GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject code: 3160002
Contributor Personality Development Program

SEMESTER VI

Type of course: Work-Personality Development

For Year: Pre-final year for all Diploma, Degree & Masters programmes over 2 semesters. For e.g. for Bachelors of Pharmacy and Engineering, the course will be conducted in Semesters V & VI.

Rationale: The Contributor Program aims to accomplish the following outcomes in the lives of students–

- Improve the employability of students by giving them the right work ethic and thinking that employers are looking for.
- Build their confidence with which they can go into any job and contribute meaningfully.
- Improve their ability to engage better in the workplace and to be able to handle the challenges that come up there.
- Build their career-worthiness and help them develop into future-ready contributors with ability to navigate a career in a volatile, changing world.
- Widen their choices of career and success, so that they are able to open up more opportunities for themselves and take up unconventional career pathways.
- Enable them to recognize how they, as technical professionals, can participate and make a positive contribution to their communities and to their state.

Towards this goal, the Contributor Program has been designed to awaken and strengthen students from within, in terms of building positive self-esteem, increasing their confidence level and I-can attitude, improving their aspirations, giving them new methods of thinking, building their cognitive capacities, exposing them to the skills and practices associated with being contributors in the workplace (not mere employees).

The Program content is also designed to expose students to real-world workplace scenarios and sensitize them to some of the challenges faced in society around them, especially in the local communities around them and in their own state of Gujarat.

The Contributor Program syllabus has been evolved and fine-tuned over several years, (a) to address the changing need and contemporary challenges being faced by industry and what employers of today are looking for in the people they hire and (b) by working extensively with universities and students building an appreciation of their challenges and concerns. At the core, the program is guided by the higher ideas and principles of practical Vedanta in work.

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	2	70	30	30	20	150

COURSE CONTENT :

Sr. No.	Content	Total Hrs
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	1.5 hrs Classroom engagement (including self-discovery/ solutioning sessions)

	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.	
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 things and identifying what really matters – both to the company and to the customers. In this topic, students learn how to build this capability.	Same as above
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.	Same as above
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").	Same as above
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.	Same as above
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.	Same as above
Showcase Lab Sessions		3 hrs
Project work		Beyond classroom

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject code: 3160002

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
-	**15**	**15**	**-**	**20**	**20**

Reference resources:

A. Basic reference for both students and teachers

1. Contributor Personality Program textbook cum workbook developed by Illumine
2. Web-based ActivGuide™ 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

B. Advanced reference for teachers

1. On Contributors, Srinivas V.; Illumine Ideas, 2011
2. Enlightened Citizenship and Democracy; Swami Ranganathananda, Bharatiya Vidya Bhavan, 1989
3. Eternal Values for a Changing Society – Vol I-IV, Swami Ranganathananda; Bharatiya Vidya Bhavan
4. Karma Yoga, Swami Vivekananda; Advaita Ashrama
5. Vivekananda: His Call to the Nation, Swami Vivekananda; Advaita Ashrama
6. Six Pillars of Self Esteem, Nathaniel Branden; Bantam, 1995
7. Mindset: The New Psychology of Success, Carol S. Dweck; Random House Publishing Group, 2007
8. Lasting Contribution: How to Think, Plan, and Act to Accomplish Meaningful Work, Tad Waddington; Agate Publishing, 2007
9. Why not?: how to use everyday ingenuity to solve problems big and small, Barry Nalebuff, Ian Ayres; Harvard Business School Press, 2003
10. The value mindset: returning to the first principles of capitalist enterprise (Ch 8 & 9); Erik Stern, Mike Hutchinson; John Wiley and Sons, 2004
11. The Power of Full Engagement: Managing Energy, Not Time, is the Key to High Performance and Personal Renewal, Jim Loehr, Tony Schwartz; Simon and Schuster, 2003
12. Creating Shared Value, Michael E. Porter and Mark R. Kramer; Harvard Business Review; Jan/Feb2011, Vol. 89 Issue 1/2
13. The Speed of Trust: The One Thing That Changes Everything, Stephen M. R. Covey, Rebecca R. Merrill, Stephen R. Covey; Free Press, 2008
14. The Courage to Meet the Demands of Reality, Henry Cloud; HarperCollins, 2009
15. Responsibility at work: how leading professionals act (or don't act) responsibly, Howard Gardner; John Wiley & Sons, 2007

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject code: 3160002

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
Outcome of theory sessions		
CO-1	Students will be able to recognize & appreciate the thinking required to find solutions in the face of any challenge.	10-12%
CO-2	Students will be able to recognize & appreciate different types of value that can be created and the different ways to create value for others.	10-12%
CO-3	Students will be able to recognize & appreciate how to engage deeply, and its need, value, payoffs and consequences in different contexts.	10-12%
CO-4	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.	10-12%
CO-5	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.	10-12%
CO-6	Students will be able to recognize & appreciate conduct which builds trust of people in contrast to conduct which breaks trust of people - in teams / organization & the value of trust conduct in various situations.	10-12%
Outcome of practical sessions		
CO-7	Students complete their 'Contributor Showcase Profile' on the Showcase Platform. This includes (a) completing Illumine's Contributor Mindset Assessment (b) building evidence to demonstrate their functional orientations as contributors.	15%
CO-8	Students learn to apply contributor thinking to think-through and address real-world challenges.	15%

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject code: 3160003
INTEGRATED PERSONALITY DEVELOPMENT COURSE

SEMESTER VI

TYPE OF COURSE –

- Value-based holistic personality development course for university students.

RATIONALE -

- This course aims to help a person understand and know his / her purpose in life, get a positive thought pattern, gain confidence, improve behaviour, learn better communication and develop a healthy physique with morality and ethics in its core.

- Todays youth lack the guidance to face insecurity about their health and career, premature relationships and family breakdown, addictions and substance abuse, negative impact of internet and social media etc. This course includes such topics that will cover all aspects and provide solution to the current challenges through creative and interactive activities.

- This course will allow students to enjoy, understand and practice invaluable lessons preparing them for a successful future.

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	2	70	30	30	20	150

COURSE CONTENT :

Lecture No.	Content	Hours
1	**Facing Failures** - Insignificance of Failures	2
2	**Facing Failures** - Power of Faith	2
3	**Facing Failures** - Practicing Faith	2
4	**From House to Home** - Bonding the Family	2
5	**Learning from Legends** - Leading without Leading (Pramukh Swami Maharaj)	2
6	**Review Lecture** – Words of Wisdom	2
7	**My India My Pride** - Glorius Past - Part 1	2
8	**My India My Pride** - Glorius Past - Part 2	2

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject code: 3160003

9	**My India My Pride** - Present Scenario	2
10	**Remaking Yourself** - Begin with the End in Mind	2
11	**My India My Pride** - An Ideal Citizen - 1 (Accountability - Responsibility - Honesty - Integrity)	2
12	**My India My Pride** - An Ideal Citizen - 2 (Loyalty - Sincerity - Punctuality)	2
13	**My India My Pride** - An Ideal Cititzen - 3 (Ethical & Moral Values/Practices)	2
14	**Financial Wisdom** - Financial Planning Process	2
15	**Review Lecture** - Student Voice-2	2

BASIC STUDY MATERIAL / MAIN COURSE WORK-BOOK -

1. IPDC Workbook-I
2. IPDC Workbook-II

IPDC REFERENCES –

- *These are the reference material for each lectures of IPDC.*

Module No.	Module/ Course Topics	Lectures	References
1	Facing Failures	Factors Affecting Failures Failures are not Always Bad Insignificance of Failures Power of Faith Practicing Faith	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, Arunima Sinha, 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

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject code: 3160003

2	Learning from Legends	Tendulkar & Tata Leading Without Leading	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 BAPS Sadhus, Swaminarayan Aksharpith, 2013
3	Mass Management	Project Management	1. Project Management Absolute Beginner's Guide, Gregory Horine, Que Publishing, 2017 2. The Fast Forward MBA in Project Management, Eric Verzuh, Wiley, 2011 3. Guide to Project Management: Getting it right and achieving lasting benefit, Paul Roberts, Wiley, 2013
4	My India My Pride	Glorious Past - Part 1 Glorious Past - Part 2 Present Scenario An Ideal Citizen - 1 An Ideal Citizen - 2 An Ideal Citizen - 3	1. Hidden Horizons, Dr. David Frawley and Dr. Navaratna S. Rajaram, 2006 2. Rishis, Mystics and Heroes of India, Sadhu Mukundcharandas, Swaminarayan Aksharpith, 2011 3. Physics in Ancient India, Narayan Dongre, Shankar Nene, National Book Trust, 2016 4. The Rise of Civilization in India and Pakistan, Raymond Allchin, Bridget Allchin, Cambridge University Press, 1982 5. The Āryabhaṭīya of Āryabhaṭa: An Ancient Indian Work on Mathematics and Astronomy (1930), Walter Eugene Clark, University of Chicago Press, reprint, Kessinger Publishing, 2006
5	Remaking Yourself	Restructuring Yourself Power of Habit Being Addiction-Free Begin with the End in Mind Handling the Devil – Social Media	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, TED Talk, 2017

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject code: 3160003

6	Financial Wisdom	Basics of Financial Planning Financial Planning Process	1. Rich Dad Poor Dad, Robert Kiyosaki, Plata Publishing, 2017 2. The Warren Buffett Way, Robert Hagstrom, Wiley, 2013 3. The Intelligent Investor, Benjamin Graham, Harper Business, 2006 4. Yogic Wealth: The Wealth That Gives Bliss, Gaurav Mashruwala, TV18 Broadcast Ltd, 2016
7	From House to Home	Affectionate Relationships Forgive & Forget Listening & Understanding Bonding the Family	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
8	Soft Skills	Teamwork & Harmony Networking - Decision Making - Leadership	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 Our Decisions, Harper Perennial, Dan Ariely, 2010
9	Review	Student Voice – 1 Student Voice – 2 Words of Wim	

COURSE OUTCOMES –

- To provide students with a holistic education – focused on increasing their intelligence quotient, physical quotient, emotional quotient and spiritual quotient.
- To provide students with hard and soft skills, making them more marketable when entering the workforce.
- To educate students on their social responsibilities as citizens of India and have a greater sense of social responsibility.
- To provide students with a value-based education which will enable them to be successful in their family, professional, and social relationships by improving their moral and ethical values.
- To teach self-analysis and self-improvement exercises to enhance the potential of the participants.
- To have a broader sense of self-confidence and a defined identity.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160914
MICROPROCESSORS AND MICROCONTROLLERS
Semester VI

Type of course: Engineering

Prerequisite: Analog and Digital Electronics

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:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Microprocessor Based Systems:** Digital Computer, Microprocessor, Microcomputer, Microcontroller, Van Neumann and Harvard Architecture, CISC and RISC Processors	**02**	5
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, 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)	**06**	10
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**	10

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**	15
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**	20
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	**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**	10
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**	30
9	**External Memory Interfacing:** Memory address decoding, interfacing 8031/8051 with ROM/EPROM and Data ROM	**02**	
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**	
11	**ARM Processor Fundamentals:** Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts and Vector Table, Core Extensions, Architecture Revisions, Arm Processor Families	**04**	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**30**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Microprocessor Architecture, Programming, and Applications with the 8085, By Romesh Gaonkar, Penram International Publishing (India) LTD.
2. 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)
3. The 8051 Microcontroller & Embedded Systems using Assembly and C By K. J. Ayala, D. V. Gadre (Cengage Learning , India Edition).
4. ARM System Developer's Guide, Designing & Optimizing System Software, by Andrew Sloss, Dominic Symes, Chris Wright, Elsevier Publications.

Course Outcomes:

At the end of this course, students will have the ability to

Sr. No.	CO statement	Marks % weightage
CO-1	Describe 8085 microprocessor and microcontroller architecture of MCS-51 family.	
CO-2	Develop assembly language/ embedded C- language code for a given problem	
CO-3	Configure a given microcontroller/ microprocessor based system for timer-counter/serial communication/interrupt operation in assembly/embedded C	
CO-4	Interface appropriate peripheral devices, memory with microcontroller for given application/problem	

Suggested List of Experiments:

1. Introduction to IDE, assembler, compiler, linker, simulator, debugger and assembler directives.
2. 8051 Assembly language programming based on data transfer, arithmetic and logical group instructions.
3. 8051 Assembly language programming using bit manipulation instructions.
4. 8051 Assembly language programming using branching group instructions
5. 8051 Timer/counter programming using assembly language and C
6. 8051 Serial programming using assembly and embedded C.
7. I/O port programming in embedded C.
8. Programming of LCD in assembly & embedded C.
9. Programming of matrix keyboard in assembly & embedded C.
10. Programming of parallel ADC and DAC in embedded C.
11. Interfacing Stepper Motor.
12. Speed Control of DC motor using PWM Technique and Microcontroller
13. Designing of SCR firing Circuit for D. C. Converter using Microcontroller
14. Interfacing Relay and opto isolators using Microcontroller

Additional experiments using ARM boards are suggested as they would be beneficial to students for project development in final year (Refer NPTEL course based on 'Embedded system design using ARM' Link:https://nptel.ac.in/courses/106/105/106105193/)

1. Interfacing of LM35 temperature sensor with STM32F401 Nucleo board
2. Interfacing of electric bulb with STM32 through SRD-05DC-SL-C relay
3. Speed control of DC motor using STM32
4. Interface relay, speaker, LDR, LM35 to the STM32 board.
5. Interfacing of SIM900A GSM module with STM32
6. Design of home automation system using STM32
7. Design of simple alarm system using touch sensor with STM32

Major Equipment: Kit for Microcontroller 8051, µVISION2/3/4 IDE, STM32F401 Nucelo Development Board

List of Open Source Software/learning website: NPTEL, www.infineon.com, www.silabs.com

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160915

Semester – VI
Subject Name: Electrical Measurements and Measuring Instruments

Type of course: Professional Core Course

Prerequisite: NA

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:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Concepts of Measurement :** Measurement System, Classification of instrument system, Methods of Measurement, Static Characteristics like accuracy, precision, sensitivity, linearity, range, reproduciblity, 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**
2	**Transducers and Sensors :** Definition, different types of transducers, criteria for selection, general characteristics and dynamic characteristics, 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	**10**
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**
4	**Measurement of R, L and C :** Different methods of measuring low, medium and high resistances, Wheatstone Bridge,	**10**

	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	
5	**D.S.O. :** Digital recorders, Digital Storage Oscilloscope - Block Diagram, theory and applications, Power scope.	**03**
6	**Display devices:** Characteristics of digital display, DVM and Digital multi meter, Clamp on meter, Megger.	**03**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	**30**	**20**	**10**	**10**	**00**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Gupta J. B., "A Course in Electronics and Electrical Measurements and Instrumentation", S.K. Kataria & Sons
2. A.K.Sawhney, "Electrical and Electronic Measurements and Instrumentation", DHANPAT RAI & CO.
3. Golding & Widis, 'Electrical Measurement and Measurement instrument', Wheelar Books
4. D. Patranabis, 'Sensors & Transducers', PHI.
5. H. S. Kalsi, " Electronic Instrumentation", Tata McGraw-Hill Education.
6. A.J. Bouwens, 'Digital Instrumentation', Tata Mc-Graw hill.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Comprehend the basics of electrical measurements.	20
CO-2	Explain basic principle, working, characteristics and applications of the various measuring instruments and transducers.	40

CO-3	Apply AC and DC bridges for measurement of electrical parameters like resistance, inductance and capacitance.	20
CO-4	Prepare the specifications of required measurement systems to be used for measurement of parameters for a specified application.	20

List of Experiments:

- 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 Open Source Software/learning website:
- http://www.scilab.org/
- http://www.vlab.co.in/

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160916
Semester – VI
Subject Name: Energy Conservation

Type of course: Professional Elective Course

Prerequisite: Fundamentals of power systems, electrical machines and power electronics.

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:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
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**
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	**11**

	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	
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**
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**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
15	30	30	15	10	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Energy Audit and Management, Volume-I, IECC Press

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

Course Outcomes:

At the end of this course, students will have the ability to

Sr. No.	CO statement	Marks % weightage
CO-1	Demonstrate the basic knowledge of energy audit and management.	**20**
CO-2	Identify the energy conservation opportunities	**15**
CO-3	Assess the energy saving & conservation in different electric system	**25**
CO-4	Analyze the heat utilization, saving and recovery in different thermal system	**25**
CO-5	Prepare energy audit report.	**15**

List of Experiments: Not Applicable

Major Equipment: Not Applicable

List of Open Source Software/learning website:

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

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160917
Semester – VI
Subject Name: Wind And Solar Energy

Type of course: Professional Elective Course

Prerequisite: Fundamental knowledge of electrical machines and power electronics

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:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
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
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
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
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	11

	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	
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**
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**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**30**	**25**	**15**	**10**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

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

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160917

Course Outcomes:

At the end of this course, students will have the ability to

Sr. No.	CO statement	Marks % weightage
CO-1	Demonstrate the importance of renewable energy source and various applications of solar and wind systems	**20**
CO-2	Do the preliminary analysis related to wind energy systems	**15**
CO-3	Do the preliminary analysis and design of solar PV and solar thermal systems	**30**
CO-4	Identify the power electronic converters for solar PV and wind energy systems	**20**
CO-5	Describe the issues related to the renewable energy in the electrical utility network	**15**

List of Experiments: Not Applicable

Major Equipment: Not Applicable

List of Open Source Software/learning website:

https://nptel.ac.in

http://web.mit.edu/renewable-iap09

https://www.digimat.in/index.html

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160918

Semester – VI
Subject Name: Element of Electrical Design

Type of course: Professional Elective Course

Prerequisite: NA

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:

.

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	**GENERAL DESIGN ASPECTS:** Basic principles of magnetic circuits – use of B-H curves in magnetic circuit; Calculationsof 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**
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. **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.	**08**
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 :**	**08**

	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.	
4	**Estimation and Costing for Residential and Commercial wiring:** Preparation of schematic diagrams and estimation of cost of wiring for Tenaments, Row houses, Bungalows, Flats, Multi – Storied Buildings, Commercial Complexes like Offices, Hospitals, Hotels,Theatres.	**08**
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**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**20**	**10**	**0**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyse and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

(Question paper should include 40 to 60% numerical problems based on design or analysis)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

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

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Explain the basic principles of electrical machine design with relevant applications	20%

CO-2	Design the electrical equipments like small transformers, choke coils, starters and field regulators	20%
CO-3	Develop the winding diagrams for AC and DC machines as per specifications	20%
CO-4	Compute the cost of wiring for residential and commercial premises	20%
CO-5	Design the supply systems for residential and industrial applications	20%

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160919
Semester – VI
Subject Name: Electric Drives

Type of course: Professional Elective Course

Prerequisite: Electrical Machine and Power Electronics

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:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
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
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
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
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	6

	specification and design, speed controller specification and design.	
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**
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**
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**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**30**	**20**	**25**	**10**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

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

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160919

Course Outcomes:

At the end of this course, students will have the ability to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the characteristics of dc motors and induction motors.	**30**
CO-2	Understand the principles of speed-control of dc motors and induction motors.	**30**
CO-3	Understand the power electronic converters used for dc motor and induction motor speed control.	**30**
CO-4	Compare conventional control and drives control for dc/ac motor.	**10**

List of Experiments:

1. To study the fundamental and block diagram of Electric drive.
2. To study different methods of speed control of D.C. Motor.
3. To study and simulate 1-Φ Semi Control of D.C. separately excited Motor.
4. To study and simulate 1-Φ Fully Controlled converter of separately excited Motor.
5. To study the control techniques used in D.C. chopper.
6. To study control of D.C. motor for (a) Current limit control (b) Closed loop torque control(c) Closed loop speed control.
7. To study chopper control of D.C. Motor for motoring and generating control.
8. To study D.C. Motor drive using PLL.
9. To study and simulate AC voltage controller based speed control of AC motor.
10. To study and simulate v/f speed control of Induction motor.

11. To study and simulate Cycloconverter based speed control of synchronous motor.
12. To study Induction Motor drive with slip power recovery scheme

Major Equipment: Not Applicable

List of Open Source Software/learning website:

https://nptel.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160920
Semester – VI
Subject Name: Inter Connected Power System

Type of course: Professional Elective Course

Prerequisite: Power Systems-I and Power Systems-II

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:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction:** Concept of Interconnection, Hierarchical Grid arrangements, Regulatory framework Cascade Tripping, Islanding, Load dispatch centre,	3
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	4
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 Load Flow Method, Comparison of different methods of solution of load flow equations, Numerical,	12
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	08

	Integrated, Purchasing Agency.	
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**
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**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**30**	**20**	**25**	**10**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

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

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160920

Course Outcomes:

At the end of this course, students will have the ability to

Sr. No.	CO statement	Marks % weightage
CO-1	Define the actual power system structure scenario and its operating mechanism in a state and country with major entities and their functions	**10**
CO-2	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	**25**
CO-3	Demonstrate the methods used for voltage and frequency regulation in electrical power network by mathematical analysis	**20**
CO-4	Solve the Unit Commitment problem using Dynamic programming techniques. Analyze the power system economics and factors effecting the economic load dispatch with and without considering network loss	**20**
CO-5	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	**25**

List of Experiments:

1. To study the Ybus formation with the help of simple study system
2. To formulate Static Load Flow Equations of few simple sample study systems
3. To obtain solution of some small study system using approximate load flow method
4. To obtain solution of some small study system using G-S method
5. To obtain solution of some small study system using N-R method
6. To obtain solution of a study system using FDLF method
7. To obtain unit commitment of a power plant
8. To obtain economic load dispatch of power plant

9. To obtain economic load dispatch of generators considering transmission losses

10. To apply analysis of various principles of Load Frequency control with the help of numerical problems

11. To apply analysis of various principles of Power system angle stability with the help of numerical problems

12. To determine stability of a small system using numerical method.

Hands-on and computational experiments related to the course contents. This should include programming of numerical methods for solution of the power flow problem, economic load dispatch, Load frequency control and stability analysis.

Visit to load dispatch centre is suggested

Major Equipment: Not Applicable

List of Open Source Software/learning website:

https://nptel.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160921
Semester – VI
Subject Name: HVDC Transmission Systems

Type of course: Professional Elective Course

Prerequisite: Electrical Power system I and II. The knowledge of Power Electronics I and II is additionally required.

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:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
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
2	**Analysis of Line Commutated Converters** Line Commutated Converters (LCCs): Basic Principal of three-phase AC–DC Conversion, six pulse 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.	08

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**
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**
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**
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**
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**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**30**	**20**	**25**	**10**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

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

Course Outcomes:

At the end of this course, students will have the ability to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the advantages of dc transmission over ac transmission.	**10**
CO-2	Analysis of Line Commutated Converters and Voltage Source Converters in HVDC Transmission System.	**35**
CO-3	Application of suitable control strategies used for LCC and VSC based HVDC transmission system.	**25**
CO-4	Evaluation of Power system angular, voltage and frequency stability using simulation models for various configuration of an HVDC system.	**30**

List of Experiments: Suggested List (But not the least)

1. Study of various HVDC transmission system components and its applications.
2. Study of AC/DC side voltage and current waveforms of six pulse converter system under variable R-L Load using simulation. (Hint: input PF, THD, converter efficiency, reactive power flow etc).
3. 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).
4. Study of reactive power control in HVDC transmission system.
5. Study of various types of Multi terminal HVDC transmission system.
6. Some simulation practices based on HVDC power and voltage stability.
7. Study of DC link control in VSC based HVDC transmission system.
8. Study of various passive filters used in LCC based HVDC transmission system.
9. Operation of VSC for power factor correction at AC side of HVDC system using sinusoidal pulse width modulation.

The above practical list is based on model syllabus. However, Hands-on MATLAB simulation based models related to the course contents can be carried out. It can include modeling of power electronics based switching devices used for rectification and inversion procedure in HVDC transmission system. The coupling of two asynchronous systems can also be modeled for power flow and frequency control analysis.

Note**: Visit to HVDC Transmission Substation is encouraged near Chandrapur–Padghe, Maharastra.

Major Equipment: Not Applicable

List of Open Source Software/learning website:

https://nptel.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160922
Semester – VI
Subject Name: Object Oriented Programming

Type of course: Open Elective

Prerequisite: Basic Programming Concepts

Rationale: This course is an introductory course in Object Oriented Programming (OOP). The fundamental concepts of OOP will be studied using the C++ programming language. OOP has become a fundamental part of software development. OOP facilitates reuse of code, flexibility and effective problem solving. This course introduces standard tools and techniques for software development, using object oriented approach.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (V)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	20	30	150

Content:

Sr. No.	Content	Total Hrs
1	**OOP Concepts** : Introduction OOP, Procedural Vs. Object Oriented Programming, Principles of OOP, Applications of OOP	2
2	**Expression and Statements** : Data types, Expression, control statements and Iteration, typecasting	3
3	**Arrays and Functions** : 1D and 2D arrays, passing data to functions, scope and visibility of variables in functions, inline function, default arguments	5
4	**Classes** : Basics of object and class in C++, access specifiers - private and public members, static data members, class scope, constructors and their types, destructors, operator overloading, scope operator,	6
5	**Overloading** : Function overloading, Operator overloading, Type conversion	3
6	**Inheritance** : Concept of Inheritance, types of inheritance: single, multiple, multilevel, hierarchical, hybrid, protected members, overriding,	4
7	**Exception Handling :** Introduction to exception, try-catch-throw, multiple catch, catch all, rethrowing exception, implementing user defined exceptions	2
8	**I/O and File management** : Concept of streams, cin and cout objects, C++ stream classes, Unformatted and formatted I/O, manipulators, File stream,	3

Reference Books:

1 Object Oriented Programming in Turbo C++, Robert Lafore, Galgotia
2 The Compete Reference C++, Herbert Schlitz, TMH
3 Object Oriented Programming With C++, E Balagurusamy, TMH
4 C++ Programming, Black Book, Steven Holzner, dreamtech
5 C++ Primer Stanley B Lippman, Josée Lajoie, Barbara E. Moo

Course Outcomes (CO):

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160922

Sr. No.	CO statement	Marks % weightage
1	Understand Object Oriented Programming concepts and basic characteristics of C++	**20**
2	Differentiate between object oriented and procedure-oriented methodology.	**10**
3	Understand the concept of function and overloading	**20**
4	Know the principles of data encapsulation, inheritance, polymorphism, access specifiers, exceptions	**35**
5	Know the concept of streams	**15**

List of Experiments:

1.	Write a program that will allow computer to be used as an ordinary calculator. Consider only common arithmetic operations.(+, -, *, /) The program should display a menu showing the different options available. Do using if and also using switch statements.
2.	Write a program to arrange an array of N elements into ascending order
3.	Write a program to demonstrate the use of Scope Resolution Operator:: with variable name.
4.	Write a program to demonstrate the use of Manipulators (setw () and endl).
5.	Write a program which calculates volume of cube, cylinder, and rectangular box. (Use function overloading).
6.	Create a class SPACE having three member data x(int),y(int),z(int).overload the unary '-' operator for the class SPACE.
7.	Create a class Box whose default constructor initializes the dimensions length, width and height of the box. The main method is to be created for the above class that creates a Box object of dimension 3.89 cm, 2.1 cm and 1.5 cm. compute the volume of this box.
8.	Write a program to create a copy constructor. A constructor should be created, then a second constructor should be created which should have values of the previous constructor.
9.	Write a simple program that multiplies two numbers and then also divides the two numbers.(Use Inline Functions)
10.	Create a class called ITEM that has separate member data for item number(int) and item cost(float).Include the following member functions: • setdata( )to set these values to predefined values in the program • getdata( )to get these values from the user • putdata( ) to display these values.
11.	Write a program to demonstrate the use of static member data and static member function.
12.	Define a class to represent a bank account. include the following members: **Data members :** 1) name of the depositor 2) account number 3) type of account 4) balance amount in the account **Member functions:** 1) to assign initial value 2) to deposite an amount 3) to withdraw an amount after checking the balance 4) to display name and balance Write a main function to test the program.
13.	Implement Student class having proper member variables and functions for the following : • To input marks of 5 subjects. • Check whether or not student is pass. (above 40 marks is required to pass) • Check grade of student

	If percentage is >=70 then A grade >=60 and <70 then B grade >=50 and <60 then C grade >=40 then D grade • Display whole result of a given student Write main program to create such, n objects for n students and enter information for all students. Write a function to display information of all students who are PASS. Write a function to display information of those students who are FAIL. Also write a function to Display information of first 3 ranker students.
14.	Implement a string class containing the following functions. • Overloaded + operator function to carry out the concatenation of strings. • Overloaded = (assignment) operator function to carry out string copy. • Function to display the length of a string. • Function to overload comparison operator (= =) for two strings.
15.	Assume that a bank maintains two kinds of accounts for customers, one called as savings account and the other as current account. The savings account provides compound interest and withdrawal facilities but no cheque book facility. The current account provides cheque book facility but no interest. Current account holders should also maintain a minimum balance and if the balance falls below this level, a service charge is imposed. Create a class account that stores customer name, account number and type of account. From this derive the classes cur_acct and sav_acct to make them more specific to their requirements. Include necessary member functions in order to achieve the following tasks: • Accept deposit from a customer and update the balance. • Display the balance. • Compute and deposit interest. • Permit withdrawal and update the balance. • Check for the minimum balance, impose penalty, necessary, and update the balance.
16.	Create a class called TIME that has separate member data for hour(int) and minutes(int). Include the following member functions: • setdata( )to set these values to predefined values in the program • getdata( )to get these values from the user • putdata( ) to display these values. • add_time( ) to add two time objects to a third time object (e.g. T3.add_time(T1,T2). • Make new function to return a time object after addition of object passed as argument with the calling object, so that the function works as follows: T3=T1.add_time(T2).
17.	Write a program with the following: • A function to read two double type numbers from keybord. • A function to calculate divison of these two numbers. • A try block to throw an exception when a wrong type of data is keyed in . • A try block to detect and throw an exception if the condition “divide by zero ” occurs. • Appropriate catch block to handle the exception thrown.
18.	WAP in c++ to convert lowercase to uppercase from a file.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160923
Semester – VI
Electrical Materials

Type of course: Engineering – Open Elective Course

Prerequisite: Physics (3110018) and Basic Electrical Engineering (3110005).

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:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total HRS	% Weightage
01	**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	20
02	**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 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.	09	20

03	**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	20
04	**Semi-Conductors and Superconductors** General concepts, energy bands, types of semiconductors: intrinsic Semi-conductors, 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	20
05	**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	20

Text Books:

1. Electrical Engineering Materials: A.J. Dekker, PHI Publication.
2. An Introduction to Electrical Engineering Materials: C. S. Indulkar and S. Thiruvengadam, S. Chand & Co., India.

Reference Books:

1. Material Science for Electrical & Electronics Engineers: Ian P. Hones, Oxford University Press.
2. Electrical Properties of Materials: L. Solymar and D. Walsh, Oxford University Press-New Delhi.
3. A Course in Electrical Engineering Materials: T K Basak, New Age Science Publications.
4. A Course in Electrical Engineering Materials: R K Rajput, Laxmi Publications.
5. A Course in Electrical Engineering Materials: S. P. Seth and P. V. Gupta, Dhanpat Rai & Sons.
6. Electrical and Electronic Engineering Materials: S.K. Bhattacharya, Khanna Publishers, New Delhi.
7. Electrical Engineering Materials: T.T.T.I Chennai, Tata MacGraw Hill.

Suggested Specification table with marks(Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	25	20	15	10	5

Legends: R: Remembrance; U: Understanding, A: Application, N: Analyze, E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome (Theory):

After learning the course the students should be able to:

Sr. No.	CO Statement	Marks % Weightage
01	Recall different material and its properties which are used in electrical equipments as conductor and its properties in electrical equipments.	20
02	Elucidate various types of dielectric materials, special purpose materials and their properties in various conditions.	40
03	Evaluate types of magnetic materials and its behavior.	20
04	Analyze semi-conductor and superconducting material used in electrical engineering and different effect associated with the materials.	20

List of Open Source 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/

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3161925
Semester – VI
Subject Name: Cyber Laws and Ethics

Type of course:

Prerequisite: Nil

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:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
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
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 Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.	10
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
4	**Electronic Business and legal issues:**	09

	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.	
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
	Total Hours	**45**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	25	25	20	10	--

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

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

Course Outcomes: Students will be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand Cyber laws	25
CO-2	Describe Information Technology act and Related Legislation.	25
CO-3	Demonstrate Electronic business and legal issues.	25
CO-4	Interpret Cyber Ethics.	25

Term Work:
The term work shall be based on the topics mentioned above.