessons from the Longest Study on Happiness”, R. Waldinger,Ted Talks, 2015 2. Long Walk To Freedom, Nelson Mandela, Back Bay Books, 1995 3. Outliers, Malcolm Gladwell, Back Bay Books, 2011

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6	Soft Skills	1. The 17 Indisputable Laws of Teamwork, John Maxwell, HarperCollins, 2013 2. Team of Teams: New Rules of Engagement for a Complex World, Stanley McChrystal,Portfolio, 2015 3. Predictably Irrational, Revised and Expanded Edition: The Hidden Forces That Shape OurDecisions, Dan Ariely, Harper Perennial, 2010
7	Selfless Service	1. Open: An Autobiography, Andre Agassi, Vintage, 10 August 2010 2. The Physiological Power of Altruism [online], James Hamblin, The Atlantic, December 30, 2015, https://www.theatlantic.com/health/archive/2015/12/altruism-for-a-better-body/422280/ [last accessed June 10, 2020]

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: Degree
Branch:Electrical Engineering
Subject Code: BE103609
Subject Name : Cyber Laws and Ethics

w.e.f.Academic Year:	2024-25
Semester:	6th
Category of the Course:	**Open Elective-2**

Prerequisite:	Basic understanding of computer fundamentals, internet usage, and foundational knowledge of legal and ethical practices in digital environments.
Rationale:	This course explores technical, legal, and social issues related to cybercrimes, Laws Cyber Ethics. Cybercrime and laws is a broad term that includes offences where a computer may be the target, crimes where a computer may be a tool used in the commission of an existing offence, and crimes where a computer may play a subsidiary role such as offering evidence for the commission of an offence. It is also required to have knowledge of Cyber Ethics and its role and significance.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
3	0	0	3	60	40	0	0	100

Detailed Syllabus –

Unit	Content	Hours	% Of Weight
1	**Introduction to Cyber law:** Evolution of computer Technology, emergence of cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.	08	20
2	**Information Technology Act:** Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences, Network Service	10	20

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Program Name: Engineering
Level: Degree
Branch:Electrical Engineering
Subject Code: BE103609
Subject Name : Cyber Laws and Ethics

	Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.		
3	**Cyber law and Related Legislation:** Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet, Alternative Dispute Resolution , Online Dispute Resolution (ODR).	**08**	**20**
4	**Electronic Business and legal issues:** Evolution and development in E-commerce, paper vs paper less contracts E-Commerce models- B2B, B2C, E security. Business, taxation, electronic payments, supply chain, EDI, E-markets, Emerging Trends.	**09**	**20**
5	**Cyber Ethics:** The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.	**10**	**20**
	Teaching Hours	**45**	**100**

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Understand the need and application of cyber laws.	Understanding
CO2	Describe the Information Technology Act and related legislation.	Understanding
CO3	Demonstrate the legal and ethical issues in electronic business activities.	Applying
CO4	Interpret principles of cyber ethics and responsible use of technology.	Analyze

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Engineering Knowledge	-	-	-	-
PO2 Problem Analysis	-	-	-	-
PO3 Design/Development of Solutions	-	-	-	-
PO4 Conduct Investigations of Complex Problems	-	-	-	-
PO5 Modern Tool Usage	2	2	3	2
PO6 The Engineer and Society	3	3	2	3

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: Degree
Branch:Electrical Engineering
Subject Code: BE103609
Subject Name : Cyber Laws and Ethics

PO7 Environment and Sustainability	-	-	-	2
PO8 Ethics	3	3	2	3
PO9 Individual and Team Work	-	-	2	-
PO10 Communication	2	2	3	2
PO11 Project Management and Finance	-	-	2	-
PO12 Life-long Learning	2	2	2	2

CO\PSO MATRIX

CO \PSO	PSO1(Cybersecurity Awareness)	PSO2(Ethics and Legal Compliance)
CO1	2	3
CO2	2	3
CO3	3	3
CO4	3	3

Reference Books –

- Cyber Laws: Intellectual property & E Commerce, Security- Kumar K, dominant Publisher
- Cyber Ethics 4.0, Christoph Stuckelberger, Pavan Duggal, by Globethic
- Information Security policy & Implementation Issues, NIIT, PHI
- Computers, Internet and New Technology Laws, Karnika Seth, Lexis Nexis Butterworths Wadhwa Nagpur.
- Legal Dimensions of Cyber Space, Verma S, K, Mittal Raman, Indian Law Institute, New Delhi,
- Cyber Law, Jonthan Rosenoer, Springer, New York, (1997).
- The Information Technology Act, 2005: A Handbook, OUP Sudhir Naib,, New York, (2011)
- Information Technology Act, 2000, S. R. Bhansali,, University Book House Pvt. Ltd., Jaipur (2003).
- Cyber Crimes and Law Enforcement, Vasu Deva, Commonwealth Publishers, New Delhi, (2003).

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: Degree
Branch:Electrical Engineering
Subject Code: BE105601
Subject Name : Microprocessor and Microcontroller

w.e.f.Academic Year:	2024-25
Semester:	6th
Category of the Course:	PCC

Prerequisite:	Basic understanding of digital electronics, number systems, logic gates, and sequential circuits such as flip-flops, counters, and registers.
Rationale:	Microprocessor and microcontrollers are the most useful electronic chips which are used to design and develop processor and computer based automatic smart electronics systems for home and industry application. This subject is devoted to the study of microprocessor and microcontroller interfacing of memory and I/O devices like A to D converter, D to A converter LED, LCD etc. The students learn Programming language (Both assembly and Embedded C) used for microcontrollers. They learn the basics of Microprocessor and designs of Microcontroller based systems and also get a brief idea of advanced microcontrollers used in industries. They will be able to use the same in electrical engineering related fields like Power system protection, instrumentation, power electronics, Electrical Drives and control of Electrical Equipments.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
4	0	2	5	60	40	20	30	150

Detailed Syllabus –

Unit	Content	Hours	% Of Weight
1	**Microprocessor Based Systems:** Digital Computer, Microprocessor, Microcomputer, Microcontroller, Van Neumann and Harvard Architecture, CISC and RISC Processors.	02	3.57
2	**8085 Microprocessor:** Architectural Block Diagram, Schematic and Pin diagrams, Pin functions, Bus Organization, Internal operations and registers, Externally initiated operations, Serial interrupt and I/O Control, Timing and Control Unit, Microprocessor communication, Multiplexing of address/data bus, Generation of control signals, 8085 machine cycles,	06	10.71

	Fetch and execution of only MOV, MVI, and OUT instructions with timing diagram. (Other 8085 instructions and Programming of assembly language using 8085 should not be covered & asked in the exam).		
3	**8051 Microcontroller architecture:** Introduction to MCS -51 Family Micro-controllers, Architectural block Diagram, Pin diagram and Pin Functions, General Purpose and Special Function Registers, Oscillator and clock circuit, Reset circuit, I/O Port circuits, Memory organization, Internal program and data memory.	**08**	**14.29**
4	**8051 Assembly language programming:** Programming model of 8051, Addressing modes, programming of 8051 based on data transfer, arithmetic and logical group, branching instructions, bit manipulation instructions and I/O Port programming. Concept of stack, subroutine and related instructions, writing programs for generating time delay, code conversions in assembly language of 8051 and testing the same using IDE.	**08**	**14.29**
5	**8051 Programming in C:** Data types in 8051 C, programming for time delay, I/O programming in 8051 C, Logic operations in 8051 C, Control statements and loops in embedded C, Functions and Arrays in embedded C, Data conversion programs in 8051 C, Accessing code ROM space using 8051 C, Data serialization using 8051 C.	**05**	**8.93**
6	**8051 Timer/Counter and Programming:** Use of counter as timer, Timer/Counters and associated registers, Various modes of timer/counter operations, Time delay programs in Assembly language/ Embedded C.	**04**	**7.14**
7	**8051 Serial Port and Programming:** Basics of serial communication, RS232 standards, 8051 connection to RS232, Serial data input/output and associated registers, Various modes of serial data communication, serial data communication programs in Assembly language/ Embedded C	**04**	**7.14**
8	**8051 Interrupts:** Concept of Interrupt, interrupt versus polling, Types of interrupts in 8051, Reset, interrupt control and associated registers, interrupt vectors, Interrupt execution, RETI instruction, software generated interrupt, interrupt handler subroutine for timer/counter and serial data transmission/reception in Assembly language/ Embedded C	**04**	**7.14**
9	**External Memory Interfacing:** Memory address decoding, interfacing 8031/8051 with ROM/EPROM and Data ROM.	**02**	**3.57**
10	**Applications and design of microcontroller based systems:** Interfacing of LEDs, 7 Segment display device, LCD display, DIP Switches, Push Button switches, Key denounce techniques, Keyboard connections load per key and matrix form, Interfacing A/D converter, D/A converter, Relay, opto isolator stepper motor and DC motor.	**09**	**16.07**

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: Degree
Branch:Electrical Engineering
Subject Code: BE105601
Subject Name : Microprocessor and Microcontroller

11	**ARM Processor Fundamentals:** Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts and Vector Table, Core Extensions, Architecture Revisions, Arm Processor Families	**04**	**7.14**
	Teaching Hours	**56**	**100**

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Describe the architecture of 8085 microprocessor and MCS-51 family microcontroller.	Understand
CO2	Develop assembly language or embedded C code to solve specific problems using microprocessor/microcontroller	Applying
CO3	Configure timer, counter, serial communication, and interrupt operations using assembly or embedded C.	Analyze
CO4	Interface peripheral devices and memory with microcontrollers for specific applications.	Applying

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Engineering Knowledge	3	3	3	3
PO2 Problem Analysis	2	3	3	3
PO3 Design/Development of Solutions	-	3	3	3
PO4 Conduct Investigations of Complex Problems	-	2	3	2
PO5 Modern Tool Usage	2	3	3	3
PO6 The Engineer and Society	-	-	-	-
PO7 Environment and Sustainability	-	-	-	-
PO8 Ethics	-	-	-	-
PO9 Individual and Team Work	-	-	-	-
PO10 Communication	1	2	2	2
PO11 Project Management and Finance	-	-	-	-
PO12 Life-long Learning	1	2	2	2

CO\PSO MATRIX

CO \PSO	PSO1(Microcontroller/Microprocessor Programming)	PSO2(System Design and Interfacing)
CO1	3	2
CO2	3	3
CO3	3	3

CO4	**3**	**3**

Reference Books –

- Microprocessor Architecture, Programming, and Applications with the 8085, By Romesh Gaonkar, Penram International Publishing (India) LTD.
- The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2/e by Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay (Second Edition, Pearson Education)
- The 8051 Microcontroller & Embedded Systems using Assembly and C By K. J. Ayala, D. V. Gadre (Cengage Learning , India Edition).
- ARM System Developer's Guide, Designing & Optimizing System Software, by Andrew Sloss, Dominic Symes, Chris Wright, Elsevier Publications.

List of Practical –

- Introduction to IDE, assembler, compiler, linker, simulator, debugger and assembler directives.
- 8051 Assembly language programming based on data transfer, arithmetic and logical group instructions.
- 8051 Assembly language programming using bit manipulation instructions.
- 8051 Assembly language programming using branching group instructions
- 8051 Timer/counter programming using assembly language and C
- 8051 Serial programming using assembly and embedded C.
- I/O port programming in embedded C.
- Programming of LCD in assembly & embedded C.
- Programming of matrix keyboard in assembly & embedded C.
- Programming of parallel ADC and DAC in embedded C.
- Interfacing Stepper Motor.
- Speed Control of DC motor using PWM Technique and Microcontroller
- Designing of SCR firing Circuit for D. C. Converter using Microcontroller
- Interfacing Relay and opto isolators using Microcontroller

Major equipment-

- Kit for Microcontroller 8051, µVISION2/3/4 IDE, STM32F401 Nucelo Development Board

List of Software/learning website-

- NPTEL, www.infineon.com, www.silabs.com

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE100601
Subject Name : Contributor Personality Development Program

w. e. f. Academic Year:	2024-25
Semester:	6TH
Category of the Course:	Elective

Prerequisite:	Basic communication skills and an openness to self-reflection, with a willingness to develop personal and professional effectiveness.
Rationale:	This course demands a better understanding of the construction, material used and principle of operation of various types of measuring instruments. This course is therefore designed to meet these needs and hence it is a core course for any electrical engineer.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
2	0	0	2	60	40	20	30	150

Detailed Syllabus –

Unit	Content	Hours	% OF Weight
1	**Finding Solutions:** The market environment in which organizations are operating, is becoming increasingly dynamic and uncertain. So, employers are increasingly seeking out people who can innovate and figure out solutions in the face of any challenge (unlike in the past when it was the people who were most efficient and productive, who were valued by organizations). At the heart of innovation lies this way of thinking of "finding solutions" rather than "seeing problems or roadblocks". Students learn how to build this way of thinking, in this topic.	**1.5**	16.67%
2	**Creating Value:** Companies are also looking for employees who do not just work hard, or work efficiently or productively - but those who will make a valuable difference to the fortunes of the company. This difference may come from innovation, but it may also come from focusing on the right	**1.5**	16.67%

	things and identifying what really matters – both to the company and to the customers. In this topic, students learn how to build this capability.		
3	**Engaging deeply:** The environment we live in is becoming increasingly complex because more and more things are getting interconnected, new fields are emerging, technologies are rapidly changing, capabilities and knowledge one is trained in will become fast obsolete. In such a scenario, the student's ability to quickly understand and master what is going on, dive deep, get involved in any area, rapidly learn new capabilities that a job demands, is important. Engaging deeply is a core way of thinking that can help them in this. In this topic, students learn how to engage deeply.	**1.5**	16.67%
4	**Enlightened self-interest & collaboration at work:** The changing nature of work in organizations and in the global environment is increasingly demanding that people work more collaboratively towards shared goals and more sustainable goals. A key to working successfully when multiple stakeholders are involved is "thinking in enlightened self-interest". In this topic, students learn how to develop this way of thinking (going beyond "narrow self-interest").	**1.5**	16.67%
5	**Human-centered thinking & Empathy:** In this topic, students explore a human-centric approach to work – where the ability to recognize and respond to other people (whether they are users or customers or team members) as a human being with human needs and difficulties, is essential. This is at the heart of user-centric design of products and solutions, at the heart of genuine customer- centricity in services, and of any successful interaction with other people.	**1.5**	16.67%
6	**Trust Conduct:** The biggest currency in a sustainable career is "trust" i.e. being trusted by team members, bosses, and customers. When we are trusted, people listen to us, they are willing to give us the chance to grow, give us the space to make mistakes, and work seamlessly with each other without always having to "prove ourselves". In this topic, students learn how to demonstrate conduct that builds the trust of people.	**1.5**	16.67%
	Teaching Hours	**9**	100

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE100601
Subject Name : Contributor Personality Development Program

Course Outcomes:

CO No	Course Outcome Description	RBT Level
CO1	Students will be able to recognize & appreciate the thinking required to find solutions in the face of any challenge	Understand
CO2	Students will be able to recognize & appreciate the thinking required to find solutions in the face of any challenge.	Understand
CO3	Students will be able to recognize & appreciate different types of value that can be created and the different ways to create value for others.	Apply
CO4	Students will be able to recognize & appreciate how to engage deeply, and its need, value, payoffs and consequences in different contexts.	Analyze
CO5	Students will be able to differentiate between 'enlightened self-interest' and 'narrow self-interest' & appreciate the payoffs/ consequences of both when working with multiple stakeholders.	Apply
CO6	Students will be able to recognize & appreciate the human side of situations or interactions or projects that will help them develop a more human-centric approach/ response to work.	Analyze

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4	CO5	CO6
PO1 Basic knowledge	-	-	-	-	-	-
PO2 Discipline knowledge	-	-	-	-	-	-
PO3 Experiments and practice	-	-	-	-	-	-
PO4 Engineering tools	-	-	-	-	-	-
PO5 The engineer and society	-	-	-	-	-	-
PO6 Environment and sustainability	**2**	**2**	**2**	**3**	**2**	**3**
PO7 Ethics	**1**	**2**	**2**	**2**	**2**	**2**
PO8 Individual and team work	**2**	**2**	**2**	**3**	**3**	**3**
PO9 Communication	-	-	**2**	**2**	**3**	**3**
PO10 Life-long learning	**2**	**2**	**3**	**2**	**2**	**2**

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE100601
Subject Name : Contributor Personality Development Program

CO\PSO MATRIX

CO \PSO	PSO1(Demonstrate ethical and empathetic decision-making in personal and professional contexts.	PSO2(Apply human values, communication, and trust-building practices to work collaboratively and socially.)
CO1	3	-
CO2	3	2
CO3	3	3
CO4	3	3
CO5	3	3
CO6	3	3

Reference Books –

- Contributor Personality Program textbook cum workbook developed by Illumine
- Web-based Active Guide TM for self-exploration of rich media resources to vividly understand many of the ideas, watch role models, learn from industry people, get reference readings – that help them enrich the understanding they gained in the class published by Illumine Foundation

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105602
Subject Name : Electrical Measurement and Measuring Instruments

w. e. f. Academic Year:	2024-25
Semester:	6TH
Category of the Course:	Professional Core

Prerequisite:	Basic knowledge of electrical circuit theory, Ohm's law, Kirchhoff's laws, and fundamental AC/DC electrical quantities.
Rationale:	Electrical installations ranging from residential consumers to huge industrial estates all are equipped with measuring instruments. In view of this, study of principles of Electrical measurements and measuring instruments becomes mandatory for all electrical engineers. This subject deals with principles of measurements, analog and measuring instruments as well as transducers.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
4	0	2	5	60	40	20	30	150

Detailed Syllabus –

Unit	Content	Hours	% Of Weight
1	**Concepts of Measurement:** Measurement System, Classification of instrument system, Methods of Measurement, Static Characteristics like accuracy, precision, sensitivity, linearity, range, reproducibility, drift, threshold, dead zone etc. Dynamic Characteristics like speed of response, fidelity overshoot etc., Measurement Standards Errors in measurement, Basic statistical evaluation of measurement data and errors - mean, standard deviation, Six sigma estimation.	06	11
2	**Transducers and Sensors:** Definition, different types of transducers, criteria for selection, general characteristics and dynamic characteristics,	10	25

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105602
Subject Name : Electrical Measurement and Measuring Instruments

	transducers for measurement of temperature ((Thermocouple and RTD), transducers for measurement of pressure, strain, transducers for measurement of displacement, speed, torque, Hall Effect transducer Sensors – basic concept – Speed and position sensors		
3	**Measurement of Parameters:** Measurement of resistance, , Extending the range of meters - Shunts, Potential divider, Instrument Transformer and their applications in the extension of instrument range, Measurement of voltage, current, power, energy, power factor and frequency (constructions and operating principles of corresponding instruments)	**10**	**25**
4	**Measurement of R, L and C:** Different methods of measuring low, medium and high resistances, Wheatstone Bridge, Measurement of inductance & capacitance with the help of AC Bridges (Hays Bridge, Schering Bridge, Maxwell bridge, Anderson Bridge), LCR meter - working principle with block diagram.	**10**	**25**
5	**D.S.O.:** Digital recorders, Digital Storage Oscilloscope - Block Diagram, theory and applications, Power scope.	**03**	**7**
6	**Display devices:** Characteristics of digital display, DVM and Digital multi meter, Clamp on meter, Megger.	**03**	**7**
	Teaching Hours	**42**	**100**

Course Outcomes:

CO No	Course Outcome Description	RBT Level
CO1	Comprehend the basics of electrical measurements.	Understand
CO2	Explain basic principle, working, characteristics and applications of the various measuring instruments and transducers.	Understand
CO3	Apply AC and DC bridges for measurement of electrical parameters like resistance, inductance and capacitance.	Apply
CO4	Prepare the specifications of required measurement systems to be used for measurement of parameters for a specified application.	Create

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105602
Subject Name : Electrical Measurement and Measuring Instruments

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4	CO5
PO1 Basic knowledge	3	3	3	3	3
PO2 Discipline knowledge	-	2	2	2	-
PO3 Experiments and practice	-	-	2	3	-
PO4 Engineering tools	-	-	2	2	-
PO5 The engineer and society	-	-	2	3	-
PO6 Environment and sustainability	1	2	2	3	1
PO7 Ethics	3	3	3	3	3
PO8 Individual and team work	-	2	2	2	-
PO9 Communication	-	-	2	3	-
PO10 Life-long learning	-	-	2	2	-

CO\PSO MATRIX

CO \PSO	**PSO1**(Apply the concepts of measurement techniques and transducers in practical electrical systems.)	**PSO2**(Use and calibrate electrical instruments for testing and troubleshooting..)
CO1	3	-
CO2	3	-
CO3	3	2
CO4	3	3

Reference Books –

- Gupta J. B., “A Course in Electronics and Electrical Measurements and Instrumentation”, S.K. Kataria & Sons
- A.K.Sawhney, “Electrical and Electronic Measurements and Instrumentation”, DHANPAT RAI & CO.

- Golding & Widis, 'Electrical Measurement and Measurement instrument', Wheelar Books
- D. Patranabis, 'Sensors & Transducers', PHI.
- H. S. Kalsi, " Electronic Instrumentation", Tata McGraw-Hill Education.
- A.J. Bouwens, 'Digital Instrumentation', Tata Mc-Graw hill.

List of Practical –

- To measure value of unknown capacitance by Schearing's bridge.
- To measure unknown inductance by & demonstrate operation of Maxwell's bridge.
- To demonstrate distance measurement using LVDT.
- To demonstrate the Kelvin Double Bridge for Low resistance measurement.
- To measure value of unknown capacitance by Owen's bridge.
- To measure value of unknown inductance using LCR meter.
- To measure high resistance and insulation resistance using Megger.
- To demonstrate usage of DSO for steady state periodic waveforms produced by a function generator.
- To measure value of unknown capacitance using LCR meter.
- Measurement of current using shunt.

Major equipment-

- Necessary number of meters, accessories and instruments etc… to be provided to conduct the above experiments in a group of maximum 4 students. Charts and cut section models of various instruments should be provided for better understanding.

List of Software/learning website-

- http://www.scilab.org/
- http://www.vlab.co.in/

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105603
Subject Name : Energy Conservation

w. e. f. Academic Year:	2024-25
Semester:	6TH
Category of the Course:	Professional Elective-1

Prerequisite:	Basic knowledge of electrical machines, thermal systems, and energy systems with an understanding of power distribution and industrial processes.
Rationale:	The course provides basic understanding of energy audit and management. The consumption of energy is increasing day by day. One way to cope up with the increase in energy demand is to increase the production of energy which demands more investment and the other way is to conserve the energy because energy conserved/saved is energy generated. Energy conservation means reduction in energy consumption but not compromising with the quality or quantity of energy production. Essential theoretical and practical knowledge about the concept of energy conservation, energy management, different approaches of energy conservation in industries, economic aspects of energy conservation project and energy audit and measuring instruments in commercial and industrial sector will be achieved by this course.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
3	0	0	3	60	40	0	0	100

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105603
Subject Name : Energy Conservation

Detailed Syllabus –

Unit	Content	Hours	% Of Weight
1	**Energy Audit Methodology and recent trends**: General Philosophy, need of Energy Audit and Management. Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy, Economics of implementation of energy optimization projects, it's constraints, barriers and limitations, Report-writing, preparations and presentations of energy audit reports, Post monitoring of energy conservation projects, MIS, Case-studies / Report studies of Energy Audits, Guidelines for writing energy audit report, data presentation in report, findings recommendations, impact of renewable energy on energy audit recommendations, Case studies of implemented energy cost optimization projects in electrical utilities as well as thermal utilities. Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy.	10	25
2	**Electrical Distribution and Utilization:** Electrical Systems, Transformers loss reductions, parallel operations, T & D losses, P.F. improvements, Demand Side management (DSM), Load Management, Harmonics & its improvements, Energy efficient motors and Soft starters, Automatic power factor Controllers, Variable speed drivers, Electronic Lighting ballasts for Lighting, LED Lighting, Trends and Approaches. Case Studies related to Power factor improvement, Electric motors, Drives, Industrial/Commercial Lighting system, etc. with respect to energy conservation.	11	25
3	**Thermal Systems:** Boilers- performance evaluation, Loss analysis, Water treatment and its impact on boiler losses, integration of different systems in boiler operation. Advances in boiler technologies, FBC and PFBC boilers, Heat recovery Boilers- it's limitations and constraints. Furnaces- Types and classifications, applications, economics and quality aspects, heat distributions, draft controls, waste heat recovering options, Furnaces refractory- types and sections. Thermic Fluid heaters, need and applications, Heat recovery and its limitations. Insulators- Hot and Cold applications, Economic thickness of insulation, Heat saving and application criteria. Steam Utilization Properties, steam distribution and losses, steam trapping, Condensate, Flash steam recovery.	11	30

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105603
Subject Name : Energy Conservation

4	**System Audit of Mechanical Utilities:** Pumps: types and application, unit's assessment, improvement option, parallel and series operating pump performance. Energy Saving in Pumps & Pumping Systems. Blowers: types & application, its performance assessment, series & parallel operation applications & advantages. Energy Saving in Blowers Compressors: types & applications, specific power consumption, compressed air system & economics of system changes. Energy Saving in Compressors & Compressed Air Systems Cooling towers: types and performance assessment & limitations, water loss in cooling tower. Energy Saving in Cooling Towers. Case Studies of Energy Audit & Management in Industries.	**10**	**20**
	Teaching Hours	**42**	**100**

Course Outcomes:

CO No	Course Outcome Description	RBT Level
CO1	Demonstrate the basic knowledge of energy audit and management.	Understand
CO2	Identify the energy conservation opportunities	Apply
CO3	Assess the energy saving & conservation in different electric system	Analyze
CO4	Analyze the heat utilization, saving and recovery in different thermal system	Analyze
CO5	Prepare energy audit report.	Create

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4	CO5
PO1 Basic knowledge	3	3	3	3	3
PO2 Discipline knowledge	-	2	3	3	2
PO3 Experiments and practice	-	-	2	2	2
PO4 Engineering tools	-	-	2	2	2
PO5 The engineer and society	-	-	-	-	2
PO6 Environment and sustainability	2	2	-	-	-
PO7 Ethics	2	3	3	3	2
PO8 Individual and team work	1	2	2	2	3
PO9 Communication	3	3	3	3	3
PO10 Life-long learning	-	2	3	3	2

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105603
Subject Name : Energy Conservation

CO\PSO MATRIX

CO \PSO	PSO1(Apply knowledge of energy systems and conservation techniques to identify and solve energy-related problems.	PSO2(Use modern tools and techniques to conduct energy audits and suggest improvements.
CO1	3	2
CO2	3	2
CO3	3	3
CO4	3	3
CO5	3	3

Reference Books –

- Energy Audit and Management, Volume-I, IECC Press
- Energy Efficiency in Electrical Systems, Volume-II, IECC Press
- Energy Management: W.R.Murphy, G.Mckay, Butterworths Scientific
- Energy Management Principles, C.B.Smith, Pergamon Press
- Industrial Energy Conservation, D.A. Reay, Pergammon Press
- Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience
- Industrial Energy Management and Utilization, L.C. Witte, P.S. Schmidt, D.R. Brown, Hemisphere Publication, Washington, 1988
- Hand Book of Energy Audits, Albert Thumann, P.E., C.E.M. William J. Younger, C.E.M., CRC Press

List of Software/learning website-

- https://beeindia.gov.in/
- http://nptel.ac.in/
- https://lbre.stanford.edu/sem/energy_conservation

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105604
Subject Name : Wind and Solar Energy

w. e. f. Academic Year:	2024-25
Semester:	6TH
Category of the Course:	Professional Elective-1

Prerequisite:	Basic understanding of electrical circuits, power electronics, and fundamentals of energy conversion.
Rationale:	This subject is offered to emphasize the role of renewable energy technologies (especially wind and solar energy) and their potentials. The course aims to introduce the basic concepts of wind and solar energy and the preliminary analysis to estimate the energy generation from the wind and solar systems. Various components involved in the wind and solar system are covered and the control approaches to improve the performance of the systems are also included. In addition to the various applications of solar and wind energy generation systems, the course also covers the issues related to the integration of these systems in the existing network. Thus, the course is intended to provide the foundation for the solar PV and thermal as well as wind energy generation systems.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
3	0	0	3	60	40	0	0	100

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105604
Subject Name : Wind and Solar Energy

Detailed Syllabus –

Unit	Content	Hours	% Of Weight
1	**Module 1: Physics of Wind Power**: History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.	4	10
2	**Module 2: Wind generator topologies**: Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converter, Generator Converter configurations, Converter Control.	11	25
3	**Module 3: The Solar Resource**: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.	3	10
4	**Module 4: Solar photovoltaic:** Solar Cell fundamentals, Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array; Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms, Converter Control, Solar PV applications, Grid-Connected System and Standalone system, Solar Water Pumps, Solar street lights, Battery sizing.	11	25
5	**Module 5: Network Integration Issues:** Overview of grid code technical requirements, Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances, Power quality issues, Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems	8	20
6	**Module 6: Solar thermal Systems:** Solar Collectors, Solar water heater, Solar Passive Heating and Cooling Systems, Solar Cookers, Solar Refrigeration and Air Conditioning, Solar thermal power generation technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.	5	10
	Teaching Hours	42	100

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105604
Subject Name : Wind and Solar Energy

Course Outcomes:

CO No	Course Outcome Description	RBT Level
CO1	Demonstrate the importance of renewable energy source and various applications of solar and wind systems	Understand
CO2	Do the preliminary analysis related to wind energy systems	Apply
CO3	Do the preliminary analysis and design of solar PV and solar thermal systems	Analyze
CO4	Identify the power electronic converters for solar PV and wind energy systems	Apply
CO5	Describe the issues related to the renewable energy in the electrical utility network	Understand

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4	CO5
PO1 Basic knowledge	**3**	**3**	**3**	**3**	**3**
PO2 Discipline knowledge	**-**	**2**	**2**	**-**	**2**
PO3 Experiments and practice	**-**	**-**	**2**	**2**	**-**
PO4 Engineering tools	**-**	**1**	**2**	**-**	**-**
PO5 The engineer and society	**-**	**-**	**-**	**3**	**-**
PO6 Environment and sustainability	**2**	**-**	**-**	**-**	**3**
PO7 Ethics	**3**	**-**	**-**	**-**	**3**
PO8 Individual and team work	**-**	**-**	**-**	**-**	**-**
PO9 Communication	**-**	**-**	**-**	**-**	**-**
PO10 Life-long learning	**-**	**-**	**-**	**-**	**-**

CO\PSO MATRIX

CO \PSO	**PSO1**(Apply knowledge of renewable energy systems to design and analyze solar and wind energy systems.)	**PSO2**(Use modern tools and power electronics to integrate renewable energy into electrical networks..)
CO1	**3**	**2**
CO2	**3**	**2**
CO3	**3**	**3**
CO4	**2**	**3**
CO5	**2**	**2**

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105604
Subject Name : Wind and Solar Energy

Reference Books –

- T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
- G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
- S. P. Sukhatme and J.K. Nayak, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 3rd ed., 2008.
- H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
- G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
- J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.
- B.H. Khan, "Non-Conventional Energy Resources", McGraw Hill 2nd Edition 2017.
- G.D. Rai, "Non-Conventional Sources of Energy", Khanna Publishers, 4th Edition, 2009

List of Software/learning website-

- https://nptel.ac.in
- http://web.mit.edu/renewable-iap09
- https://www.digimat.in/index.html

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105605
Subject Name : Element of Electrical Design

w. e. f. Academic Year:	2024-25
Semester:	6TH
Category of the Course:	Professional Elective-1

Prerequisite:	Basic knowledge of electrical circuits, electrical machines, and fundamentals of wiring systems and electrical safety.
Rationale:	This course is a preliminary course for design of various electrical equipments. The aim is to provide the basic principles useful for the subjects related to design in subsequent semesters. The course also includes basics of estimation and costing of house wirings and commercial wirings.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
3	0	0	3	60	40	0	0	100

Detailed Syllabus –

Unit	Content	Hours	% Of Weight
1	**GENERAL DESIGN ASPECTS:** Basic principles of magnetic circuits – use of B-H curves in magnetic circuit; Calculations of MMF for air gap and teeth; Real and apparent flux density; Field Form; Air gap flux distribution factor (field form factor); Magnetizing current calculation; Leakage Reactance calculation for various types of slots, Iron loss calculation concepts; Application of FEM in calculation of force, torque, potential distribution and magnetic flux density; Insulating Materials & Classifications.	10	30
2	**DESIGN OF STARTERS AND FIELD REGULATORS:** Introduction and review of A.C. and D.C. starters; Schematic diagrams of control circuit and power circuit for starters with contactors and timers. Design of starters and Field regulators.	08	20

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105605
Subject Name : Element of Electrical Design

	DESIGN OF SMALL TRANSFORMERS AND CHOKE COILS: Design of Small single-phase transformers; Design of variable air gap single phase and three phase choke coil.		
3	**Armature Windings:** **DC windings:** Simplex & Duplex windings; Lap & Wave windings; Applications; Basic terms related to armature windings; Dummy Coils; Equalizer connections; Split coils. **AC windings:** Introduction; No. of phases; Phase spread; Concentric winding, Hemitropic winding; Whole coil winding; Mush winding; Double layer windings; Integral slot lap and wave winding; Fractional slot lap and wave windings; Performance analysis of various windings.	**08**	**20**
4	**Estimation and Costing for Residential and Commercial wiring:** Preparation of schematic diagrams and estimation of cost of wiring for Tenements, Row houses, Bungalows, Flats, Multi – Storied Buildings, Commercial Complexes like Offices, Hospitals, Hotels,Theatres.	**08**	**15**
5	**Design consideration of Electrical Installation:** Types of load, Electrical Supply Systems, wiring systems, Load Assessment, Permissible voltage drops & Conductor size calculations, Design of Control panel. Estimation and costing for service connections.	**08**	**15**
	Teaching Hours	**42**	**100**

Course Outcomes:

CO No	Course Outcome Description	RBT Level
CO1	Explain the basic principles of electrical machine design with relevant applications	Understand
CO2	Design the electrical equipments like small transformers, choke coils, starters and field regulators	Evaluate
CO3	Develop the winding diagrams for AC and DC machines as per specifications	Apply
CO4	Compute the cost of wiring for residential and commercial premises	Analyze
CO5	Design the supply systems for residential and industrial applications	Create

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4	CO5

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105605
Subject Name : Element of Electrical Design

PO1 Basic knowledge	**3**	**3**	**3**	**2**	**3**
PO2 Discipline knowledge	**-**	**2**	**2**	**2**	**2**
PO3 Experiments and practice	**-**	**3**	**3**	**2**	**3**
PO4 Engineering tools	**-**	**-**	**-**	**-**	**-**
PO5 The engineer and society	**-**	**2**	**2**	**2**	**3**
PO6 Environment and sustainability	**-**	**-**	**-**	**-**	**-**
PO7 Ethics	**-**	**-**	**-**	**-**	**-**
PO8 Individual and team work	**-**	**-**	**-**	**-**	**-**
PO9 Communication	**-**	**-**	**-**	**-**	**-**
PO10 Life-long learning	**-**	**-**	**-**	**-**	**-**

CO\PSO MATRIX

CO \PSO	**PSO1**(Apply electrical engineering knowledge to design and maintain machines and electrical installations..)	**PSO2**(Use modern tools and cost analysis techniques in electrical design and estimation work.
CO1	**3**	**2**
CO2	**3**	**2**
CO3	**3**	**2**
CO4	**2**	**3**
CO5	**3**	**3**

Reference Books –

- A course in electrical machine Design – A. K. Sawhney
- Electrical Machine Design – R. K. Agrawal
- Design of Electrical Machine - V. N. Mittle
- Elements of Electrical Design – J G Jamnani.
- Electrical Design, Estimating and Costing – K. B. Raina
- Residential, Commercial and Industrial Systems – H. Joshi
- Principles of Electromagnetics, 6th edition – Matthew N. O. Sadiku & S. V. Kulkarni
- Finite Element Analysis of Electrical Machines – Sheppard J Salon (chapter-6)

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105606
Subject Name : Electric Drives

w. e. f. Academic Year:	2024-25
Semester:	6TH
Category of the Course:	Professional Elective -2

Prerequisite:	Basic understanding of electrical machines (especially DC and induction motors), power electronics (converters and inverters), and control systems.
Rationale:	Today's industrial and domestic loads demands precise and smooth variable speed control. In the era of renewable energy and electric vehicle the efficient electric drive required for DC and AC motors. The major industrial electric load is induction motor. The development of compact power converters has made this possible. This course enables to develop the basics of electric drives and advantage over conventional speed control methods.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
3	0	2	4	60	40	20	30	150

Detailed Syllabus –

Unit	Content	Hours	% Of Weight
1	**Module 1. DC motor characteristics:** Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation.	5	14
2	**Module 2 Chopper fed DC drive:** Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.	5	14

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105606
Subject Name : Electric Drives

3	**Module 3: Multi-quadrant DC drive:** Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.	**6**	**14**
4	**Module 4 Closed-loop control of DC Drive**: Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.	**6**	**14**
5	**Module 5 Induction motor characteristics:** Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.	**6**	**15**
6	**Module 6 Scalar control or constant V/f control of induction motor:** Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.	**6**	**15**
7	**Module 7 Control of slip ring induction motor:** Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery.	**6**	**14**
	Teaching Hours	**40**	**100**

Course Outcomes:

CO No	Course Outcome Description	RBT Level
CO1	Understand the characteristics of dc motors and induction motors.	Understanding
CO2	Understand the principles of speed-control of dc motors and induction motors.	Understanding
CO3	Understand the power electronic converters used for dc motor and induction motor speed control.	Understanding
CO4	Compare conventional control and drives control for dc/ac motor.	Analyze

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105606
Subject Name : Electric Drives

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Basic knowledge	**3**	**3**	**3**	**2**
PO2 Discipline knowledge	**2**	**2**		**2**
PO3 Experiments and practice				**2**
PO4 Engineering tools				**2**
PO5 The engineer and society			**3**	
PO6 Environment and sustainability	**-**	**-**	**-**	**-**
PO7 Ethics	**-**	**-**	**-**	**-**
PO8 Individual and team work	**-**	**-**	**-**	**-**
PO9 Communication	**-**	**-**	**-**	**-**
PO10 Life-long learning	**-**	**-**	**-**	**-**

CO\PSO MATRIX

CO \PSO	**PSO1**(Apply electrical engineering knowledge to analyze and solve problems in electrical machines and drives..)	**PSO2**(Use modern tools and control techniques for analysis and design of power electronic systems.
CO1	**3**	
CO2	**3**	
CO3	**2**	**3**
CO4	**2**	**2**

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105606
Subject Name : Electric Drives

Reference Books –

- G. K. Dubey, “Power Semiconductor Controlled Drives” , Prentice Hall, 1989.
- R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control” , Prentice Hall, 2001.
- G. K. Dubey, “Fundamentals of Electrical Drives” , CRC Press, 2002.
- W. Leonhard, “Control of Electric Drives” , Springer Science & Business Media, 2001.
- Bimal K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education
- Vedam Subrahmanyam, “Electric Drives”, TMH (I), Second Edition,
- J.M.D. Murphy and F.G. Turnbull, “Power Electronics Control of AC Motors”, Peragmo
- Theodore Wildi, “Electrical Machines, Drives and Power Systems”, sixth edition, Pearson

List of Practical –

- To study the fundamental and block diagram of Electric drive.
- To study different methods of speed control of D.C. Motor.
- To study and simulate 1-Φ Semi Control of D.C. separately excited Motor.
- To study and simulate 1-Φ Fully Controlled converter of separately excited Motor.
- To study the control techniques used in D.C. chopper.
- To study control of D.C. motor for (a) Current limit control (b) Closed loop torque control (c) Closed loop speed control.
- To study chopper control of D.C. Motor for motoring and generating control.
- To study D.C. Motor drive using PLL.
- To study and simulate AC voltage controller based speed control of AC motor.
- To study and simulate v/f speed control of Induction motor.
- To study and simulate Cycloconverter based speed control of synchronous motor.
- To study Induction Motor drive with slip power recovery scheme

List of Software/learning website-

- https://nptel.ac.in

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105607
Subject Name : Inter Connected Power System

w. e. f. Academic Year:	2024-25
Semester:	6TH
Category of the Course:	Professional Elective -2

Prerequisite:	Basic knowledge of electrical networks, power system components, and numerical methods used in electrical engineering.
Rationale:	This subject is offered to study of behavior of power systems during normal operating conditions and/or when subjected to disturbances by mathematical modeling of components of power systems. It also briefs the students about the modeling of power systems networks for steady state analysis. They will also learn the economic operation and planning of power system network and also use the knowledge for the selection of components like Circuit Breaker for Power system protection.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
3	0	2	4	60	40	20	30	150

Detailed Syllabus –

Unit	Content	Hours	%Of Weight
1	**Introduction:** Concept of Interconnection, Hierarchical Grid arrangements, Regulatory framework Cascade Tripping, Islanding, Load dispatch centre.	03	7
2	**Power system matrices**: Brief explanation of Graph theory, Primitive Network, Ybus formation methods, Singular transformation method, Direct method, effect of addition and deletion of shunt elements on YBus, Numerical.	04	8
3	**Load flow studies:** Introduction, Bus Classifications, formation of Static Load Flow Equations (LFE), Approximate method of solution of LFE, Application of Numerical method for solution of nonlinear algebraic equations - Gauss-Seidel Method, Newton Raphson Method, Fast Decoupled	12	30

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105607
Subject Name : Inter Connected Power System

	Load Flow Method, Comparison of different methods of solution of load flow equations, Numerical.		
4	**Economic operation of power systems:** Generator operating cost, Economic operation of generators within thermal plant, Optimal operation by co-ordination equation, Penalty factor, Derivation of transmission loss formula (Kron's method), Unit commitment problem solution by dynamic programming, Numerical, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency.	**08**	**15**
5	**Frequency and voltage control methods:** Speed governing mechanism, Mathematical modeling, Adjustment of Governor characteristics, Single area control, Flat frequency control, Selective frequency control, Tie line load bias control, Methods of voltage control, Numerical.	**06**	**10**
6	**Power system stability:** Introduction, Mechanics of angular motion, The swing Education, transfer reactance, power relations, Steady state stability, Synchronizing power coefficient, Analysis of steady state stability, steady state stability with automatic voltage regulators, concept of shunt fault, transfer reactance during fault, reduction of power system to one machine connected to infinite bus, Transient stability, simplified transient generator model, The equal area stability criterion, solution of swing equation, Numerical.	**12**	**30**
	Teaching Hours	**45**	**100**

Course Outcomes:

CO No	Course Outcome Description	RBT Level
CO1	Define the actual power system structure scenario and its operating mechanism in a state and country with major entities and their functions	Remembering
CO2	Develop proper mathematical model of transmission network for analysis of power flow study, form Static Load Flow Equations, Select and identify the most appropriate numerical technique Solving SLFE	Apply
CO3	Demonstrate the methods used for voltage and frequency regulation in electrical power network by mathematical analysis	Apply
CO4	Solve the Unit Commitment problem using Dynamic programming techniques. Analyze the power system economics	Analyze

	and factors effecting the economic load dispatch with and without considering network loss	
CO5	Demonstrate the factors which determine steady state and transient angle stability. Analyze the same for a single machine/infinite bus system using both analytical and graphical (Equal area) methods. Apply numerical technique for stability study	Analyze

CO\PO MATRIX

CO \ PO	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
PO1 Basic knowledge	**3**	**3**	**3**	**3**	**3**
PO2 Discipline knowledge	**2**	**3**	**3**	**3**	**3**
PO3 Experiments and practice	**-**	**2**	**2**	**3**	**2**
PO4 Engineering tools	**-**	**2**	**2**	**2**	**3**
PO5 The engineer and society	**-**	**3**	**2**	**2**	**3**
PO6 Environment and sustainability	**2**	**-**	**-**	**-**	**-**
PO7 Ethics	**-**	**-**	**-**	**-**	**-**
PO8 Individual and team work	**-**	**-**	**-**	**-**	**-**
PO9 Communication	**-**	**-**	**-**	**-**	**-**
PO10 Life-long learning	**1**	**-**	**-**	**-**	**-**

CO\PSO MATRIX

CO \PSO	**PSO1(**Apply fundamental knowledge of electrical engineering to solve power system and control-related problems.)	**PSO2(**Analyze, design, and simulate electrical systems using modern tools and techniques.
CO1	**3**	**-**
CO2	**3**	**3**
CO3	**3**	**2**
CO4	**3**	**2**
CO5	**3**	**3**

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105607
Subject Name : Inter Connected Power System

Reference Books –

- Modern Power System Analysis, D. P. Kothari, I. J. Nagrath, Tata McGraw-Hill Education,
- Power System Analysis and Stability, S.S. Vadhera, Khanna Publication
- Power System Analysis, Hadi Saadat, Tata McGraw-Hill Education
- Computer Aided Power System Analysis, G.L. Kusic, © 1986
- Elements of Power System Analysis by William D. Stevenson McGraw-Hill
- O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
- A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.

List of Practical –

- To study the Ybus formation with the help of simple study system
- To formulate Static Load Flow Equations of few simple sample study systems
- To obtain solution of some small study system using approximate load flow method
- To obtain solution of some small study system using G-S method
- To obtain solution of some small study system using N-R method
- To obtain solution of a study system using FDLF method
- To obtain unit commitment of a power plant
- To obtain economic load dispatch of power plant
- To obtain economic load dispatch of generators considering transmission losses
- To apply analysis of various principles of Load Frequency control with the help of numerical problems
- To apply analysis of various principles of Power system angle stability with the help of numerical problems
- To determine stability of a small system using numerical method.

List of Software/learning website-

- https://nptel.ac.in

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105608
Subject Name : HVDC Transmission Systems

w. e. f. Academic Year:	2024-25
Semester:	6TH
Category of the Course:	Professional Elective -2

Prerequisite:	Basic understanding of power system analysis, electrical machines, and power electronics—especially AC/DC converters and transmission line fundamentals.
Rationale:	This subject is offered at higher UG level to study the various operating as well as configurational aspects of HVDC transmission system. The control strategy for frequency and voltage regulation in DC link is covered in detail for interconnected HVDC system. It also presents the power system stability and fault analysis. Students will be able to enhance their learning domain by distinguishing the requirement of HVDC system over HVAC system. They will also learn the components used and role of power electronics involved for regulating the voltage angle and frequency for power flow and interconnection.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
3	0	2	4	60	40	20	30	150

Detailed Syllabus –

Unit	Content	Hours	% Of Weight
1	**HVDC Transmission:** The State of Art Introduction, Historical Developments, Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission, Types of HVDC Systems, Limitations of HVDC Transmission lines, Components of a HVDC system, Line Commutated Converter and Voltage Source Converter based HVDC Systems.	06	15
2	**Analysis of Line Commutated Converters:** Line Commutated Converters (LCCs): Basic Principal of three-phase AC–DC Conversion, six pulse	08	

	converter operation, Effect of Delaying the Firing Instant, The Commutation Process, Analysis of the Commutation Circuit, Analysis neglecting commutation overlap, Rectifier Operation, Inverter Operation, Power Factor and Reactive Power, Characteristic Harmonics, DC Side Harmonics, AC Side Harmonics, Twelve Pulse Converters operation, AC/DC side voltage and current waveforms, Expressions for average dc voltage.		**15**
3	**Voltage Source Converters (VSCs):** VSC Operating Principle, PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation, PWM Carrier-Based Implementation, Naturally Sampled PWM, Uniformly Sampled PWM, Equation in rotating reference frame, Real and Reactive power control using a VSC.	**04**	**10**
4	**Control of HVDC Converters and System:** Principles of DC Link Control in a LCC HVDC System. Control Hierarchy, Firing Angle Control, Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a DC Link. Higher level Controllers, Power control, Frequency Control, Reactive Power Control, Principles of DC Link Control in a VSC based HVDC system: Power flow and dc voltage control. Reactive Power Control / AC voltage regulation using VSC.	**10**	**30**
5	**Components of HVDC Systems:** Smoothing Reactors, Reactive Power Sources and Filters in LCC HVDC systems DC line: Corona Effects, Insulators and Transient Over-voltages. DC line faults in LCC systems. DC line faults in VSC systems, dc breakers, Mono-polar Operation. Ground Electrodes.	**08**	**10**
6	**Stability Enhancement Using HVDC Control:** Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/DC systems.	**04**	**10**
7	**Multi Terminal HVDC System:** Introduction, Types of Multi-terminal HVDC System, Parallel Operation of HVDC, Control of Power in MTDC, Disconnecting of units or converters, Modern Trends in HVDC Technology. Introduction to Modular Multi-level Converters.	**04**	**10**
	Teaching Hours	**44**	**100**

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105608
Subject Name : HVDC Transmission Systems

Course Outcomes:

CO No.	Course Outcome Statement	RBT Level
CO1	Understand the advantages of DC transmission over AC transmission	Understand
CO2	Analyze Line Commutated Converters and Voltage Source Converters in HVDC Transmission System	Analyze
CO3	Application of suitable control strategies used for LCC and VSC based HVDC transmission system	Apply
CO4	Evaluate power system angular, voltage, and frequency stability using simulation models in HVDC system configurations	Evaluate

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Basic knowledge	**2**	**3**	**2**	**3**
PO2 Discipline knowledge	**2**	**3**	**2**	**3**
PO3 Experiments and practice	–	**2**	**3**	**2**
PO4 Engineering tools	–	**2**	**2**	**3**
PO5 The engineer and society	–	–	**1**	–
PO6 Environment and	-	-	-	-
PO7 Ethics	-	-	-	-
PO8 Individual and team work	-	-	-	-
PO9 Communication	-	-	-	-
PO10 Life-long learning	-	-	-	-

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105608
Subject Name : HVDC Transmission Systems

CO\PSO MATRIX

CO \ PSO	**PSO1**(Apply knowledge of power electronics and control strategies in high-voltage transmission systems.)	**PSO2**(Use simulation tools and modeling to analyze stability and performance of HVDC systems in modern power grids.)
CO1	**2**	**1**
CO2	**3**	**2**
CO3	**3**	**2**
CO4	**3**	**3**

Reference Books –

- K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011.
- J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1983.
- E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley- Inder-science, 1971.
- Vijay K Sood, "HVDC and FACTS Controller" Springer Publication, 2004.
- S Kamakshaiah and V Kamaraju, "HVDC Transmission" TMH Publications, 2011.
- M. H Rashid, "Power Electronics Handbook" Academic Press, 2001.

List of Practical –

- Study of various HVDC transmission system components and its applications.
- Study of AC/DC side voltage and current waveforms of six pulse converter system under variable RL Load using simulation. (Hint: input PF, THD, converter efficiency, reactive power flow etc).
- Study of AC/DC side voltage and current waveforms of twelve pulse converter system under variable R-L Load using simulation. (Hint: input PF, THD, converter efficiency, reactive power flow etc).
- Study of reactive power control in HVDC transmission system.

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105608
Subject Name : HVDC Transmission Systems

- Study of various types of Multi terminal HVDC transmission system.
- Some simulation practices based on HVDC power and voltage stability.
- Study of DC link control in VSC based HVDC transmission system.
- Study of various passive filters used in LCC based HVDC transmission system.
- Operation of VSC for power factor correction at AC side of HVDC system using sinusoidal pulse width modulation.

List of Software/learning website-

- https://nptel.ac.in

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105609
Subject Name : Electrical Materials

w. e. f. Academic Year:	2024-25
Semester:	6TH
Category of the Course:	Open Elective-2

Prerequisite:	Basic understanding of physics and chemistry concepts related to atomic structure, electric charge, and magnetism, along with knowledge of electrical circuits.
Rationale:	The course is aimed to provide exposure to the various electrical materials which are used in electrical engineering and their applications in designing electrical equipments and it gives the fundamental knowledge of various material used in electrical engineering. This course provides the essential knowledge in the selection of conducting, dielectric, insulating, magnetic, semiconductor and superconductor materials during design of electrical engineering equipments.

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P		E	M	I	V	
3	0	0	3	60	40	0	0	100

Detailed Syllabus –

Unit	Content	Hours	% Of Weight
1	**Conductors:** Classification: High conductivity, high resistivity materials, fundamental requirements of high conductivity materials and high resistivity materials, mobility of electron in metals, factors affecting conductivity and resistivity of electrical material, thermoelectric Effect: Seeback effect, Peltier effect, commonly used high conducting materials: copper, aluminum, bronze brass properties and characteristics, constantan, platinum and nichrome properties, characteristics and applications, material used for AC and DC machines	09	30
2	**Dielectric Materials and Insulators:** Properties of gaseous, liquid and solid dielectric, dielectric as a field medium, electric conduction in gaseous, liquid and solid dielectric, breakdown in dielectric materials, mechanical and electrical properties of dielectric materials, effect of temperature on dielectric materials, polarization, loss angle and dielectric loss, petroleum based	09	30

	insulating oils, transformer oil, capacitor oils and its properties, classification of insulation (Solid) and application in AC and DC machines, solid electrical insulating materials, fibrous, paper boards, yarns, cloth tapes, sleeving wood, impregnation, plastics, filling and bounding materials, fibrous, film, mica, rubber, mica based materials, ceramic materials.		
3	**Magnetic Materials:** Basic terms, classification of magnetic material: diamagnetic, paramagnetic, ferromagnetic, anti- ferromagnetic and amorphous material, hysteresis loop, magnetic susceptibility. coercive force, curie temperature, magneto-striction, factors affecting permeability and hysteresis loss, common magnetic materials: soft and hard magnetic materials, electric steel, sheet steel, cold rolled grain-oriented silicon steel, hot rolled grain oriented silicon steel.	**08**	**15**
4	**Semi-Conductors and Superconductors:** General concepts, energy bands, types of semiconductors: intrinsic Semiconductors, extrinsic Semi-conductors, compound semiconductor, amorphous semiconductor, hall effect, drift, mobility, diffusion in Semiconductors, semi-conductors and their applications. **Superconductors:** Superconductivity, properties of superconductors, critical field, Meissner effect, type-I and type-II Superconductors.	**08**	**15**
5	**Special purpose materials:** Nickel iron alloys, high frequency materials, permanent magnet materials, feebly magnetic materials, ageing of a permanent magnet, effect of impurities, Losses in Magnetic materials, Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials.	**08**	**10**
	Teaching Hours	**42**	**100**

Course Outcomes:

SWAMINARAYAN UNIVERSITY

Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105609
Subject Name : Electrical Materials

CO No.	Course Outcome Statement	RBT Level
CO1	Recall different material and its properties which are used in electrical equipments as conductor	Remember
CO2	Elucidate various types of dielectric materials, special purpose materials and their properties in conditions	Understand
CO3	Evaluate types of magnetic materials and its behavior	Evaluate
CO4	Analyze semiconductor and superconducting materials and associated effects	Analyze

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Basic knowledge	**3**	**2**	**3**	**3**
PO2 Discipline knowledge	**2**	**2**	**2**	**2**
PO3 Experiments and practice	–	–	**2**	**2**
PO4 Engineering tools	–	–	–	–
PO5 The engineer and society	–	–	–	–
PO6 Environment and sustainability	–	–	–	–
PO7 Ethics	–	–	–	–
PO8 Individual and team work	–	–	–	–
PO9 Communication	–	–	–	–
PO10 Life-long learning	–	–	–	–

CO\PSO MATRIX

SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: UG
Branch: Electrical Engineering
Subject Code: BE105609
Subject Name : Electrical Materials

CO \ PSO	**PSO1(**Apply knowledge of electrical materials and their properties for selection, design, and testing of electrical equipment and components.)	**PSO2(**Demonstrate awareness of modern and advanced materials (semiconductors, superconductors, special purpose materials) and their relevance in emerging technologies.)
CO1	**3**	**2**
CO2	**2**	**2**
CO3	**3**	**2**
CO4	**3**	**2**

Reference Books –

- Electrical Engineering Materials: A.J. Dekker, PHI Publication.
- An Introduction to Electrical Engineering Materials: C. S. Indulkar and S. Thiruvengadam, S. Chand & Co., India.
- Material Science for Electrical & Electronics Engineers: Ian P. Hones, Oxford University Press.
- Electrical Properties of Materials: L. Solymar and D. Walsh, Oxford University Press-New Delhi.
- A Course in Electrical Engineering Materials: T K Basak, New Age Science Publications.
- A Course in Electrical Engineering Materials: R K Rajput, Laxmi Publications.
- A Course in Electrical Engineering Materials: S. P. Seth and P. V. Gupta, Dhanpat Rai & Sons.
- Electrical and Electronic Engineering Materials: S.K. Bhattacharya, Khanna Publishers, New Delhi.
- Electrical Engineering Materials: T.T.T.I Chennai, Tata MacGraw Hill.

List of Software/learning website-

- https://nptel.ac.in/courses/108/108/108108116/
- https://nptel.ac.in/courses/113/104/113104096/
- https://nptel.ac.in/courses/108/108/108108112/
- https://nptel.ac.in/courses/115/103/115103108/