Gandhinagar Institute of Technology

Academic Regulation & Curriculum For

B. Tech in

Electrical Engineering (EE) Department

(w.e.f. 2026-27)

Preamble

The Department of Electrical Engineering is dedicated to quality education, innovation, and practical learning in the field of electrical systems, power electronics, and smart energy technologies. The B.Tech. curriculum for the academic session 2026–2027 has been developed as per UGC, AICTE, NCrF, NEP 2020, and IEEE blended learning syllabus guidelines with an Outcome-Based Curriculum (OBC) and Choice-Based Credit System (CBCS).

The curriculum includes emerging technologies such as Artificial Intelligence & Machine Learning applications in power systems, Smart Grid Technology, Electric Vehicles (EVs), and Design Thinking. Special focus is placed on Sustainable Energy Systems through Renewable Energy Integration, Power Electronics & Drives, and Advanced Control Systems to meet the growing demands of the modern power, automation, and green energy industries.

The department continuously updates the syllabus through stakeholder feedback to ensure industry relevance, practical exposure, and future readiness, helping students become skilled engineers and innovators.

Table of Contents

1. Institutional Vision & Mission

VISION:

To create a flexible and learner-focused engineering ecosystem that builds strong technical skills, practical knowledge, and innovative thinking, preparing graduates to adapt, perform, and lead in a rapidly evolving technological and societal environment.

MISSION:

To provide a holistic learning environment that develops technical skilled, innovative, and socially responsible engineers capable of addressing industrial, technological, and societal needs.

Departmental Vision & Mission

VISION

To promote specialized knowledge in the field of Electrical Engineering along with interdisciplinary awareness and to develop a framework to support the communicative and ethical needs of industry and society at global level..

MISSION

To impart quality education in the field of Electrical Engineering and to pursue research and higher studies by providing latest development through expert lectures, conferences and workshops..

2. Program Objectives

1. To provide quality education in electrical engineering, power systems, and related technologies.
2. To develop strong theoretical knowledge and practical skills required for designing, analyzing, and implementing electrical engineering solutions.
3. To equip students with the ability to use modern engineering tools and simulation software for solving real-world power and automation problems.
4. To encourage innovation, creativity, and research in emerging areas such as Renewable Energy, Smart Grids, Electric Vehicles (EVs), Power Electronics, and Wireless Power Transfer.
5. To provide hands-on learning through electrical laboratories, projects, internships, and industry interaction.
6. To develop effective communication, teamwork, leadership, and problem-solving skills among students.
7. To promote professional ethics, social responsibility, energy conservation awareness, and lifelong learning.
8. To prepare students for successful careers in the power industry, manufacturing, higher education, entrepreneurship, and research.

3. Program Educational Objectives (PEOs)

PEO1
"Utilize sound principles of Electrical Engineering in various fields like electrical machines, Renewable energy, power system, power electronics, control system, etc."

PEO2
"Demonstrate professionalism including continued learning and professional activities."

PEO3
"Work successfully in their chosen career individually and within a professional team environment."

PEO4

"To prepare graduates with effective communication skills, professional ethics, leadership qualities, and an aptitude for contributing to societal and national needs."

4. Program Details

1. Program Structure & Duration

- Duration & Intake : 4 Years & 60 Seats
- Semesters: 8
- Mode: Full Time
- Credit Structure: As per NCrF, NEP / University norms
- Medium of Instruction: English

2. Eligibility Criteria for Admission

Candidates who have obtained a bachelor's degree in any discipline from a recognized University/Institution approved by UGC, with minimum 50% aggregate marks (45% for reserved category candidates as per applicable norms), shall be eligible for admission to the program.

3. Admission Procedure

Admission to the B. Tech in Electrical program may be granted on the basis of merit obtained in the ACPC Allotment and in the qualifying examination and or performance in the Entrance Test and or Personal Interview or evaluation of Statement of Purpose, as prescribed by the University from time to time.

The University reserves the right to revise admission procedures.

4. Credit distribution as per NEP-2020 for B Tech Course in EE

Course Type	**EE Credit**
Humanities and Social Sciences including Management Courses	05%
Basic Science Courses	15%
Engineering Science Courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer, etc.	10%
Program Core Courses	50%
Multidisciplinary	05%
Project / Training	10%
Skills (AEC, VAC, SEC), IKS	05%
Total	100%

Definition of Credit (as per UGC / AICTE):

- 1 Hour Lecture (L) per Week = 1 Credit 1 Hour Tutorial (T) per Week = 1 Credit
- 1 Hour Practical (P) per Week = 0.5 Credits 2 Hours Practical (Lab) per Week = 1 Credit

5. Curriculum Structure

Gandhinagar Institute of Technology - 01

Program Name: Bachelor of Technology (01)			Branch Name (Code): EE (003) Batch – III & IV, V-2024-25, 2025-26 & 2026-27				
Semester / Year: 01 / 01							
NCrF LEVEL	Subject Code	Course Type	Subject Name	Credit	Hours per week		
					L	T	P	Total
NCR – 4.5	10000101	Basic Science	Engineering Mathematics-I	5	3	2	0	5
	10050101	Professional Core	Programming for Problem Solving	5	4	0	2	6
	10010105	Engineering Science	Engineering Foundation	4	3	0	2	5
	10050102	Professional Core (Basic Science)	ICT Fundamental & Workshop	4	4	0	0	4
	SEC001	SEC-I	Animation & Graphics Design	2	2	0	0	2
	VAC003	VAC-I	Awareness of Cybercrime and Ethical Hacking	2	2	0	0	2
	AEC016	AEC-I (Humanities)	Practical English	2	2	0	0	2
				24	**20**	**2**	**4**	**26**

Program Name: Bachelor of Technology (01)			Branch Name (Code): EE (003) Batch – III & IV, V-2024-25, 2025-26 & 2026-27				
Semester / Year: 02 / 01							
NCrF LEVEL	Subject Code	Course Type	Subject Name	Credit	Hours per week		
					L	T	P	Total
NCR – 4.5	10000201	Basic Science	Engineering Mathematics-II	5	3	2	0	5
	10000003	Basic Science	Engineering Physics	4	3	0	2	5
	10050201	Professional Core	Basics of Python / Fundamental of Civil	4	3	0	2	5
	10030101	Professional Core	Basic of Electrical & Electronics	4	3	0	2	5
	SEC019	SEC-II (Basic Science)	Social Media Management	2	2	0	0	2
	VAC021	VAC-II (Humanities)	Stress & Time Management	2	2	0	0	2
	AEC015	AEC-II	Personality Development for Effective Leadership	2	2	0	0	2
	IKS0201	IKS	Indian Ancient History & Cultural Heritage	2	1	0	2	3
				25	**19**	**2**	**6**	**26**

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Program Name: Bachelor of Technology (01)			Branch Name (Code): EE (003) Batch – III & IV, V-2024-25, 2025-26 & 2026-27					
Semester / Year: 03 / 02								
NCrF LEVEL	Subject Code	Course Type	Subject Name	Credit	Hours per week			
					L	T	P	Total
NCR – 5.0	10030301	Professional Core	Analog and Digital Electronics	4	3	0	2	5
	10030302	Professional Core	Electrical Measurement and measuring Instrument	4	3	0	2	5
	10030303	Professional Core	Circuit and Networks	4	3	0	2	5
	10030304	Basic Science	Numerical and Statistical Methods	4	3	1	0	4
	10000302	Humanities and Social Science	Economics and Management	3	3	0	0	3
	VAC023	VAC	UHV	2	2	0	0	2
			Total	**21**	**17**			**24**

Program Name: Bachelor of Technology (01)			Branch Name (Code): EE (003) Batch – III & IV, V-2024-25, 2025-26 & 2026-27					
Semester / Year: 04 /02								
NCrF LEVEL	Subject Code	Course Type	Subject Name	Credit	Hours per week			
					L	T	P	Total
NCR – 5.0	10030401	Professional Core	Electrical Machine-1	4	3	0	2	5
	10030402	Professional Core	Power System -1	4	3	0	2	5
	10030403	Engineering Science	Control Theory	4	3	0	2	5
	10030404	Professional Core	Power Electonics	4	3	0	2	5
	100000401	IKS	IKS – Vedic Maths	2	2	0	0	2
	SEC014	SEC	Introduction of Cyber Security	2	2	0	2	4
			Total	**20**	**16**			**24**

Program Name: Bachelor of Technology (01)			Branch Name (Code): EE (003) Batch – III & IV, V-2024-25, 2025-26 & 2026-27					
Semester / Year: 05 / 03								
NCrF LEVEL	Subject Code	Course Type	Subject Name	Credit	Hours per week			
					L	T	P	Total
NCR – 5.5	10030501	Professional Core	Electrical Machine-II	4	3	0	2	5
	10030502	Professional Core	Power System -II	4	3	0	2	5
	10030504	Professional Core	Advanced Power Electronics	4	3	0	2	5
	10030503	Professional Core	Microprocessor and Microcontroller	4	3	0	2	5
	10030505	Basic Science	Electromagnetic Field Theory	4	3	0	2	5
		Professional Core	**Open Elective – I**	**3**	**3**	**0**	**0**	**3**
				23	**18**			**28**
		Eng. Science (Minor Sub)	Open Elective – I					
	10030507	**Electrical Power Utilisation and Safety**						
	10030508	**Introduction to Robotics**						

Program Name: Bachelor of Technology (01)			Branch Name (Code): EE (003) Batch – III & IV, V-2024-25, 2025-26 & 2026-27					
Semester / Year: 06 / 03								
NCrF LEVEL	Subject Code	Course Type	Subject Name	Credit	Hours per week			
					L	T	P	Total
NCR – 5.5	10030601	DSC	Interconnected Power system	4	3	0	2	5
	10030605	DSC	Electrical Machine design	4	3	0	2	5
	10030603	DSC	Electrical Drives	4	3	0	2	5
	10030604	DSC	Signal and system	3	2	0	2	4
	10030601	DSC	Interconnected Power system	4	3	0	2	5
		Professional Elective	Elective I	4	3	0	2	5
		Professional Elective	Elective II	3	3	0	0	3
		IKS	Seminar on IKS	2	0	0	4	4
				25	**17**			**31**
		Elective-I						
	10030609	Professional Elective	Electric Vehicle Technology					
	10030606	Professional Elective	Hight Voltage Engineering					
		Elective-II						
	10030607	Professional Elective	Renewable energy					
	10030608	Professional Elective	Energy Conservation and Audit					

Program Name: Bachelor of Technology (01)			Branch Name (Code): EE (003) Batch – III & IV, V-2024-25, 2025-26 & 2026-27					
Semester / Year: 07/04								
NCrF LEVEL	Subject Code	Course Type	Subject Name	Credit	Hours per week			
					L	T	P	Total
NCF – 6.0	100000707	IKS	IKS - P10 (Ancient India and World)	2	**2**	**0**	**0**	**2**
	10030702	Professional Core	Switch Gear and Protection	4	3	0	2	**5**
			Professional Elective- III	4	3	0	2	**5**
			Professional Elective- IV	4	3	0	2	**5**
	10030703		Summer Internship/ Minor Project	4	0	0	8	**8**
	10030708	Technical Seminar	Technical Seminar	4	0	0	8	**8**
				22	**11**		**22**	**33**
	Elective-III							
	10030704	Professional Core	Electrical Machine design					
	10030705	Professional Core	HVDC Transmission system					
	Elective-IV							
	10030706	Professional Core	Advanced Electrical drives					
	10030707	Professional Core	Powe Quality and Facts					

Program Name: Bachelor of Technology (01)			Branch Name (Code): EE (003) Batch – III & IV, V-2024-25, 2025-26 & 2026-27					
Semester / Year : 08/04								
NCrF LEVEL	Subject Code	Course Type	Subject Name	Credit	Hours per week			
					L	T	P	Total
NCF – 6.0	10030801	Major Project	Major Project / Intership	1	0	0	2	8
	10030802	Technical Seminar	Technical Seminar	11	0	0	12	24
				12			**14**	**32**

Overall Credit Summary

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Credit	**24**	**25**	**21**	**20**	**23**	**25**	**22**	**12**	**172**

6. Teaching, Learning & Evaluation

1. Teaching Methodology

The program shall adopt:

- Classroom Teaching
- Case Studies
- Industry Interaction
- Site Visits
- Workshops
- GIS/Software Training
- Field Surveys
- Research Projects
- Internships
- AI-based Learning Tools
- Blended and Digital Learning

2. Attendance Rules

- Minimum 75% attendance shall be mandatory in each course.
- Students below prescribed attendance may not be permitted to appear in examination.
- Additional attendance requirements may apply for practical's, internships, and field work.

3. **Examination and Evaluation System**

6.3.1 Evaluation Components

- The evaluation may consist of Continuous Internal Evaluation (CIE) and End Semester Examination (ESE)
- Continuous Internal Evaluation (CIE) may include:
- Mid-Semester Examination
- Assignments
- Presentations
- Field work
- Class Test
- AI Quiz & Viva Voce
- Dissertation
- Project work

4. Suggested Weightage

- Continuous Internal Evaluation: 40%
- End Semester Examination: 50%

5. Passing Standards

- Minimum 50% marks in each component where applicable.
- Minimum 50% aggregate for passing the course/program.
- Separate passing may be required in theory and practical examinations.

6. Grading System

The program shall follow Gandhinagar University grading norms.

6.6.1 Grade Table

Evaluation Scheme:

- Grading Scheme: A student is awarded a grade on the basis of his/her performance in examination assignments, practical exam etc. These grades are described by the letters AA, AB, BB, BC, CC, CD, DD FF and their numerical equivalent called "grade point" are as below.

UG	Range of Marks (%)	≥80	≥73 <80	≥66 <73	≥60 <66	≥55 <60	≥50 <55	≥45 <50	<45
	Letter Grade	AA	AB	BB	BC	CC	CD	DD	FF
	Grade Point	**10**	**09**	**08**	**07**	**06**	**05**	**04**	**00**
UG B.Pharm.	Range of Marks (%)	≥90	≥80 <90	≥70 <80	≥60 <70	≥50 <60	<50	-	-
	Letter Grade	AA	AB	BB	BC	CC	FF	-	-
	Grade Point	**10**	**09**	**08**	**07**	**06**	**00**	-	-
PG	Range of Marks (%)	≥80	≥75 <80	≥70 <75	≥65 <70	≥60 <65	≥55 <60	≥50 <55	<50
	Letter Grade	AA	AB	BB	BC	CC	CD	DD	FF
	Grade Point	**10**	**09**	**08**	**07**	**06**	**05**	**04**	**00**
Diploma in Engg.	Range of Marks (%)	≥90	≥80 <90	≥70 <80	≥62 <70	≥53 <62	≥44 <53	≥35 <44	<35
	Letter Grade	AA	AB	BB	BC	CC	CD	DD	FF
	Grade Point	**10**	**09**	**08**	**07**	**06**	**05**	**04**	**00**
Diploma in Pharmacy	Range of Marks (%)	≥85	≥75 <85	≥65 <75	≥55 <65	≥45 <55	≥40 <45	<40	-
	Letter Grade	AA	AB	BB	BC	CC	CD	FF	-
	Grade Point	**10**	**09**	**08**	**07**	**06**	**05**	**00**	-

7. Dissertation / Project Work

Students shall undertake Research Project OR Industry-Based Dissertation. Requirements may include:

- Proposal Presentation
- Periodic Review
- Final Report Submission
- Viva Voce Examination

The dissertation shall be evaluated by internal and external examiners.

7. Rules and Regulations

1. Rules for Promotion

A student shall be promoted to the next semester as per Gandhinagar University rules subject to fulfilment of academic requirements, minimum attendance and Completion of required credits.

2. Maximum Duration for Completion

The maximum duration for completing the program shall be 4 years from the date of admission (or as prescribed by the University.)

3. Internship Guidelines

7.3.1 Students shall undergo mandatory internship / field training in:

- Power Sector Utilities (Power Generation, Transmission, and Distribution Companies)
- Core Electrical Manufacturing Industries (Transformers, Motors, Switchgears, and Cables)
- Renewable Energy and Smart Grid Companies (Solar, Wind, and Microgrid operations)
- Electric Vehicle (EV) and Battery Infrastructure Companies
- Industrial Automation & Control Systems (PLC, SCADA, and Drives)
- Energy Auditing and Consulting Firms
- Research Organizations & National Labs (e.g., CPRI, DRDO, ISRO, BARC)

➢ Optional Sub-categories (If you need to provide specific examples to your students):

- Power & Energy: State Electricity Boards, Torrent Power, Adani Power, Tata Power.
- Manufacturing: ABB, Siemens, Schneider Electric, L&T, Crompton Greaves.
- EV & Modern Tech: Tata Motors, Ather Energy, companies working on Vehicle-to-Grid (V2G) or Wireless Power Transfer infrastructure.

7.3.2 Students must submit:

- Internship Report
- Work Diary / Logbook
- Completion Certificate
- Presentation

4. Discipline Rules

Students shall maintain discipline, professional ethics, and proper conduct within the institution,

during field visits, internships, industry interactions, examinations, and all academic activities. Students are expected to attend classes regularly, follow institutional rules and regulations, respect faculty members, staff, fellow students, and institutional property, and maintain academic integrity in assignments, projects, and examinations. Any form of misconduct, ragging, indiscipline, use of unfair means in examinations, damage to institutional property, harassment, or behavior affecting the academic environment shall be treated seriously and may result in disciplinary action including warning, suspension, cancellation of examination, withholding of results, or expulsion from the

Program as per University rules and UGC regulations. Students shall also comply with all safety, ethical, and professional standards prescribed by the institution from time to time.

5. Anti-Ragging Policy

The program shall strictly follow:

- UGC Anti-Ragging Regulations
- Anti-Ragging Affidavit requirements
- Institutional disciplinary procedures
- Ragging in any form is strictly prohibited.

6. Ethical use of Technology and AI Tools

Students are encouraged to use:

- Various Software and AI Tools
- Data Analytics Tools
- AI-based Learning Platforms
- AS per Subject Use various Software
- Digital Tools

Use of AI tools shall be ethical and academic integrity must be maintained.

8. Student Support

1.1 Industry Collaboration

The department shall actively promote collaboration with real estate companies, infrastructure firms, valuation agencies, urban planning organizations, government departments, financial institutions, municipal bodies, smart city projects, and professional organizations to enhance practical exposure and industry relevance of the program. Such collaborations may include internships, field training, live projects, expert lectures, workshops, industrial visits, consultancy assignments, joint research activities, skill development programs, and placement support. The institution may also establish Memoranda of Understanding (MoUs) with industry partners and professional bodies for academic enrichment, technology support, certification programs, and collaborative initiatives aimed at improving employability, entrepreneurship, innovation, and professional competency among students.

1.2 Research and Consultancy

The department shall encourage faculty members and students to actively engage in research, consultancy, innovation, and applied studies related to real estate, valuation, urban development, infrastructure planning, sustainability, smart cities, GIS, and emerging technologies. Students may undertake research projects, market surveys, valuation studies, policy analysis, urban development assessments, and data-driven studies as part of their academic and professional training. The institution may also undertake consultancy assignments for government agencies, local authorities, industries, financial institutions, developers, and other organizations in areas such as property valuation, feasibility analysis, urban planning, infrastructure assessment, GIS mapping, and real estate market studies. Participation in seminars, conferences, workshops, publications, funded projects, and collaborative research activities shall be encouraged to promote academic excellence, innovation, and industry- oriented learning.

1.3 Library and Laboratory Facilities

1.4 Adequate library, laboratory, and digital learning facilities shall be made available to support effective teaching, practical training, research, and skill development under the Electrical Engineering program. The department shall facilitate access to relevant books, journals, research publications, e-resources, technical standards (e.g., IEEE, IEC), grid codes, equipment manuals, simulation databases, and digital learning platforms related to power systems, electrical machines, control systems, renewable energy, electric vehicles, and emerging technologies. Necessary computing facilities, electrical simulation and modeling software (such as MATLAB/Simulink, ETAP, or AutoCAD Electrical), hardware testing setups, internet access, and other technical resources required for practical and project-based learning shall also be provided to enhance industry-oriented education, research capability, and professional competency among students.

1.5 Student Support and Mentoring

1.6 A structured system for student support, academic mentoring, and professional guidance shall be implemented for students enrolled in the Electrical Engineering program. The department shall facilitate academic counselling, mentoring, career guidance, research support, and skill development activities to assist students in their academic progression and professional growth. Students may also be provided opportunities for interaction with industry experts, participation in workshops, seminars, field visits, training programs, and extracurricular activities aimed at enhancing employability, leadership qualities, communication skills, and overall personality development. Necessary support mechanisms for addressing academic and personal concerns shall also be made available as per institutional policies.

1.7 Placement and Career Development

The department shall promote placement assistance and career development activities for students through industry interaction, professional networking, training programs, internships, and campus engagement initiatives. Efforts shall be made to establish linkages with power sector utilities, electrical equipment manufacturers, renewable energy firms, electric vehicle (EV) companies, industrial automation providers, and related engineering sectors to facilitate internships, live projects, industrial exposure, and employment opportunities for students. Career development activities such as aptitude training, resume preparation, soft skill development, entrepreneurship guidance, certification programs, expert sessions, and placement-oriented workshops may also be organized to enhance professional competency and employability of students.

9. Program Credibility

9.1 Executive Summary

The Department of Electrical Engineering focuses on developing technically skilled, innovative, and industry-ready graduates with strong fundamentals in electrical networks, power systems, electrical machines, control systems, power electronics, renewable energy, and smart grid technologies.

The program prepares students for placement opportunities in power sector utilities, electrical equipment manufacturing, renewable energy firms, electric vehicle (EV) industries, industrial automation, energy consulting, and research organizations. Through practical learning, industry interaction, internships, and project-based training, students gain the knowledge and professional skills required to adapt to emerging technologies and succeed in diverse technical careers.

9.2 Scope and Career Opportunities

Graduates of the Electrical Engineering program may work in:

- Power Generation, Transmission, and Distribution Utilities
- Electrical Equipment Manufacturing Companies (Transformers, Motors, Switchgear)
- Renewable Energy and Smart Grid Companies
- Electric Vehicle (EV) and Battery Infrastructure Industries
- Industrial Automation and Control Industries
- Energy Auditing and Consulting Firms
- MEP (Mechanical, Electrical, and Plumbing) and Infrastructure Organizations
- Defense and Aerospace Organizations
- Railways and Transportation Sectors
- Research and Development Organizations
- Government Departments and Public Sector Undertakings (PSUs)
- Software and IT Companies (focusing on Power System Simulation, IoT, and Energy Analytics)

Potential Job Roles

- Electrical Engineer
- Power Systems Engineer
- Electrical Design Engineer
- Power Electronics Engineer
- Control and Instrumentation Engineer
- Renewable Energy Engineer
- Electric Vehicle (EV) Engineer
- Smart Grid Engineer
- Protection and Relay Engineer
- Energy Auditor / Energy Manager
- Industrial Automation Engineer
- Testing and Commissioning Engineer
- Maintenance and Operations Engineer
- Project Engineer
- Research and Development Engineer

9.3 Higher Study & Professional Opportunities

Students may pursue:

- M. Tech. in Electrical Engineering
- M. Tech. in Power Systems Engineering
- M. Tech. in Power Electronics and Drives
- M. Tech. in Control Systems and Instrumentation
- M. Tech. in Renewable Energy and Smart Grids
- M. Tech. in Electric Vehicle (EV) Technology
- MBA in Energy Management, Technology Management, or Operations Management
- Ph.D. in Electrical Engineering, Power Systems, Renewable Energy, or related disciplines
- GATE Qualification for Higher Studies and PSU Opportunities
- Industry Certifications in Industrial Automation (PLC/SCADA), Energy Auditing, Electric Vehicles, and Smart Grids
- International Certifications in Energy Management, Power Quality, and Electrical Safety
- Research and Innovation Projects in Emerging Technologies

10. Collaborative Field Work / Experimental Work

The B. Tech Electrical Engineering programme shall emphasize practical learning, industry exposure, and application-oriented engineering education through collaborative field work, laboratory practice, workshops, industrial training, and experimental learning activities.

Students may participate in:

1. Industrial visits, field training, and exposure to power plants, substations, and manufacturing units.
2. MATLAB/Simulink, ETAP, and power system modelling, simulation, and design-based exercises.
3. Hardware development, PCB fabrication, and prototype-building activities for electrical circuits and power electronics.
4. Smart grid technologies, Electric Vehicle (EV) infrastructure, Vehicle-to-Grid (V2G) integration, Wireless Power Transfer (WPT), and renewable energy-related experimental projects.
5. Research projects, innovation challenges, technical competitions, and interdisciplinary engineering activities.
6. Internship programs, industry-oriented mini projects, and major project work in collaboration with power utilities, industries, and research organizations.

The programme shall encourage experiential learning, problem-solving ability, teamwork, innovation, technical communication, and practical engineering competency aligned with modern industrial and technological requirements.

11. Market Survey Review

11.1 Executive Summary

Electrical Engineering – Future Scope & Industry Demand

The demand for Electrical engineers is expected to grow continuously from 2026 onwards due to the rapid global transition towards sustainable energy, electrification, and smart automation. Growth in renewable energy integration, electric vehicles (EVs) and charging infrastructure, smart grids, power electronics, industrial automation, and intelligent energy management is creating large career opportunities for EE graduates.

Students completing a B. Tech. in Electrical Engineering can work in power generation and distribution utilities, electrical equipment manufacturing, renewable energy firms, EV and battery technology companies, industrial automation sectors, energy consulting, and research organizations. Industries are seeking graduates with practical knowledge, technical skills, innovation ability, and adaptability to modern power systems and digital grid technologies.

The program offers opportunities in core technical roles, software-related power simulations, research, higher studies, government sectors (PSUs), and entrepreneurship. The future market trend indicates that Electrical Engineering will remain one of the most demanding and career-oriented engineering branches in the coming years.

Market Demand & Industry Trends

The Electrical Engineering (EE) sector plays a vital role in technological advancement, sustainable energy transition, digital power grids, and industrial automation. The demand for skilled EE professionals continues to grow across various industries. Major growth areas include:

1. Renewable Energy Systems and Integration (Solar, Wind, and Hydro power)
2. Smart Grid Technologies and Digital Substation Automation
3. Electric Vehicles (EVs), Battery Management Systems (BMS), and Charging Infrastructure
4. Power Electronics, Drivers, and Energy Efficient Systems
5. Industrial Automation, Robotics, and Control Systems (PLC/SCADA)
6. Energy Storage Systems (ESS) and High-Capacity Battery Technologies
7. Microgrids and Decentralized Power Distribution Generation
8. High Voltage Direct Current (HVDC) and Flexible AC Transmission Systems (FACTS)
9. Energy Auditing, Management, and Sustainability Solutions
10. Aerospace, Defense, Marine, and Rail Electrification
11. Smart Cities, Intelligent Building Management Systems (BMS), and Digital Infrastructure
12. Cyber-Physical Systems, Internet of Energy (IoE), and Industry 4.0 Grid Technologies

Industries are increasingly looking for engineers with strong technical knowledge, practical skills, digital competency, innovation capability, and the ability to work with emerging technologies in a rapidly changing environment.

11.2 Skill Gap Identified by Industry

Industry feedback and market analysis have identified several skill gaps commonly observed among engineering graduates, including:

1. Limited practical and hands-on experience with electrical power systems, industrial machinery, and high-voltage equipment.
2. Insufficient industrial exposure and application-based learning in core electrical environments such as power plants, substations, and manufacturing units.
3. Lack of proficiency in industry-standard software and electrical simulation tools (e.g., MATLAB/Simulink, ETAP, AutoCAD Electrical, and PLC programming).
4. Limited knowledge of modern power transitions, including Electric Vehicles (EVs), renewable energy integration, and Battery Management Systems (BMS).
5. Insufficient exposure to digital grid infrastructure, industrial automation (SCADA/PLC), and advanced protective relaying.
6. Limited understanding of AI, machine learning, and data-driven applications in energy management, power quality analysis, and system optimization.
7. Weak problem-solving, communication, teamwork, and project management skills.
8. Insufficient industry interaction and real-world project experience.

The industry has emphasized the need for graduates who are technically competent, innovative, adaptable, and capable of contributing effectively to the power sector, renewable energy, electrical equipment manufacturing, industrial automation, and smart grid technology sectors.

11.3 Employment Opportunities & Industry Support

Graduates of the programme shall have employment opportunities in power sector utilities, electrical equipment manufacturing companies, renewable energy firms, electric vehicle (EV) industries, industrial automation providers, energy consulting agencies, aerospace and defense sectors, information technology companies, research organizations, startups, and public sector undertakings (PSUs).

Industries have also expressed willingness to support the programme through:

1.Internships and Industrial Training

2.Industrial Visits and Expert Lectures

3.Industry-Sponsored Projects

4.Collaborative Research and Development Activities

5.Workshops, Seminars, and Skill Development Programs

6.Innovation and Entrepreneurship Support

7.Placement and Career Development Activities

The programme is therefore expected to contribute significantly towards developing industry-ready Electrical Engineers equipped with modern technical knowledge, practical skills, innovation capability, digital competency, and professional ethics required by the global energy and technology ecosystem.

12. Review and Revision of Regulation

The University reserves the right to interpret, modify, revise, amend, or update any provision, rule, regulation, curriculum structure, evaluation pattern, academic requirement, or operational guideline related to the Electrical Engineering program from time to time in accordance with University regulations, statutory requirements, industry developments, and academic needs.

In case of any ambiguity or dispute regarding the interpretation of any provision of this manual, the decision of the University/Competent Authority shall be final and binding on all stakeholders. Any amendments, additions, or revisions approved by the appropriate academic or statutory bodies of the University shall automatically become applicable to the program.

Annexure I : Detailed Syllabus

GANDHINAGAR
UNIVERSITY

GANDHINAGAR INSTITUTE OF TECHNOLOGY

B.TECH. 1st SEMESTER

ALL BRANCHES

DOC NO: 4061

Subject Code: 10000101	**Subject Title: Engineering Mathematics-I**
Pre-requisite: Nil	

Course Objective:

- To acquaint aspiring engineers with calculus, multivariate analysis and linear algebra techniques.
- To provide students with intermediate to advance level standard ideas and tools that will help them approach more challenging concepts and applications that they will find relevant in their fields.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	02	-	05	70	30	-	-	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Differential Calculus:** Convergent sequence, Bounded sequence, Monotonic sequence, Infinite series, Geometric series, Telescoping series, Convergent, Divergent and Oscillatory Series, Cauchy's Fundamental test for Divergent, p-series, Comparison test, D'Alembert's Ratio test, Raabe's test, Gauss's test, Cauchy's Integral test, Cauchy's root test, Logarithmic test, De Morgan's and Bertrand's test, Cauchy's Condensation test, Alternating series, Leibniz's rule, Power series in x, Absolute and conditional convergence tests, Taylor's & Maclaurin's expansions of single variable, Indeterminate forms, Improper Integrals	12	25
2	**Partial Differentiations:** Limit and Continuity, Partial derivative, Implicit and Explicit functions, Euler's theorem, Geometrical interpretation of partial derivatives **Application of Partial Differentiations**: Tangent plane and Normal line, Maxima and Minima of functions of two variables, Lagrange's multiplier method, Jacobians	10	25
3	**Vector Calculus:** Vector and Scalar Fields, Gradient, curl and divergence, directional derivatives, Conservative fields, Line Integral, Work Done, Circulation and Flux, Green's Theorem	8	20

4	**Multiple Integral:** Double integral, change of order of integration, Application of Double Integral: Transformation of variables by Jacobian only for double integration, Change into polar co-ordinates in double integrals only, Triple integral, Applications of Integral: Change to spherical coordinates, Volume of a solid	8	20
5	**Curve Tracing:** Concavity, Curve Sketching, Relation between Polar Coordinates and Cartesian Coordinates, Graphs in Polar Coordinates	4	10

Course Outcome: After completion of this course, student will be able to

- Use Improper integral as a tool for differential and Integral calculus and understand the basic concepts of Indeterminate forms. Apply the various convergence tests to sequences, series and learning tools for power series in advanced engineering mathematics.
- Understand basic knowledge of partial derivatives and to compute extreme values of functions of several variables via partial derivatives, Tangent planes and Normal lines.
- Learn the basic concepts in vector calculus including gradient, directional derivatives, curl, work done, flux and Green's theorem.
- Gain the knowledge about solving double and triple integration to analyze engineering problems.
- Understand the geometrical terminology of cartesian and polar curves.

List of References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Edition.
2. Peter O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage
3. James Stewart, Calculus: Early Transcendentals with Course Mate, 7e, Cengage, 2012.
4. T. M. Apostol, Calculus, Volumes 1 & 2,, Wiley Eastern.
5. Maurice D. Weir, Joel Hass, Thomas' Calculus, Early Transcendentals, 13e, Pearson, 2014
6. H.K.Dass, Advanced Engineering Mathematics, S. Chand.

Open e-Resource:

1. https://nptel.ac.in/courses/111108098
2. https://nptel.ac.in/courses/111104125
3. https://nptel.ac.in/courses/111105121

Gandhinagar institute of Technology
B.Tech Mechanical Engineering (Offered in All programs)
Semester 1/2

Doc 4061

Subject Code: 10010105	**Subject Title: Engineering Foundation**
Pre-requisite:- Zeal to learn the subject	

Course Objective: p

- Acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements.
- Irrespective of branch, the use of workshop practices in day to day industrial as well domestic life helps to dissolve the problems
- Improve analytical skills to understand design blueprints
- Learn basic properties of materials and concepts of advanced manufacturing process
- Discover the root cause of a problem or event and fully understand how to fix, compensate or learn from any underlying issues within the root cause
- Provide the engineer a means of ensuring consistent design, quality and operating characteristics with adequate reliability and safety

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Measurements:** Introduction to Measurement, Definition, objectives and concept of Metrology, Need of inspection, Principles, process, methods of measurement, Classification and selection of measuring instruments and systems. Accuracy, precision and errors in measurement. System of measurement, Material Standard, Wavelength Standards, Subdivision of standards, Line and End standards, Classification of standards and Traceability, calibration of End bars, standardization.	08	20

	Slip gauges- Indian standards on slip gauge, method of selection of slip gauge, stack of slip gauge, adjustable slip gauge, wringing of slip gauge, care of slip gauge, slip gauge accessories, problems on building of slip gauges (M87, M112). Measurement of angles- sine bar, sine center, angle gauges, optical instruments for angular measurements		
2.	**Engineering Workshop:** Introduction, Safety slogans and rules in Mechanical workshop, Tools and Equipment used for safety in Mechanical workshop. Types of layouts, Rules and regulations for Workshop layouts and Preparation of actual layout. Introduction, Classification and characteristics of Engineering Materials, Tools and Equipment. *Demonstration of the operation performed on sheet metal for bending operation. Preparation of job in Drilling operation and demonstration on vertical drilling machine. Tools and Equipment for plumbing shop. Preparation of job in Plumbing for joining and threading operation. *Introduction to Arduino, components and working, Electronic circuit drawing, Electronic circuit on breadboard, Demonstration of Arduino for different configuration.	10	24
3.	**Engineering Design:** Introduction to Engineering Drawing and its significance, Drawing instruments and accessories, BIS – SP 46, Types of Lines and their Application, Lettering, Dimensioning Systems, Construction of Regular Polygons, Use of Plane Scales, Diagonal Scales and Representative Fraction.	10	24
4.	**Engineering Materials:** Types, properties and applications of Ferrous & Nonferrous metals, Timber, Abrasive material, silica, ceramics, glass, graphite, diamond, plastic and polymer **Modeling, Simulation and Conceptual Prototyping:** Concept of Modelling and Simulation, Goal of Modelling & simulation, Application of simulations, advantages and disadvantages of simulation, Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems, FDM, SLS, SLA.	06	14
5.	**Root Cause Analysis:** Introduction, Complete Root Cause Analysis, QM & T Approach to Root Cause Analysis, Practical guide to carry out and RCA, RCA Tools & Techniques, Lookup Table for Completing an RCA, Examples, Hints & Tips, 12 Pitfalls of RCA	04	9
6.	**Standards:** Introduction, Basic Definitions, Requirements, Guidelines, History of Standards, Modern Examples, Conformity Assessment	04	9

*** - Topic will be covered during laboratory session**

Course Outcome: After completion of this course, student will be able to

1. Understand the objectives of metrology, methods of measurement, selection of measuring instruments, standards of measurement and calibration of end bars.
2. Students will learn about taking safety and precautionary measures of self and machines during operations.
3. Interpret engineering drawings using fundamental technical mathematics.
4. Interpret appropriate advanced material processing techniques for different requirement and application
5. Identify the breakdowns in processes and systems that contributed to event and how to prevent future events

List of References:

1. Elements of Workshop Technology: Vol- I and Vol - II", K Hajra Choudhury, A K. Hajra, Media Promoters Pvt Ltd
2. Mechanical Measurement and Metrology by R K Jain, Khanna Publisher Mechanical Measurement & Control by D.S. Kumar.
3. A Text Book of Engineering Graphics by P.J.Shah S.Chand & Company Ltd., New Delhi
4. Modern Machining Processes, P. C. Pandey, H. S. Shan, Tata McGraw Hill
5. Root Cause Analysis - Improving Performance for Bottom-line Results, Robert J Latino, Kenneth C Latino, Taylor & Francis Group, CRC Press

Open e-Resource:

1. https://onlinecourses.swayam2.ac.in/aic22_ts42/preview
2. https://onlinecourses.nptel.ac.in/noc24_me123/preview

List of Suggested Experiments:

1. Introduction to Engineering workshop: working layout and safety.
2. Demonstration of the sheet metal bending operation and observe safety measures.
3. Demonstration of the drilling operation on vertical drilling machines and observe safety measures.
4. Demonstrate and understand the plumbing operation and tools in detail.
5. Demonstrate Arduino programming for different configurations.
6. Basic understanding of measurements and metrology: concepts, application, advantage and future aspects
7. Performance on linear and angular measurements and check different characteristics of measurements
8. Drawing Practice Sheet (which includes dimensioning methods, different types of line, construction of different polygon, divide the line and angle in parts, use of stencil)
9. Problems on Plane Scale.
10. Problems on Diagonal Scale.

11. Demonstration of prototype in FDM 3D Printing

GANDHINAGAR INSTITUTE OF TECHNOLOGY
B.TECH 1st /2nd SEMESTER
CE/IT/EC/EE/CL/ME

DOC NO: 4061

Subject Code: 10050101	**Subject Title: Programming for Problem Solving**
Pre-requisite: - Nil	

Course Objective:

- To understand the various steps in Program development.
- To understand the basic concepts in C Programming Language.
- To learn how to write modular and readable C Programs
- To learn to write programs (using structured programming approach) in C to solve problems.
- To provide complete knowledge of C language

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
4	0	2	5	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction:** Basic block diagram and functions of various components of computer, Concepts of Hardware and software, Types of software, Compiler and interpreter, Concepts of Machine level, Assembly level and high level programming, Flowcharts and Algorithms	3	5
2	**Fundamentals:** Introduction to C, structure of C Program, comments, header files, data types, constants, variables, declarations, expression statements, arithmetic operations, unary operations, relational and logical, conditional, library functions, single character input and output, entering and writing data, Evaluation of expressions, type conversion, precedence and associativity, I/O functions.	4	10
3	**Control structure in C:** Simple statements, Decision making statements, Looping statements, Nesting of control structures, break and continue, The Case control structure switch and goto statement.	5	10
4	**Array & String:** Concepts of array, processing an array, declaration and initialization of arrays, passing arrays to function, multidimensional array, string, string storage, Built-in string functions, command line arguments.	5	10

5	**Functions:** Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function: different way of solving problems, recursive program for finding factorial, fibonacci series etc.	8	25
6	**Pointers:** Basics of pointers, pointer to pointer, pointer and array, pointer to array, array to pointer, function returning pointer	6	15
7	**Structure:** Basics of structure, structure members, accessing structure members, nested structures, array of structures, structure and functions, structures and pointers	6	15
8	**Dynamic memory allocation and File management:** Introduction to Dynamic memory allocation, malloc, calloc. Introduction to file management and its functions	8	10

Course Outcome: After completion of this course, student will be able to

- Write a C program using correct syntax and execute it.
- Write programs using conditional, branching, iteration, and recursion.
- Write programs using array and strings.
- Decompose a problem into function.
- Develop an application using the concepts of array, pointer,structure, and file management to solve engineering /scientific problems.

List of References:

1. Programming in ANSI C, Balagurusamy, TMH
2. Lets C, Y. Kanitkar, BPB
3. Programming with C, Gottafried, Schaum Series
4. C The Complete Reference, Scholdt, TMH
5. Structured Programming Approach Using C, B. Forouzen, Thomas

Open e-Resource:

1. NPTEL C Programming: https://nptel.ac.in/courses/106104128
2. NPTEL Problem Solving through C: https://onlinecourses.nptel.ac.in/noc22_cs101/preview

List of Suggested Experiments:

1. Write a program that performs as a calculator (addition, multiplication, division, subtraction).
2. Write a C program to interchange two numbers.
3. Write a program to read three numbers from the keyboard and find out the maximum out of these three.
4. Write a program to read marks from keyboard and your program should display equivalent grade according to following table(switch case)
   Marks Grade
   100 - 80 Distinction
   79 - 60 First Class
   59 - 40 Second Class
   < 40 Fail

5. a. Write a C program to input an integer number and check if the last digit of the number is even or odd.
   b. Write a C program to find the factorial of a given number.
   c. Write a program to reverse a number.
   d. Write a program to generate the first n number of Fibonacci series.
6. a. Write a C program to find the sum and average of different numbers which are accepted by the user as many as the user wants.
   b. Write a program to check whether the given number is prime or not.
7. Write a C program to find 1+1/2+1/3+1/4+…. +1/n.
8. Write a program to print following patterns :

```
*                    *              12345
* *                  * *            1234
* * *                * * *          123
* * * *              * * * *        12
* * * * *            * * * * *      1
```

9. a. Write a program to find maximum element from 1-Dimensional array
   b.Write a program to sort given array in ascending order (Use Insertion sort, Bubble sort, Selection sort, Mergesort)
10. a.Write a program to find a character from a given string.
    b.Write a program to reverse the string.
    c. Write a program to convert string into upper case.
11. Write a program to find the factorial of a number using recursion.
12. Define a structure called cricket that will describe the following information:
    Player name
    Team name
    Batting average
    Using cricket, declare an array player with 50 elements and write a C program to read the information about all the 50 players and print team wise list containing names of players with their batting average.
13. Write a C program to swap the two values using pointers.

GANDHINAGAR INSTITUTE OF TECHNOLOGY

CE/IT/CSE/ICT/CS/EE/EC/AI

B. TECH 1st/2nd SEMESTER

DOC NO: 4061

Subject Code: 10050102	**Subject Title: ICT Fundamental & Workshop**
Pre-requisite: - Nil	

Course Objective:

1. Understand the basics of Information and communication technology.
2. To explain the fundamentals of computers and peripherals.
3. To introduce hardware and software computers basics.
4. To brief the students regarding various operating systems.
5. Understand the basic functions and features of Google Workspace tools and explore emerging trends and technologies.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	1	0	4	70	30	00	00	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to ICT:** Definition and Scope, Components, Data, Information and Knowledge, Data Collection, Data Storage and Data Transmission, Data Integrity, Information Quality.	03	10
2	**Introduction to computer system:** Introduction to various computer hardware and their application in ICT. Introduction to computer software and its application. Introduction to computer operating systems. What is Operating Systems, ERP, CRM, Service Architecture introduction — Concepts of SaaS, PaaS, IaaS.	05	15
3	**Fundamentals of computer Networks:** Introduction to computer networks, types of networks. Introduction to network devices.	03	15
4	**Storage and Servers:** Primary and Secondary storage, Cloud technology, mail server, data server, Concept of Data centers.	03	10
5	**Microsoft office suite:** Professional Document writing using Word Processing Tool, Data Processing using Spreadsheet, Creating Dynamic and Informative Slide Show using Presentation Software	04	10
6	**G Suite (Google Workspace):** Introduction to Google Workspace,	05	10

	Google Drive Basics, Google Docs, Google Forms, Google Calendar, Google Meet, Google Sites.		
7	**Introduction to the Web:** World Wide Web (WWW): A system of interlinked hypertext documents accessed via the internet. Internet: A global network of interconnected computers that communicate using standard protocols Website, Webpage, Web browser, Web server, Web development tools, web hosting and deployment.	05	10
8	**Cybersecurity Trends:** Emerging Threats, Advanced Security Technologies, Protective Measures, Ethical and Societal Implications.	04	10
9	**Introduction to Emerging Technologies:** Artificial Intelligence, Machine Learning, Big Data Analytics, Block chain, Data Science, Internet of Things (IoT), Virtual reality.	04	10

Course Outcome (COs):

1. Understand the basics of Information and communication technology.
2. Explore the applications of ICT for development.
3. A student can be able to use various G Suite, Microsoft office suite and computer Networks.
4. Students can explore Emerging technologies like IoT, Block chain, Data Science.

List of Reference Books:

1. "Understanding Computers: Today and Tomorrow" by Deborah Morley and Charles S. Parker
2. "Google Workspace for Dummies" by Blake R. Smith.
3. "Google Workspace: A Complete Guide to Google Workspace Tools" by Dr. Mikhail Kasyanov
4. "Computer Science: An Overview" by J. Glenn Brookshear and Dennis Bylaw
5. "Introduction to Computer Science: A Text-Based Approach" by Jean-Paul Tremblay and Paul G. Sorenson
6. "Practical Malware Analysis handbook dissecting malicious code" by Michael Sikorski and Andrew Hoing
7. "Computer Networking: A Top-Down Approach" by James F. Kurose

Web Resources:

1. https://www.w3schools.com
2. https://www.javatpoint.com
3. https://www.tutorialspoint.com/index.htm
4. https://teacher-network.in/OER/images/9/9a/ICT_student_textbook.pdf

GANDHINAGAR INSTITUTE OF LIBERAL STUDIES
Ability Enhancement Course
SEMESTER 1

Subject Code: AEC 016	**Subject Title: PRACTICAL ENGLISH**
Pre-requisite: Basic knowledge of English language.	

Course Objective:
To enhance vocabulary and grammar that enable the learners to communicate and write effectively in real life situation. Proficient spoken and written English help students to communicate clearly and precisely.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
2	-	-	2	50	50	-	-	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Vocabulary Building** Importance of Vocabulary Building, Word Formation and Types of word Formation, Synonyms, antonyms, Homonyms, homophones, Suffix, Prefix, One word substitute, Making sentences using words, Rearrange the words to make sentences.	07	25%
2	**Communication:** Definition of Communication, Characteristics of Communication, Types of Communication, Importance of Communication, Process of Communication, Barriers of Communication. Kinesics, Proxemics, Paralinguistics, Haptics	07	25%
3	**Listening Skills** Definition of Listening, Hearing and Listening, Types of Listening, Barriers of Listening, ways to improve listening, Traits of a good listener. Listening Practice: Listening comprehension- Listening for information	07	25%
4	**Grammar** Tenses, Voice, Concord, Modal auxiliaries.	07	25%

Course Outcome: After completion of this course, student will be able to:

1. Expand vocabulary so as to enhance proficiency in listening, speaking, reading and writing.
2. Develop strategies to Communicate Effectively and Appropriately.
3. Use strategies appropriately to improve one's ability to listen and to understand people.
4. Guide learners to gain knowledge of English grammar on an advanced level.

List of Reference Books:

1. Communication Skills by Sanjay Kumar and Pushp Lata, Oxford University Press - 2019.
2. Raymond Murphy, English Grammar in Use- A self-study reference and practice book for elementary students of English, Cambridge University Press, fourth edition.
3. Technical Communication – Principles and Practice, Third Edition by Meenakshi Raman and Sangeetha Sharma, Oxford University Press 2017.
4. Advanced Writing Skills: Success in 20 Minutes a Day, by D.S. Paul, Goodwill Publication

Open e-Resource: NPTEL

1. https://nptel.ac.in/courses/109104031

M. Sc. IT in Animation, VFX and Gaming (SEC)

Semester 1

Subject Code: SEC001	**Subject Title: Animation and Graphic Design**
Pre-requisite:	

Course Objective:

- Acquire the skills off off visualization for different products
- Develop the skill of animation and conceptual visualisation.
- Learn animation and how it works for different kinds of product and commercial values.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Practical		**Theory**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
1	0	2	2	00	00	25	25	50

Subject Contents			
Sr. No.	**Topics**	**Teaching Hrs.**	**Weightage (%)**
1	Subject and topic overview Fundamental of design and introduction to elements and principle of design Elements of design line shape space texture and colour	3	
2	Principals of design balance contrast emphasize freedom unity	3	
3	Basics of typography on type spacing redibility	2	
4	Visual design as a communication (including colour phycology and colour meaning).	2	
5	Architecture of advertising design. Design psychology and emotion Product brand identity and each importance like logo designs etc. Design for Digital media and print media	4	
6	Introduction to animation and its different types . Animation as a form of advertising in different domains. Understanding the various pipeline of animation production in contrast to different media. Different types of tools for animation.	2	
7	Motion graphics and video editing Understanding motion graphics like explainer videos corporate presentations e-learning product promotion	2	
8	Doubt solving solution student can show their works and clear doubts	2	

Course Outcomes:

- The students will be able to understand the concepts of visualization and story telling in different way and will understand different production pipeline of animation, game

designing ,e-learning, e-commerce and various other content and its structure.

- They will be able to understand how to visualize different contents according to target audience in different sectors in this entertainment industry
- The students will able to understand the basic objective and the fundamentals of Graphic design and animation concepts and apply them in different product.
- They will be able to design and implement them, making good use of the features of the software such as apps designing , game designing , animated short film , Advertising design, with different media and materials.

List of Reference Books:

1. Script to screen by Linda seger
2. Ogilvy on advertising buy a ogilvy.
3. Animators survival kit by Richard William
4. Thinking with type by Ellen Lupton
5. Graphic design the new basic by Ellen Lupton and Jennifer cole Philips
6. Making and breaking the grid a graphic design layout workshop by Timothy samara

List of suggested experiments :

1. Typographical poster design. Create a poster using only typography focusing on layout font selection hierarchy and balance to convey a message visually

2. Colour theory practice experiment with colour schemes (complementary analogue triadic) by creating a set of poster or images using this colour combination.

3. Logo design basics designer logo for an imaginary brand to practice simplicity.

4. Design a simple animation showing any product promotion

5 . Design a simple explainer video of any service provider.

GANDHINAGAR INSTITUTE OF TECHNOLOGY

B. Tech 1st /2nd SEMESTER

CSE/IT/EE/EC/CS/AI/ICT

DOC NO: 4061

Subject Code: 10000003	**Subject Title: ENGINEERING PHYSICS**
Pre-requisite: Nil	

Course Objective:

- To understand concepts of applications of semiconductor Physics, nanomaterials and non-linear optics in respective engineering branches and measurement techniques to solve problems.
- To educate students for engineering occupations in which Physics concepts may be applied to technological development. Students will be able to find work in engineering after completing this study at the interface of engineering and Physics upon graduation, while also laying a solid basis for graduate school and engineering research.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	-	02	04	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Nanoscience and nanotechnology:** Introduction to Quantum Physics: Particle in a three dimensional box, Introduction – Nanoscale; Nanomaterials: Methods for synthesis of nanomaterials, Properties of nanomaterials, Characterization techniques – X ray Diffraction (XRD) - Single Crystal, Powder and Laue techniques, Low energy Electron Diffraction (LEED), Scanning Electron Microscopy, Tunnelling Electron Microscopy, Nanostructures; Carbon nanotubes, Characteristics and applications, Nanotechnology and environment.	8	19

2	**Classification of Electronic Materials:** Free electron theory, crystal structure and reciprocal lattice, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Brillouin zone, electron in a crystal- Bloch's electron, Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Effective mass, Phonons.	8	19
3	**Physics of Semiconductors:** Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction diode, Metal-semiconductor junction (Ohmic and Schottky), Photovoltaic effect, Exciton, Applications with numericals, Lasers and its properties, Spontaneous and stimulated emission, Einstein coefficients, Gas laser (He-Ne Laser), Semiconductor Laser, Applications of Laser.	8	19
4	**(A)Analysis of Errors:** Uncertainties in Measurements: Sources and estimation of errors, accuracy and precision, systematic error, random error, Significant figure and round off, Uncertainties, Parent and Sample Distributions, Mean and Standard Deviation of Distributions, Average error, r.m.s error, probable error and error propagation, **(B) Non-linear Optics:** Introduction to regression analysis and its uses, Basic Principle of Holography, Construction and reconstruction of hologram, Applications of Holography, Introduction to optical fiber, Numerical Aperture of optical fiber, Types of optical fiber, applications of optical fiber **(C)Measurement Techniques:** Four-point probe and Van Der Pauw measurements for carrier density, Resistivity and hall mobility, Hall effect, Hot-point probe measurement, capacitance-voltage measurements, DLTS.	12	29
5	**Physics of Superconductors:** Introduction of Superconductivity, Properties of superconductor, Effect of magnetic field, Meissner effect, Pressure effect, Impurity effect, Isotopic mass effect, Mechanism of Superconductivity: BCS Theory, Penetration depth: Magnetic field, Josephson's junction and its application, Application of superconductors	6	14

Course Outcome: After completion of this course, student will be able to

- Acquire understanding of fundamental physics concepts and link them to engineering science at the conclusion of the course.
- Use physics ideas to solve difficulties in engineering.
- Apply basic Physics concepts to solve new and difficult technological issues.

- The student will gain knowledge of basic theoretical and mathematical concept of nanomaterials and electronic materials.
- Demonstrate understanding of basic principles, properties and applications associated with semiconducting materials.
- Learn how to calculate and find the errors and also characterize diverse semiconducting, electrical, and optoelectrical materials and devices using various measurement techniques and non-linear optics.
- Demonstrate knowledge of superconductivity's fundamental theory, characteristics, and applications.

List of References:

1. T. Pradeep, Nano: The Essentials, New Central book Agency.
2. S. N. Goswami, Elements of Plasma Physics, Tata McGraw Hill publication.
3. B. L. Theraja, Physics for Engineers, S Chand Publication
4. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc.
5. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc.
6. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
7. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
8. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
9. Engineering Physics by Dattu R Joshi, McGraw hill Publications.
10. Resnick, Halliday and Krane, Physics part I and II, 5th Edition John Wiley (2002)
11. Physics for scientists and engineers with modern physics by Jewett & Serwey, Cengage publications.

Open e-Resource:

1. Online course: “Semiconductor Optoelectronics” by M R Shenoy on NPTEL. (URL Link: https://nptel.ac.in/courses/115102026)
2. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL. (URL Link: https://nptel.ac.in/courses/113104012)
3. Online course: “Fiber Optics” by Prof. Vipul Rastogi on NPTEL. (URL link: https://nptel.ac.in/courses/115107095)
4. Online course: “Introduction to Physics of Nanoparticles and Nanostructures” by Prof. G. Mukhopadhyay on NPTEL. (URL Link: https://nptel.ac.in/courses/115101007)
5. Online course: “Introduction to Non-linear optics and its applications” by Prof. Samudra Roy on NPTEL (URL Link: https://nptel.ac.in/courses/115105105)
6. Online course “Superconductivity” by Prof. P. P. Singh and Prof. A. V. Mahajan (URL Link: https://nptel.ac.in/courses/115101012)
7. Online course “A brief course on Superconductivity” by Dr. Saurabh Basu on NPTEL. (URL Link: https://nptel.ac.in/courses/115103108)
8. The Feynman Lectures series on Physics Vol 2, Pearson Education India

List of Suggested Experiments:

1. To find the numerical aperture of an optical fiber.
2. To determine the band gap in a semiconductor using a junction diode.
3. To determine the wavelength of laser using diffraction grating.
4. To find the efficiency of a solar cell.
5. To Study the characteristics of a Zener diode and a LED.

6. To study the “Hall effect” by measuring the voltage and magnetic field, keeping current constant.
7. Determination of radii of curvature of lens using the Newton’s ring formula.
8. Analysis of errors using Least square fitting.

GANDHINAGAR UNIVERSITY
GANDHINAGAR INSTITUTE OF TECHNOLOGY

10000201: Engineering Mathematics-II
B. TECH. 2nd SEMESTER (All Branches)

DOC NO: 4061

Subject Code: 10000201	**Subject Title: Engineering Mathematics-II**
Pre-requisite: Basic knowledge of differentiation, integration, algebra	

Course Objective: The objective of this course is to familiarize the prospective engineers with techniques in integration, ordinary differential equations and matrices. It aims to equip the students to deal with advanced level of mathematics and applications that are required in their disciplines.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	2	0	5	70	30	0	50	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**First order ordinary differential equations:** Order and Degree, Solutions of Ordinary differential equations, Geometrical Interpretations, Exact, Non-exact, Linear and Bernoulli's equations, Euler's equations	6	10%
2	**Higher order Ordinary differential equations:** Second order linear differential equations with constant coefficients, Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation, Series Solutions of ordinary differential equations	10	25%
3	**Laplace Transformation:** Definition of Laplace Transform, Existence of Laplace transform, Properties of Laplace transforms, Laplace transform of periodic functions, Inverse Laplace transform and their properties, Convolution theorem, Applications of Laplace transforms in solving ordinary differential equations and system of differential equations	8	20%
4	**Fourier Series and Fourier Integral:** Dirichlet's Condition, Fourier series of Odd and Even functions, Half range sine series and cosine series, Fourier Integral, Fourier Cosine and Sine Integrals **Gamma and Beta functions:** Definitions of Gamma and Beta functions and their properties	8	20%
5	**Matrix Algebra:** Definition of Matrix, types of matrices and their properties, Determination of rank, The inverse of a matrix by Gauss Jordan method, Solution of a system of linear equations by Gauss elimination and Gauss Jordan Methods, Eigen values and Eigen vectors of matrices, Cayley-Hamilton's Theorem and its applications, Diagonalization	10	25%

Course Outcome:
At the end of the course the students will be able to

1. Learn the techniques to solve ordinary differential equations for Mathematical modelling of real-world problems.
2. Apply effective mathematical methods for the solutions of higher order ordinary differential equations.
3. Apply the techniques of Laplace transforms and inverse Laplace transforms to solve the Ordinary differential equations of real-world problems
4. Utilize Fourier series to study the behavior of periodic functions and to gain the knowledge of Fourier Integral and to acquire understanding on how to tackle integration problems using Gamma and Beta functions.
5. Understand the algebra of matrices in order to solve applies and theoretical issues using algebraic operations

List of References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Edition.
2. Peter O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage
3. H.K.Dass, Advanced Engineering Mathematics, S. Chand.
4. H. Anton, Elementary linear algebra with applications (8th Edition), John Wiley 1995
5. Fuzhen Zhang, Matrix Theory- Basic Results and Techniques, Springer, 1999
6. Shanti Narayan, P.K. Mittal, A Textbook of Matrices, S Chand & Company, 2010

Open e-Resource: Digital Platforms

- National Programme on Technology Enhanced Learning (NPTEL)
- SWAYAM
- National Digital Library of India (NDLI)
- Massachusetts Institute of Technology (MIT) Open Learning

GANDHINAGAR INSTITUTE OF TECHNOLOGY

B.TECH 1st / 2nd SEMESTER

Computer Engineering /Information Technology /Electronics & Communication Engineering / Electrical Engineering / Civil Engineering / Mechanical Engineering

DOC NO: 4061

Subject Code: 10030101	**Subject Title:** Basics of Electrical & Electronics Engineering
Pre-requisite: Nil	

Course Objective:

- To Impart the basic knowledge of electrical quantities and to understand the impact of technology in a global and social context.
- To provide knowledge of analog and digital electronics.
- To Introduce the basic knowledge of transformer and electrical machines and electrical safety.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**DC Circuits** Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.	8	20%
2	**AC Circuit:** Representation of sinusoidal waveforms, sinusoidal function- Terminology, Form Factor and Peak Factor, Phase and Phase Difference, Phasor representation of alternating quantities, Phasor addition and subtraction Behavior of purely resistive, inductive and capacitive circuits, Phase relation RL circuit, series RC circuits, series RLC circuit between voltage and current Active, Reactive and Apparent Power, Power Factor and Parallel and series-parallel AC circuits, Resonance in series and parallel circuit. Three-phase balanced circuits, voltage and current relations in star and delta connections.	10	23%

3	**Transformers and Electrical machines** Construction and working principle of single phase and three phase transformers Equation, voltage and current Ideal and practical transformer, autotransformer. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, single phase induction motor	6	14%
4	**Analog Electronics and Applications:** Semiconductor Diode & its characteristics, Half-Wave, Full-Wave & Bridge Rectifier, Zener Diode, Light-Emitting Diode (LED), Photo diode, Solar cell and Seven Segment Display. Bipolar Junction Transistor, Amplifier, Oscillator and Operational Amplifier.	8	20%
5	**Digital Electronics:** Number System, Basic Logic Gates, Building AND, OR & NOT Gate using Diodes and Transistors, Digital logic families, RTL, DTL, TTL.	4	9%
6	**Electrical Installations:** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.	6	14%

Course Outcome: After completion of this course, student will be able to

- Analyze electrical circuits with different elements and describe qualitative comparison between AC and DC systems.
- Understand the construction, working and basic characteristics of transformer and Induction machine
- Learn about the working of Bread-Board, Multimeter, Power Supply, Function Generator, CRO/DSO, GCB/PCB.
- Apply Diodes, Transistors and Logic Gates in different circuits.
- Recognize the importance of protective devices and electrical safety measures.

List of References:

1. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
2. Basic Electrical Engineering - Nagsarkar and Sukhija, Oxford University Press
3. B. L. Theraja, “Electrical Technology – Part I and II”, S. Chand and Co. 2012
4. V.N. Mittal, ‘Basic Electrical Engineering’, Tata Mcgraw-Hill,2nd edition 2006.
5. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
6. A. Chakrabarti, S. Nath, C. Chanda, ‘Basic Electrical Engineering’, Tata McGrawHill Education India Pvt. Ltd, 2013.
7. Robert Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, Pearson Education, 10th Edition, 2009.
8. Albert Malvino and David Bates, “Electronics Principles” Tata McGraw-Hill, 7th Edition, 2006.
9. Digital Logic and Computer Design By M Morris Mano, Prentice Hall Publication, Fourth Edition.

Open e-Resource:

1. http://vlab.amrita.edu/index.php
2. https://www.facstaff.bucknell.edu/mastascu/eLessonsHTML/EEIndex.html
3. http://www.learnabout-electronics.org
4. http://www.electronics-tutorials.ws
5. https://www.coursera.org/course/eefunlab
6. https://www.coursera.org/course/introtoelectronics
7. http://www.electronicsandyou.com
8. https://onlinecourses.nptel.ac.in/noc21_ee55/preview
9. PSpices and NGSpice (Open Source Software)

List of Suggested Experiments:

1. To verify ohm's law in an electric circuit.
2. To verify KCL and KVL in an electric circuit.
3. To verify the Network theorems
4. To determine power in a single phase circuit using wattmeter.
5. Determination of B-H curve of magnetic material.
6. Analysis series RLC circuit.
7. Demonstration of domestic installations like MCB, ELCB, MCCB
8. To determine power in a three phase circuit using two wattmeter.
9. Demonstration of cut-section models and charts of various machines.
10. Understanding of various electrical bills and calculation for energy consumption.
11. To study and perform the VI characteristics of P-N junction diode
12. To study and perform the VI characteristics of Zener diode.
13. To study and perform about the Half Wave and Full Wave Rectifier.
14. To study and perform the Input and Output characteristics of a Transistor.
15. To study and configure an op-amp as an inverting and non-inverting amplifier.
16. To study and verify digital logic gates.
17. To configure diodes and transistors as logic gates and verify the truth table.

Gandhinagar Institute of Technology
B.Tech CE/IT/CSE/ICT/CS/AI/EC/EE
Semester 2

Subject Code: 10050201	**Subject Title: Basics Of Python**
Pre-requisite: Basic Programming Knowledge of Computer System	

Course Objective:

1. Leran the syntax and semantic of Python Programming
2. Write Python functions to facilities code reuse and manipulate strings.
3. Ilustrate the process of structuring the data using lists,tuples and dictionaries.
4. Demostrate the use of built-in function to navigate the file system.
5. Appraise the need for networking on File system.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to python programming:** What is python language and its applications, Features of python language, Installing Python packages(Linux, Windows).	04	20
2	**Python Programming:** Data Types, Operators, Control Structures, Iterations, List, Tuple, Dictionary, Functions: Functions and scoping, List Operations, Recursion, Global Variable, modules, I/O operations, In Built Functions and Parameters, Python Library and its uses.	16	40
3	**Modularization and classes:** Classes and Object Oriented Programming-Procedural and Object – Oriented Programming-classes-working with Instances-Techniques for Designing classes, Inheritance-Introduction to inheritance-Polymorphism.	04	10

4	**Input and Output in Python:** Reading and writing text files, writing Text Files, Appending to Files and challenge, writing Binary Files Manually, Using Pickle to Write Binary Files.	07	20
5	Exception Errors in Python: Compile –time Errors, Runtime Errors, Logical Errors, What is Exception, Handling an exception, try…except…else, try-finally clause, Argument of an Exception, Python Standard Exception, Raising an exceptions, User–defined Exception.	04	10

Course Outcome:

1. Understand concepts of problem solving approach.
2. Able to write basic python code.
3. Understand the basics of Kali Linux & its importance.
4. Understand the security policies & cyber laws.

List of Textbooks:

1. Learn Python Programming Fundamentals: A Beginner's Guide.
2. Introduction to Computation and Programming Using Python, Third Edition by John V. Guttag.
3. Fundamentals of Python: First Programs with MindTap Author(s): Kenneth A. Lambert.

List of Reference Books:

1. Advanced Python Programming by Dr. Gabriele Lanro, Quan nyugen
2. Core Python Programming, By Dr.R Nagaeshwar Rao.
3. Python All-in-One for Dummies by John Sovic.

Open e-Resource:

1. https://www.w3schools.com/python/
2. https://www.javatpoint.com/python-tutorial
3. NPTEL Video lecture on Python Programming
4. Turtle - https://docs.python.org/2/library/turtle.html
5. PyLab - https://scipy.github.io/old-wiki/pages/PyLab
   Anaconda software

List of Suggested Experiments:

1. Write a program to perform basic mathematical operations.
2. Write a program to find largest element in array.
3. Write a program to use various string functions.
4. Write a program to print addition of 5 elements of an array using looping structure.

5. Write a program to demonstrate the use of conditional structure.
6. Write a program to find sum of all elements in the directory.
7. Write a program to swap to elements in a list.
8. Write a program to sort python directories by key or a value.

9. Write a program to demonstrate the user defined function creation & calling.
10. Demonstrate a program that show the use of python library.

Gandhinagar Institute of Management

B.Tech

Semester II **DOC NO: 4061**

Subject Code: AEC015	**Subject Title: Personality Development for Effective Leadership**
Pre-requisite: NA	

Course Objective:

1. To help students in enhancing their self-awareness, interpersonal skills, and overall personal grooming.
2. To foster personal growth and development by focusing on self-awareness, communication skills, emotional intelligence, and goal setting.
3. To explore various aspects of personality enhancement and leadership qualities for improving their confidence, firmness, and relationships with others.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
2	-	-	2	25	25	-	-	50

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Understanding Personality Development** • Definition and Importance of Personality • Determinants of Personality: Heredity and Environment • Theories of Personality (Big Five Model, MBTI, etc.) **Self-Awareness and Self-Analysis** • SWOT Analysis for Personality Growth • Building Self-Confidence and Positive Thinking • Overcoming Self-Limiting Beliefs	7	25%
2	**Leadership and Its Significance** • Definition and Characteristics of an Effective Leader • Leadership vs. Management • Different Leadership Styles (Autocratic, Democratic, Transformational, etc.) **Effective Communication Skills**	7	25%

	• Verbal and Non-Verbal Communication • Barriers to Communication and Overcoming Them • Public Speaking and Presentation Skills		
3	**Emotional Intelligence (EI) and Leadership** • Components of Emotional Intelligence (Self-Awareness, Self-Regulation, Motivation, Empathy, Social Skills) • Role of EI in Decision-Making and Conflict Resolution • Developing Empathy and Active Listening Skills **Building Leadership Skills** • Goal Setting and Strategic Thinking • Motivation and Team Building • Time Management and Delegation	7	25%
4	**Decision-Making and Problem-Solving** • Decision-Making Models (Rational Model, Intuitive Model, etc.) • Overcoming Decision-Making Biases • Critical Thinking and Analytical Skills **Ethics and Values in Leadership** • Ethical Decision-Making in Leadership • Corporate Social Responsibility and Leadership Ethics • Leading with Integrity	7	25%

Course Outcome:

- To comprehend the role of confidence and self-esteem in personal development.
- To create a comprehensive action plan for personality enhancement and leadership development.
- To cultivate personality and leadership qualities in diverse and inclusive environments.

List of Textbooks:

1. D. P. Subharwal – Personality Development Handbook
2. Rajiv Mishra – Personality Development: Transform Yourself
3. Dr. Shailesh Tondon & Dr. Asish Kaushal – Personality Development & Grooming
4. Del Carnegie – The Leader in You
5. Andrew Bryant – Self Leadership
6. Peter G. Northouse – Leadership: Theory and Practice
7. Radcliffe – Leadership: Plain and Simple

List of Reference Books:

NA

Open e-Resource:

1. English GUETA Website
2. English GUETA App
3. English GUETA YouTube Channel

List of Suggested Experiments: NA

Gandhinagar University
UG/PG
Semester-II

Subject Code: IKS0201	Subject Title: Indian Ancient History and Cultural Heritage

Course Objective:

- Foster an appreciation for the composite nature of Indian history, culture and heritage.
- Instill a sense of love and belonging among learners, contributing to nation-building efforts.
- Provide an overview of various components of cultural heritage, including fairs, festivals, dances, art, architecture, and historical landmarks, which are crucial for a deeper understanding of history.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory		Practical		
Lecture	Tutorial	Practical	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	Total
01	0	2	02	0	25/ Project	25/ Project		50

Subject Contents			
Sr. No	**Topics**	**Total Hours**	**Credit**
1	**Indian Ancient History:** Introduction of Ancient India. Harappan Civilization. Rigvedic & Later Vedic Period. India in the 6th Century B.C. Persian and Greek invasions and its impact. Mauryan and Gupta Periods. Post – Mauryan. Brief History of the Sanskrit literature: The Vedas, The Brahmanas and Upanishads & Sutras, Epics: Ramayana and Mahabharata & Puranas.	15	1
2	**Indian Cultural Heritage:** Ethnic Indian Cultural Construct – Fairs & Festivals and their historical background. Indian dances as Cultural Heritage. Indian Architecture: Temples, Stupas, Caves, Chaityas. Medieval Architecture and Colonial Architecture. Social culture in India- Vedic culture. Ancient period- varna and jati, family and marriage in India, position of women in ancient India, Contemporary period; caste system and communalism.	15	1

Course Outcome: After completion of this course, students will be able to

- Demonstrate knowledge of the key events, periods, and figures that have shaped Indian history from ancient to modern times, including their impact on the socio-political and economic landscape.
- Analyze the rich cultural heritage of India, including art, architecture, literature, and philosophy, while recognizing the contributions of various communities to India's pluralistic society.

List of Text Books:

1. An advanced history of India – causes and decline of Guptas by B.C. Majumdar and others, 1967, Macmillan.
2. Ancient India by R.C. Majumdar, 1977, Motilal Banarasi Das.
3. History of Ancient India by Rama sankar Tripati, 1942, Motilal Banarasi Das.
4. History and culture of India to 1000 A.D. by H.V. Srinivasa Murthy, 1980, S. Chand and Co.
5. History of South India by K.A. Nilakanta Sastry 1976, Oxford University Press.
6. History of Ancient India by Krishnaswamy Aiyangar, 1980, Seema Publishers.
7. Ancient India by V.D. Mahajan, 1985, S.Chand and Company.
8. Advance History of India by K.A. Nilakantasastry and C.S.Srinivasachari, 1980, Allied Publishers.
9. Ancient Indian History and Civilization by Silendranath Sen, 1988, Wiley Eastern.
10. Lothal and Indus Civilizations by S.R.Rao, 1972, Asia Publishers, Madras

GANDHINAGAR UNIVERSITY

(Established and Incorporated Under Gujarat Private Universities Act 2009, Amendment: Guj. Act No. 7 of 2022)

Gandhinagar Institute of Technology

B. Tech

Department of CE & IT

Semester 2

Subject Code: SEC019	Subject Title: Social Media Management
Prerequisite: Active mindset, Basic Computer understanding & Practical Thinking	

Course Objective:

- Students will learn by doing assignments focusing on social media, post writing and publishing, management and measurement tools, a social media audit, editorial calendar and crises management.
- Students will master the skills necessary to become successful social media managers.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory		Practical		Total
Lecture	Tutorial	Practical	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	0	0	2	-	50	-	-	50

Subject Contents			
Sr. No.	Topics	Teaching Hrs.	Weightage (%)
1	Unit 1: Introduction To Social Media Introduction to Social Media, importance of social Media, History and evolution of Social Media, Managing Information, Aggregators. Facebook, Twitter, Instagram, LinkedIn, YouTube, Blogs.	6	
2	Unit 2: Using Social Media Strategy Plan for Social Media Management, Touchpoint, Analysis Scheduling, Creating Content, Managing Content programmes, Planning Worksheet, Social media campaign.	6	

3	Unit 3: Evaluating Social Media Evaluation of Social Media Platforms, Content Management Systems (CMS), Tools to manage and measure performance of social media content and campaign, Handling critical issues in social media management and legal aspects of social media.	6	
4	Unit-4: Social Media Awareness	2	

List of Reference Books:

1. Guy Kawasaki & Peg Fitzpatrick, "The art of social media: power tips for power users
2. Social media marketing all in one for dummies, Jan Zimmerman & Deborah N
3. Social media explained by Mark W. Schaefer

Approved
For SEC (Social Media & Management) for first year - 2024-25 onwards Batch.

15/04/25 (HOD CE&IT)

Gandhinagar institute of Technology
B.Tech Electrical Engineering
Semester 3

Subject Code: 10000302	**Subject Title: Economics & Management**
Pre-requisite: Zeel to learn the subject	

Course Objective: **(1)** Enrich the knowledge of essential elements of Economics and its application.
(2) Understand the concepts of Management, Organizational structure & Corporate social responsibility.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	0	3	70	30	0	0	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	Introduction to Economics; Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics Theory of Demand & Supply; law of demand, law of supply, equilibrium between demand & supply Elasticity; elasticity of demand, price elasticity, income elasticity, cross elasticity	05	12
2.	Theory of production; production function, meaning, factors of production (meaning & characteristics of Land, Labour, capital & entrepreneur), Law of variable proportions & law of returns to scale Cost; meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. Break even analysis; meaning, explanation, numerical	04	12
3.	Markets; meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Completion, Oligopoly) National	04	12

	Income; meaning, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP,NDP, Personal income, disposal income.		
4.	Basic economic problems; Poverty-meaning, absolute & relative poverty, causes, measures to reduce Unemployment: meaning, types, causes, remedies Inflation; meaning, types, causes, measures to control	04	12
5.	Money; meaning, functions, types, Monetary policy- meaning, objectives, tools, fiscal policy-meaning, objectives, tools Banking; meaning, types, functions, Central Bank- RBI; its functions, concepts; CRR, bank rate, repo rate, reverse repo rate, SLR	04	12
6.	Introduction to Management; Definitions, Nature, Management Difference between Management & administration, skill, types and roles of managers Management Principles; Scientific principles, Administrative principles, Maslow's Hierarchy of needs theory	05	12
7.	Functions of Management; Planning, Organizing, Staffing, Directing, Controlling (meaning, nature and importance) Organizational Structures; meaning, principles of organization, types-formal and informal, line, line & staff, matrix, hybrid (explanation with merits and demerits), span of control, departmentalization, chain of command, centralization and decentralisation	06	12
8.	Organisational culture of Environment concept of culture and its importance, attributes culture, How does culture affect managers and employees.	04	10
9.	Corporate Social Responsibility; meaning, importance Business Ethics; meaning, importance.	03	06

Course Outcome: After completion of this course, student will be able to

1. Understand the concept of elasticity & analyze how it affects revenue.
2. Relate production function and cost function.
3. Analyze different market types and their characteristics for optimal quantity and pricing decisions to achieve profit maximization.
4. Describe basic principles of management: planning, organizing, controlling and directing.
5. Analyze ethical dilemmas faced by business and managers.

List of Reference Books:

1. Paneerselvam R., Engineering Economics, PHI publication.
2. Robbins S.P. and Decenzo David A, Fundamentals of Management: Essential Concepts and Applications, Pearson Education.
3. Gregory Mankiw N, Economics: Principles of Economics, Cengage Learning.
4. Prasad L.M., Principles and Practices of Management.
5. Tripathy and Reddy., Principles of Management.
6. Dewett K.K. & Navalur M.H., Modern Economic Theory, S.Chand Publication.

Open e-Resource:

1. https://nptel.ac.in/courses/122106031
2. https://nptel.ac.in/courses/109104125

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 3rd

Subject Code: 1030301	**Subject Title: Analog and Digital Electronics**
Pre-requisite:	

Course Objective:

(1) To Impart the fundamental knowledge of analogue integrated circuits and digital electronics
(2) To provide in-depth knowledge about Digital logic ICs, Combinational and Sequential circuits.
(3) To Understand on the significance of low power, small size, reliable, high performance Operational Amplifiers.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction:** Overview of analog and digital circuits, comparison between analog and digital circuits, their applications	1	6
2	**Differential Amplifier** Design of Common Emitter amplifier, development of differential amplifier from conventional amplifier, Input output characteristics of differential amplifier, differential amplifier circuit configurations, dc and ac analysis of dual input balanced output differential amplifier, current mirror and level translator	5	10
3	**Operational Amplifier:**	5	10

	Ideal analysis of op – amp, Open loop op-amp configuration and its importance, concept of positive and negative feedback, op-amps with voltage series and voltage shunt negative feedback, Op-amp parameters, frequency response of op-amp		
4	**Nonlinear applications of op-amp:** Zero Crossing Detector, Square-wave and triangular-wave generators, Hysteretic Comparator. Precision rectifier, peak detector.	8	20
5	**Boolean Algebra, Logic Gates & Combinational Circuits:** Binary Arithmetic, Binary Codes, Binary Logic, Basic Theorems & Properties of Boolean Algebra, Boolean Functions, Canonical & Standard Forms, Digital Logic Gates & Their Properties, K-Map Method, Four/Five Variable Map, POS & SOP Simplification, Don't Care Conditions, NAND & NOR Implementation, Exclusive OR Functions.	5	12
6	**Combinational Logic:** Combinational Circuit – Analysis & Design, Binary Adder & Subtractor, Decimal Adder, Binary Multiplier, Decoder, Encoder, Multiplexer & De-Multiplexers.	5	12
7	**Sequential Circuits:** Latches, Flip-Flops & Excitation Tables, Analysis of Clocked Sequential Circuits, Design of Sequential Circuits, Registers, Shift registers, Ripple Counter, Synchronous Counters, Ring/Johnson Counter.	10	20
8	**Analog to Digital and Digital to Analog Converters:** Digital to analog conversion, R-2R ladder type DAC, weighted resistor type DAC, switched current source type DAC, analog to digital conversion, counter type ADC, tracking type ADC, successive approximation type ADC, flash type ADC	05	10

Course Outcome:

CO1: Analyse the function of differential and operational amplifier
CO2: Design and Develop OP-AMP base circuit with the application.
CO3: Develop analogue and digital circuit to solve real time engineering problems.
CO4: Apply the knowledge of Combinational and sequential circuits to develop circuits for various application

List of Text Books:

1. R. Gayakwad, Textbook of Operational Amplifiers and Linear Integrated Circuits, PHI Publication.
2. R. Boylestad and L. Nashelsky, Textbook of Electronics Devices & Circuit Theory, PHI Publication.

List of Reference Books:

1. A. Mottershed, Textbook of Electronics Devices and Circuits An Introduction, PHI Publication.
2. Millman and Halkias, Textbook of Integrated Electronics, Mc Graw Hill.
3. Sergio Franko, Textbook of Designing with Operational Amplifiers and Analog Integrated Circuits, Mc Graw Hill. 6. R. Coughlin and Driscoll, Textbook of OpAmp & Linear Integrated Circuits, PHI Publications.
4. A. Anandkumar, Fundamentals of Digital Circuits, PHI publication
5. Malvino, Digital Computer Electronics, TMH publication
6. Morris Mano, Computer Logic Design, PHI publication

Open e-Resource:

Courses available through NPTEL.
- website : nptel.ac.in

List of Suggested Experiments:

1. Study the different parameter of op-amp.
2. Frequency response of inverting amplifier and non-inverting amplifier.
3. Study of op-amp as inverting amplifier and non-inverting amplifier.
4. OPAMP circuits –integrator, differentiator, and comparator.
5. Phase shift and Wein's Bridge oscillator with amplitude stabilization using OPAMPs.
6. Waveform generation – Square, triangular and saw tooth wave form generation using OPAMPs.
7. Application of op-amp as low pass filter, high pass filter and band-pass filter.
8. Verification of function of Half/Full adder circuits.
9. Verification of function of Binary to Grey code conversion.
10. Verification of function of Latch and flip-flop.
11. 11 Verification of counter circuit like binary up/down counter, decimal counter, ring counter, Johnson counter etc.
12. Verification of Specification and Performance indices of D/A and A/D converters

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Sem 3

Subject Code: 10030302	**Subject Title: Electrical Measurement and Measuring Instrument**
Pre-requisite: NA	

Course Objective: (1) To provide an overview of electrical measurement techniques that is problem-oriented.
(2) To concentrate on researching electrical measurements.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Philosophy Of Measurement- Methods of Measurement, Measurement System**,** Classification of instrument system, Characteristics of instruments & measurement system**,** Errors in measurement & its analysis, Standards.	04	10
2	Analog Measurement of Electrical Quantities **–** Electro dynamic, Thermocouple, Electrostatic & Rectifier type Ammeters & Voltmeters, Electro dynamic Wattmeter, Three Phase Wattmeter, Power in three phase system, errors & remedies in wattmeter and energy meter. Instrument Transformer and their applications, Introduction to measurement of speed, frequency and power factor.	10	20
3	Bridge Measurement of Resistance: Measurement of low, medium & high resistances, insulation resistance measurement, localization of cable fault, Loop tests. Bridge Measurement of Inductance and Capacitance: A. C. bridges for inductance measurement Maxwell, Hays, anderson and owen bridges, capacitance measurement – Desauty and Schering Bridge. Measurement of frequency by Wien's bridge.	10	25
4	Digital Measurement of Electrical Quantities - Concept of digital measurement, block diagram and study of digital voltmeter, frequency meter, Power Analyzer and Harmonics Analyzer; Electronic Multimeters.	04	10

5	Transducers: Definition - different types of transducers – criteria for selection –general characteristics–dynamic characteristics – transducers for measurement of displacement (RVDT &LVDT), speed, angular rotation, altitude, force, torque, humidity and moisture, pressure, strain and temperature (Thermocouple and RTD method), Hall Effect transducer and applications Instrumentation amplifiers – differential amplifiers – Data transmission and telemetry – methods of data transmission, General telemetry systems – Digital methods of frequency, phase, time and period measurements.	10	25
6	Display methods, recorders: Display methods and devices – different types of recorders – galvanometric recorders – magnetic recorders – digital recorders, digital storage oscilloscope (Block Diagram, theory and applications only)	04	10

Course Outcome:

(1) The student can acquire the basic knowledge of measurement principles and their application in electrical engineering.

(2) The students will be able to effectively employ electrical and electronics instruments for measurements of various electrical quantities.

List of Text Books:

1. J. B. Gupta - A course in Electronic and Electrical measurements and Instrumentation, S. K. Kataria Publication
2. R.K.Rajput - Electrical and Electronic Measurements and Instrumentation

List of Reference Books:

1. A.K.Sawhney, A course in Elect. & Electronic Measurement and Instrumentation, Dhapat Rai & Co.
2. Golding & Widis, Electrical Measurement and Measurement instrument, Wheelar Books
3. H.S. Kalsi, Electronic Instruments, Tata Mc-Graw hill.
4. A.J. Bouwens, Digital Instrumentation, Tata Mc-Graw hill.
5. H.K.P. Neubert, Instrument transducers, Oxford University press.

Open e-Resource:

Open Source Sfteware:
- LTSpice for circuit simulation,
- KiCAD for CAD application

Web-based tools for design:
- http://www.fairchildsemi.com/support/design-tools/power-supply-webdesigner/
- http://www.ti.com/lsds/ti/analog/webench/overview.page

Circuit Lab:
- https://www.circuitlab.com/editor/

Open source Math Tools:
- http://www.scilab.org/
- http://www.gnu.org/software/octave/

Learning website
- http://www.electrical-engineering-portal.com/
- http://nptel.iitm.ac.in/courses.php

List of Suggested Experiments:

1. Measurement of resistance using Wheastone's Bridge and Kelvin Double bridge.
2. Extension of range of wattmeter using CT & PT
3. Measurement of displacement using LVDT
4. Measurement of current/ voltage using Hall effect transducer.
5. Thermocouple based ON – OFF controller
6. Measurement of physical quantities – strain, torque and angle
7. Measurement of temperature by RTD method
8. Measurement of low resistance by Kelvin‟s double bridge.
9. Measurement of voltage, current and resistance using dc potentiometer.
10. Measurement of inductance by Maxwell‟s bridge, Hay‟s bridge, Anderson‟s bridge.
11. Measurement of capacitance by Owen‟s bridge, De Sauty bridge, Schering bridge.
12. Measurement of flow rate by anemometer.

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 3

Subject Code: 1030303	**Subject Title:** Circuit Analysis
Pre-requisite:	

Course Objective:

(1) To impart the knowledge of Network theorems with their application
(2) To provide the knowledge transient analysis of electrical circuits
(3) To Introduce transient analysis using Laplace transform
(4) To Understand the concept of two port netwoks

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Network Theorems:** Maximum power transfer theorem ,Superposition theorem, Compensation theorem, Thevenin theorem, Reciprocity theorem, Norton theorem,. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.	10	25
2	**Transient analysis using time domain approach** Suspension of first & second order differential equations for Series & parallel R-L, R-C, RL-C circuits, forced and free response, initial & final conditions in network elements, steady state and transient state response for AC & DC excitation, time constants	12	30

3	**Transient analysis using Laplace transform approach:** Analysis of Laplace Transform, Investigation of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, Transfer function representation, transformed network with initial conditions, Concept of Poles &Zeroes representation	8	20
4	**Two Port Networks and Network Functions:** Terminal pairs, relationship of two port variables, admittance parameters, impedance parameters, transmission parameters and hybrid parameters, interdependence & relationship, interconnections of two port networks. Network functions: Concepts of Complex Frequency, Transform Impedance, Network Functions of 1&2 Port Networks, Concept of Poles &Zeroes, Properties of Driving Point & Transfer Functions, Time Response Stability from Pole-Zero Plot.	10	25

Course Outcome:

CO1: Apply the knowledge of basic circuital law for analysing an electrical Circuit
CO2: Obtain the Transient analysis of different order system
CO3: Apply Laplace transform to get transient response of electrical network
CO4: Analyse the two port network and understand the network functions

List of Text Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. A. A. Nimje and D. P. Kothari, "Electrical Circuit Analysis and synthesis", New Age International Publications, 2017

List of Reference Books:

1. K.S.Suresh Kumar, "Electric Circuit Analysis", Pearson Publications, 2013Millman and Halkias, Textbook of Integrated Electronics, Mc Graw Hill.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

Open e-Resource:

Courses available through NPTEL.
- website : nptel.ac.in

List of Suggested Experiments:

1. To verify the Superposition theorem.
2. To verify the Thevenin and Norton's theorems.

3. To verify the maximum power transfer theorem.
4. To verify the reciprocity theorem.
5. To measure and verify the steady-state and transient time-response of R-L circuit.
6. To measure and verify the steady-state and transient time-response of R-C circuit.
7. To measure and verify the steady-state and transient time-response of R-L-C circuit.
8. To verify the current and voltage phasors in complex AC circuits by measurement and theoretical analysis.
9. To obtain the solution of first order and second order linear differential equations with Laplace transform.
10. To obtain the solution of R-L-C networks with impedance functions.
11. To verify the impedance parameters for a two-port network.
12. To verify the admittance parameters for a two-port network.
13. To verify the hybrid parameters for a two-port network.
14. To verify the transmission parameters for a two-port network.

Gandhinagar Institute of Technology
B.Tech. Electrical Engineering
Semester 3

Subject Code: 10000302	**Subject Title: Numerical and statistical Methods**
Pre-requisite: Various Mathematical Series, Calculus, introductory knowledge of probability and statistics	

Course Objective: **(1)** To Understand different kind of mathematical analysis tools for linear, non-linear and dynamical systems and to study of uncertainty (randomness) by probability - statistics and curve fitting.
(2) Understand different methods of solution of the various types of equations, its error analysis and its comparison.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	1	0	4	70	30	0	0	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Numerical Solutions:** Roots of Algebraic and Transcendental Equations: Bisection, false position, Secant and Newton-Raphson methods, Fixed Point Iteration, Rate of convergence, Applications to electrical engineering problems.	06	15 %
2	**Interpolation:** Finite Differences, Forward, Backward and Central operators, Interpolation by polynomials: Newton's forward, Backward interpolation formulae, Newton's divided formulae and Lagrange's interpolation formulae for unequal intervals, Applications to electrical engineering problems. **Curve fitting by the numerical method:** Curve fitting by least square method, fitting of straight lines, quadratic, exponential and logarithmic curves.	10	25 %
3	**Numerical Integration:** Newton-Cotes formula, Trapezoidal, Simpson's formulae and its error, Gaussian quadrature formulae, **Numerical solution of Ordinary Differential Equations:** Picard, Taylor, Euler methods and Runge-Kutta methods.	8	20 %
4	**Basic Probability:** Experiment, definition of probability, conditional probability, independent events, Bayes' rule, Bernoulli trials; Random variables (One variable only): discrete random variable, probability mass function, continuous random variable, probability density function, cumulative	10	20 %

	distribution function, properties of cumulative distribution function, Applications to electrical engineering problems.		
5	**Basic Statistics:** Measures of central tendency: mean, median, mode; Measures of dispersion: variance, standard deviation, coefficient of variance; Expectation, variance, Moments, Skewness, kurtosis, Bounds on probability, Chebyshev's Inequality, Applications to electrical engineering problems.	8	20 %

Course Outcome:

After learning the course, the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Solve algebraic and transcendental equation related to electric engineering problem by using numerical methods and understand convergent of it	15
CO-2	Find unknown value of given data by using various interpolation and curve fitting methods	25
CO-3	Calculate integration and solve differential equations by using numerical methods	20
CO-4	Understand the terminologies of basic probability and their probability functions and apply it in electrical problems	20
CO-5	Understand the central tendency and dispersion methods for various types of data and apply it in electrical problems	20

List of Text Books:

(1) Dr S S Patel and Dr N B Desai, Applied Mathematics for Electrical Engineering, Atul Prakashan.
(2) Chapra S.C, Canale, R P, Numerical Methods for Engineers, Tata McGraw Hill, 2003.
(3) S. Ross, A First Course in Probability, 6th Ed., Pearson Education India.

List of Reference Books:

(1) E. Kreyszig, Advanced Engineering Mathematics, John Wiley (1999)
(2) J. L. Devore, Probability and Statistics for Engineering and the Sciences, Cengage Learning
(3) Gerald C. F. and Wheatley P.O., Applied Numerical Analysis (5th Edition), Addison Wesley, Singapore, 1998
(4) P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall.
(5) W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, Wiley.
(6) D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, Wiley.

Open e-Resource: E-materials available at the website of NPTEL- https://swayam.gov.in/

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 4

Subject Code: 10030401	**Subject Title:** Electrical Machine - 1
Pre-requisite:	

Course Objective:

(1) To Understand the Basic working construction of DC Machine and transformer
(2) To Analyse the performance of DC machine and transformer
(3) To Impart the knowledge of Various speed control techniques for DC motor
(4) To Enable to students to solve problems in transformer and DC machine

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Magnetic fields and magnetic circuits:** Analysis of magnetic circuits - MMF, flux, reluctance, inductance, Conception of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air. Review of Ampere's law and Biot Savart law.	8	10
2	**Electromechanical Energy Conversion:** Principles of energy conversion, singly excited magnetic system, doubly excited magnetic system	8	10
3	**DC Machines:** Construction and working of a DC machine, Conception of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil.	15	40

	Armature winding and commutation – armature coil and commutator, lap and wave windings, construction of commutator, Commutation, B x ack EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction. Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control methods. Losses and Efficiency in DC machines. Swinburn's test, Hopkinson's test, Field test, Retardation test, Separation of losses of a DC shunt machine.		
4	**Transformers:** Basics of Magnetics Circuits and Electromechanical Energy Conversion, Types, Working Principle, Construction, EMF Equation, Transformer on No-Load & ON Load, Ideal Transformer, Actual Transformer, Vector Diagrams, Equivalent Resistance & Reactance, Equivalent Circuits, Losses, Efficiency & Voltage Regulation, All Day Efficiency, Direct Load Test, O.C. &S.C. Tests, Sumpner's Test, Polarity Test, Parallel Operation & Load Sharing, per unit impedance, Auto Transformers, Applications, Testing and Trouble Shooting of Single Phase Transformer Construction, Types, Vector Groups, Connections (Including Open Delta), Parallel Operation of 3-Phase Transformers, Scott Connection, Three Winding Transformer, Tertiary Winding, Voltage Regulation & Tap Changers, Magnetizing Inrush, Harmonics in Transformer, Cooling Methods, Protective & Safety Devices Fitted on Transformers, Power & Distribution Transformer, Testing and Trouble Shooting of Three Phase Transformer	15	40

Course Outcome:

CO1: Understand the concepts of Magnetic field and Electromechanical energy conversion
CO2: Describe the construction working of DC machine and Transformer
CO3: Analyze the performance of DC machine and Transformer
CO4: Evaluate the operating performance of DC Machine and transformer under various load condition

List of Text Books:

1. B.L. Theraja& A.K. Theraja, A text book of Electrical Technology Volume II-AC & DC Machines, S. Chand & Co.
2. J. G. Jamnani, Electrical Machines, Mahajan Publishing House
3. J.B.Gupta, Theory and performance of electrical machines, Katson Publication, S.K.Kataria& Sons.

List of Reference Books:

4. Ashfaq Hussain, Electric Machines, Dhanpat Rai and Co.
5. D.P. Kothari and I. J. Nagrath, Electric Machines, Tata McGraw Hill
6. P. S. Bimbhra, Electrical Machinery, Khanna Publishers
7. M. G. Say, Alternating Current Machines, Pitman and Sons

Open e-Resource:

Courses available through NPTEL.
- website : nptel.ac.in
- http://www.scilab.org/
- http://www.gnu.org/software/octave/
- http://www.vlab.co.in
- http://www.femm.info

List of Suggested Experiments:

1. To obtain Magnetizing Characteristics, Internal & External Characteristic of Self Excited DC Shunt Generator. Also obtain the critical field resistance of the machine from magnetizing Characteristics.
2. To conduct direct load test on a D.C. compound generator with a) Shunt field alone b) Cumulative and differential compounding for short and long shunt connections.
3. To obtain Speed-Torque characteristics of DC Series Motor and DC Shunt Motor.
4. To determine the efficiency of two similar shunt machines by regenerative method. (Hopkinson's Test.)
5. To perform field test on identical D.C. series machines.
6. To determine the various losses in a D.C. machine and separation of its core losses.
7. To perform direct load test on a D.C. shunt motor and plot variation of (a) Input current (b) Speed(c) Torque (d) Efficiency versus output power.
8. To separate hysteresis and eddy current losses of a single phase transformer at rated voltage, frequency by conducting no load tests at different frequencies keeping V/f constant.
9. To operate two single phase transformers of different KVA ratings in parallel and plot the variation of currents shared by each transformer versus load current.
10. To conduct Sumpner test on two identical single phase transformers and determine their efficiency at various loads.
11. To make Scott connection of two single phase transformer and to verify the three phase to two phase conversion.
12. To conduct open circuit and short circuit test on a three phase transformer and determine the equivalent circuit parameters.
13. To perform Swinburn's test on DC shunt motor to find out its efficiency
14. Speed control of DC Shunt Motor using a) Armature control and b) field control methods.

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Sem 4

Subject Code: 10030402	**Subject Title: Power System-I**
Pre-requisite: Basic knowledge of Electrical Engineering	

Course Objective: (1) To provide an overview of electrical power system.
(2) To concentrate on researching electrical power system with different technique.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Basic of Power generation: Generation scenario in India and Gujarat Steam power station, schematic diagram, choice of site, equipment and efficiency for thermal power plant, hydro power plant, nuclear power plant, gas turbine power plant, combined cycle power plants, load curves. Load curves, Important terms and factors, Load duration curve, Examples. Tariff, Desirable characteristics of tariff, Types of tariff, Examples.	05	15
2	Renewable Energy Resources The wind power plant – Introduction, Classification, Wind Turbine Components (Rotor, Nacelle, Tower, Electric Substation, Foundations) Wind Energy Conversion – Rotation principle, Forces on a rotor blade, Factors affecting performance of rotor, Thrust and torque on rotor, Power curve. The Solar Power Plant - Concentrated Solar Power (CSP) plant Operation and its working, Photovoltaic Conversion – Introduction, Description and principle of working, performance characteristics of a solar cell, types of solar cell, photovoltaic system applications, Grid-connected PV systems.	05	15
3	Mechanical Features and Design of Overhead Transmission Line: Main components of overhead lines, Conductor materials, Line supports, Insulators, Types of insulators, String efficiency, Methods of improving string efficiency, Examples, Sag in overhead lines, Calculation of sag, Examples based on design. Concept of Corona.	06	15
4	Electrical Supply Systems: Electric supply system, Typical ac power supply scheme, Advantages of high transmission voltage, Overhead v/s underground systems, Requirements of a distribution system, Connection schemes of distribution system.	06	10

	AC Distribution – Methods of solving AC distribution problems, Four wires star connected unbalanced load, Examples.		
5	Transmission System: Classification and performance of short lines, medium and long transmission lines, generalized constants, Ferranti effect, power circle diagram	10	20
6	Distribution System: Sub-stations types and equipment, layouts and bus-bar configuration, supply system, various configurations of distribution system, earthing, underground cables, power factor improvement	10	20

Course Outcome:

(1) understand the conventional and renewable energy sources of power generation, with associated issues and challenges
(2) apply the basic concepts of designing the transmission and distribution system
(3) know the technical specifications to be met by the utility and the consumer to ensure secure and economic functioning of the grid

List of Text Books:

1. J. B. Gupta, A Course in Electrical Power, Dhanpat Rai Publishers.
2. C.L. Wadhwa, "Electric Power Systems", New Age Intl. (P) Ltd.

List of Reference Books:

1. D.P. Kothari and I. J. Nagrath, Modern Power System analysis, McGraw Hill.
2. A. Chakrabarti, M. L. Soni, U.S. Bhatnagar and P.V. Gupta, Power System Engineering, Dhanpat Rai Publishers.
3. S. Sivanagaraju and S. Satyanarayana, Electric Power Transmission and Distribution, Pearson Education.
4. P. K. Nag, Power Plant Engineering, McGraw Hill Education (India) Private Limited.
5. D. P. Kothari, K. C. Singal and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI Learning Private Limited.

Open e-Resource:

Open source Math Tools:
- http://www.scilab.org/

Learning website
- http://www.electrical-engineering-portal.com/
- http://nptel.iitm.ac.in/courses.php

List of Suggested Experiments:

1. Survey of generation scenario and power plants of Gujarat.
2. Survey of different type of power plants of India to observe the power and energy supplied by them daily, their rates of energy, daily schedule etc.
3. Plot VI and PV characteristics of solar cell/panel.
4. Simulation of three phase system with three phase balanced load with neutral grounded
5. Simulation of three phase system with three phase load, effect of unbalanced load on the voltages of phases with and without neutral grounded.
6. Write a program to calculate string efficiency of string of insulating discs for voltage levels upto 400 kV

7. Write a program for calculating line inductance for different conductor configurations and dimensions.
8. Write a program for calculating line capacitance for different configurations and design of line.
9. Write a program for calculating sag of transmission line under different loading conditions.
10. Prepare layout of substation for a given bus arrangement and given voltage rating with all necessary equipment.
11. Write a program for calculating voltage drop in a radial AC feeder.

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Sem 4

Subject Code: 10030403	**Subject Title: Control Systems**
Pre-requisite: Basic knowledge of Electrical Engineering	

Course Objective: (1) To be able to obtain a working mathematical model of a system.
(2) To be able to do time-domain and frequency-domain analyses of the model to predict the system's behavior.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Introduction to control systems: Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Introduction to linear control, open loop and closed loop control system.	05	15
2	Time Domain Analysis and Concept of Stability: Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time response. Necessary condition for stability, R-H criterion.	10	25
3	Root Locus and Frequency Response Analysis: Construction of root locus, steps to solve the problem on root locus, stability analysis of control system using root locus plots. Introduction to bode diagrams, construction of bode plots, nyquist plots, nyquist stability criterion, relative stability using frequency response analysis.	12	25
4	Design of Controller System: Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.	08	15
5	State variable Analysis Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of	08	20

	controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time Systems. Stability of linear discrete-time systems.		

Course Outcome:

(1) assess and evaluate the liner control system's stability and feedback qualities
(2) develop an ability to analyze time response of control system
(3) determine and model the control system's frequency response
(4) demonstrate the fundamentals of state space for a linear time-invariant control system

List of Text Books:

1. U.A. Patel, Control System Engineering, Mahajan Publication.

List of Reference Books:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995
3. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
4. Noman S. Nise, Control System Engineering, Wiley Publication
5. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

Open e-Resource:

Open source Math Tools:
- http://www.scilab.org/

Learning website
- http://www.electrical-engineering-portal.com/
- http://nptel.iitm.ac.in/courses.php
- http://nptel.ac.in/

List of Suggested Experiments:

1. Introduction to MATLAB (Mathematical Computational & Simulation Software) - Applications in Control Theory.
2. To study mathematical modelling of Electrical Systems & Simulate using MATLAB.
3. To study mathematical modelling of Mechanical Systems & Simulate using MATLAB.
4. Transient response analysis of first order systems (Simulation Exercise using MATLAB).
5. Transient response analysis of second order systems (Simulation Exercise using MATLAB).
6. To solve ordinary differential equations (state space models) using solvers in MATLAB.
7. To solve ordinary differential equations (state space models) using Simulink in MATLAB.
8. To study transient and steady state response of liquid level system using open loop experimental runs and verify them using open loop simulations.
9. To study stability analysis using Root Locus (verifying using MATLAB).
10. To study stability analysis using Bode Plots (verifying using MATLAB).
11. To check controllability and observability of the system using state space models (verifying using MATLAB).

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 4

Subject Code: 10030404	**Subject Title:** Power Electronics
Pre-requisite:	

Course Objective:

(1) To Introduce the Semiconductor devices used in Converter
(2) To impart the knowledge of AC to DC and DC to AC converter with their application
(3) To Provide the knowledge of AC Voltage controller.
(4) To Introduce the control techniques of converter

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Power Semiconductor Devices:** Diode, Thyristor, MOSFET, IGBT; Static characteristics of these devices; Operation of power devices as switches and switching losses, Single-quadrant switches, two-quadrant and bidirectional switches; Firing circuit for thyristors; Gate drive circuits for MOSFET and IGBT.	8	15
2	**AC to DC Converters:** Single Phase Half Wave and full wave Controlled Rectifiers with R, RL and RLE loads, Three Phase Half Wave and Full Wave Controlled Rectifier with R, RL, RLE loads, Dual Converter with circulating and non-circulating current mode, Effect of source inductance in controlled rectifiers, Introduction to PWM rectifiers	10	20

3	**Non Isolated and Isolated DC-DC Converters:** Switching Voltage Regulators Linear voltage regulator, Concept of switching voltage regulators and advantages, Operation and Principle of Basic DC-DC converter topologies like Buck, Boost and Buck-Boost converter, Various control techniques for output voltage control, Mathematical analysis for these converters for steady state, Concept of CCM and DCM and factors affecting them, Closed loop control for voltage regulation, Isolated converters: Forward converter and Flyback converter; Multi-quadrant operation of DC-DC converters; Applications	10	20
4	**DC-AC Converter:** Basic concept of inverters, three phase inverters (120° and 180° mode), Multilevel inverters- Diode Clamped, Flying Capacitor & Cascaded H-Bridge, Different types of PWM strategies-Multi carrier PWM, Single & Multiple PWM – Sine Triangle PWM (Bipolar & Unipolar), SVPWM	10	20
5	**AC-AC Converters** Principle of Phase Control – Single Phase AC Voltage Controllers with R and RL loads, Three Phase AC Voltage Controllers with R and RL loads, Principle of On-Off (ICC) Control. Basic principle of operation-Single phase to single phase, Three phase to single phase Cycloconverter. Three phase to three phase cycloconverter	8	15
6	**Miscellaneous** Frequency Control: Introduction to cycloconverter and matrix converter; basic power circuit and their operating principle. Datasheet interpretation, Ratings of the devices and Selection of switches. Overvoltage, overcurrent and short-circuit protection; Electromagnetic interference and its remedies; Snubber circuit and its design .	8	10

Course Outcome:

CO1: To understand the working of power semiconductor devices
CO2: Analyse the working of Converter
CO3: Apply Laplace transform to get transient response of electrical network
CO4: Analyse the two port network and understand the network functions

List of Text Books:

1. Muhammad H. Rashid, Power Electronics: Circuits, Devices and Applications, Pearson Education, New DelhiA. A. Nimje and D. P. Kothari, "Electrical Circuit Analysis and synthesis", New Age International Publications, 2017
2. Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics: Converters, Applications and Design, John Wiley & Sons, Inc., New York
3. L Umanand, Power Electronics, Essentials & Applications, Wiley India

List of Reference Books:

1. M. S. Jamil Asghar, Power Electronics, Prentice-Hall of India Pvt. Ltd., New DelhiD. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
2. M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw-Hill Publishing Company Ltd., New Delhi
3. G. K. Dubey, S. R. Doradla, A. Joshi, R. M. K. Sinha, Thyristorized Power Controllers, New Age International, Delhi
4. B. Jayant Baliga, Power Semiconductor Devices, Thompson Course Technology, Singapore.
5. P. S. Bhimbra, Power Electronics, Khanna Publishers, New Delhi.
6. C. W. Lander, Power Electronics, McGraw-Hill, UK

Open e-Resource:

Courses available through NPTEL.
- website : nptel.ac.in

List of Suggested Experiments:

1. Static and dynamic characteristic of SCR, MOSFET and IGBT
2. R, RC and UJT triggering of SCR
3. To analyse the performance of single phase and three-phase full bridge thyristor rectifier for R and RL load.
4. Duty ratio control for regulating the output voltage of DC-DC Buck/Boost/Buck-Boost converter
5. Modelling and simulation of closed-loop control of DC-DC Buck/Boost/Buck-Boost converter.
6. To study the effect of inductance, switching frequency, duty cycle, load current on the output ripple voltage of a step-down chopper (using simulation platform like MATLAB/Simulink)
7. Performance of 1-phase bridge inverter with R and R-L load
8. Study of harmonic spectrum of output voltage for unipolar and bipolar PWM controlled half-bridge and full bridge converter.
9. Performance of 3-phase bridge inverter operating with 120° and 180° conduction mode.
10. Simulation of SVPWM and and to study its effectiveness over SPWM
11. Output AC voltage control of SCR based 1-phase ac voltage controller using ON-OFF and phase-control principle
12. Output AC voltage control of SCR based 3-phase ac voltage controller using ON-OFF and phase-control principle
13. To study the performance of single-phase fully controlled and semi-controlled converter for R and R-L load
14. To study the performance of three-phase fully controlled and semi-controlled converter for R and R-L load

Gandhinagar Institute of Technology
Bachelor of Technology
Semester 4

Subject Code: IKS0403	**Subject Title: Vedic Mathematics**
Pre-requisite: -	

Course Objective: The main objective of this course is to make students appreciate the amazing computational power of Vedic Sutras and help them to develop skill for doing faster and accurate calculations.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
2	-	-	2	-	50	-	-	50

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Vinculum, Multiplication, Division & Roots** Vinculum: Conversion, Application, Addition and Subtraction, Beejank, Multiplication: Vertically and Crosswise, Base number/sub base number, Sum and difference of Products, Division: Nikhilam, Paravartya Yojayet, Flag Digit (Vertically and Crosswise), Mixed Operations, Indices: Meru Prastar, Square, Cube, Fourth and Fifth Power, Mixed Operations, Roots: Vilokanam (up to Fifth Root), Square root and Cube root, Mixed Operations	10	50 %
2	**Expansion & Factorisation:** Introduction -Meru Prastar -upto fifth Power, Mixed Operations, Factorisation (Cubic expression) -Remainder Theorem, use of Differentiation, LCM/HCF Partial Fractions, Anurupye sunyamanyat (3 elementary methods), Solution of Equations, (Quadratic equations /simultaneous equations of 2 or 3 variables)	10	25 %
3	**Complex Numbers & Calculus:** Complex Numbers: Multiplication, Division and square-root, Calculus: Differentiation, Integration, Various Number System: (Binary, Quadral, Octal and Hexadecimal Systems) – Conversion and Basic operations.	10	25 %

Course Outcome:

After Completion of this Course Students will be able to:

- Understand and apply Vedic methods for arithmetic operations, including vinculum, Beejank multiplication, and division techniques like Nikhilam and Paravartya Yojayet.
- Solve problems involving indices, roots, LCM/HCF, divisibility, recurring decimals, and numerical codes using traditional Vedic approaches.

- Apply Vedic techniques in algebra for multiplication, division, expansion, factorisation, partial fractions, and solving equations.
- Demonstrate basic understanding of, complex numbers, calculus, and number systems using foundational Vedic and mathematical concepts.

List of Reference Books:

1. Bharatiya Krishna Teerth : Vedic Mathematics (Motilal Banarasidas New Delhi, 2001).
2. V.G. Heroor : The History mathematics and Mathematicians of India.
3. V.G. Unkalkar : Magical world of Mathematics, (Vandana Publishers Bangalore, 2008).
4. Dr. Vyawahare-Chouthaiwale- Borgaonkar: Introduction to Vedic Mathematics.

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 5

Subject Code: 10030501	**Subject Title: Electrical Machine- *II***
Pre-requisite:	

Course Objective:

(1) Electrical power sector is the backbone of industries, agriculture, irrigation, urban development and almost all the segments of society

(2) In view of this, the rotating electrical equipments play a vital role for the society

(3) This subject deals with the theory and performance analysis of various electrical machines.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Induction Machines:** Revision of the concept of rotating magnetic field. Construction, working and types of induction motor (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. No-load & blocked rotor test, Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Induction generator operation. Self-excitation of induction generator. Double cage induction motor. Circle diagram of induction	12	30

	motor. Effect of harmonics, Cogging & Crawling, Effect of unbalanced voltages on performance of motor.		
2	**Single-phase induction motors:** Constructional features double revolving field theory, equivalent circuit, Determination of parameters. Split-phase starting methods and applications. Universal motor. Repulsion motor. Shaded pole single phase motor.	7	10
3	**Synchronous machines:** Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Methods to find voltage regulation: Synchronous impedance method, MMF method, ZPF method. Operating characteristics of synchronous machines, Salient pole machine – two reaction theory, power angle characteristics. Parallel operation of alternators - synchronization and load division.	15	40
4	**Synchronous motors:** Methods of starting of synchronous motors, Different torques in Synchronous motor, Stability, Synchronous condenser, Synchronous phase modifiers, V-curves of Synchronous motors, Auto Synchronous Motor: Construction, principle of operation, equivalent excitation current for various rotor connections, circle diagram.	7	10
5	**Special machines:** Magnetic levitation principle, advantages and applications of linear induction motor. Introduction to axial flux machines. Construction, working and applications of Permanent magnet brushless DC motor, Stepper motor and Switched reluctance motor	7	10

Course Outcome:

CO1: Describe the construction, working principle and applications of induction machines and synchronous machines.
CO2: Analyze the performance of rotating electrical machines using the tools like equivalent circuit, phasor diagram and circle diagram.
CO3: Evaluate the performance parameters of rotating machines with different operating conditions.
CO4: Illustrate the construction, working, applications and advantages of special machines.

List of Text Books:

1. J B Gupta, “Theory and Performance of Electrical Machines”, Katson Publication, 2009
2. B L Theraja, “Electrical Technology – Part II”, S Chand Publications, 2011

List of Reference Books:

3. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
4. I J Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
6. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
7. G C Garg, "Electrical machines – II", Khanna Publishers,

Open e-Resource:

- http://www.scilab.org/
- http://www.gnu.org/software/octave/
- http://www.vlab.co.in
- http://www.femm.info

List of Suggested Experiments:

1. To perform no load and blocked rotor test on three phase induction motor to obtain the parameters of equivalent circuit
2. To perform no load and blocked rotor test on three phase induction motor to evaluate the performance parameters using circle diagram
3. To perform no load and blocked rotor test on single phase induction motor to obtain the parameters of equivalent circuit
4. To obtain the performance parameters of three phase induction motor using direct load test.
5. To find out the voltage regulation of three phase alternator using direct load test
6. To perform open circuit, short circuit and resistance measurement tests on alternator to find out its voltage regulation using synchronous impedance method and MMF method.
7. To perform open circuit, short circuit, zero power factor and resistance measurement tests on alternator to find out its voltage regulation using ZPF method.
8. To perform synchronization of alternator using dark lamp method, two bright one dark lamp method and synchro scope.
9. To obtain direct axis and quadrature axis reactance of salient pole synchronous machine using slip test.
10. To obtain the v-curves of a synchronous motor.
11. To study the construction and working of special electric machines like stepper motor, permanent brushless DC motor and switched reluctance motor

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 5

Subject Code: 10030502	**Subject Title: Power system - II**
Pre-requisite:	

Course Objective:

(1) To Understand the Basic Principles of AC power flow
(2) To Provide Exposure About the Modeling of Power Systems Components and Transmission Line
(3) Its Analysis and Performance Including the Fault Analysis of Power Systems

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Basic Principles:** Power in single phase AC circuits, Complex power, Complex power balance, Complex power flow, Balanced Three Phase Circuits, Star connected loads, Delta connected loads, Delta-star transformation, three phase analysis, Balanced three phase power	4	5
2	**Representation of Power System Components:** One line and impedance diagram, Per unit system, Per unit representation of transformer, Per unit impedance diagram of power system, Examples – per unit system and impedance diagram, Synchronous machine, Power factor and power control, Salient pole synchronous generator, Operating chart of a synchronous generator, Representation of loads.	8	10

3	**Transmission Line Modeling and Performance:** Introduction, Short transmission line, Medium transmission line, Long transmission line – Rigorous solution, Evaluation of ABCD constants, Interpretation of long line equations, Ferranti effect, tuned power lines, Power through a transmission line, Circle diagrams, Methods of voltage control, Examples	15	40
4	**Symmetrical Components:** Symmetrical component transformation, Phase shift in star-delta transformers, Sequence impedances of transmission lines, Sequence - impedances and networks of synchronous machines, Sequence impedances and networks of transformers, Construction of sequence networks of a power system, Examples	8	15
5	**Symmetrical Fault Analysis:** Introduction, Transient on a transmission line, Short circuit of a synchronous machine on no load, short circuit of a loaded synchronous machine, Selection of circuit breakers, Examples, ZBUS formulation – by inverting YBUS, current injection technique, ZBUS building algorithm (Type – 1, 2, 3, 4 modifications).	7	15
6	**Unsymmetrical Fault Analysis:** Introduction, Symmetrical component analysis of unsymmetrical faults, Single line to ground fault, Line to line fault, Double line to ground fault, Open conductor faults.	7	15

Course Outcome:

CO1: Prepare the model of transmission line, generator and transformer of power system for single line diagram representation and per unit quantity calculation.
CO2: Evaluate performance of short, medium and long transmission lines.
CO3: Analyze Symmetrical Component Transformation.
CO4: Analyze symmetrical and unsymmetrical faults in power system.

List of Text Books:

1. J. B. Gupta, A Course in Electrical Power, Dhanpat Rai Publishers.
2. C.L. Wadhwa, "Electric Power Systems", New Age Intl. (P) Ltd.

List of Reference Books:

3. Modern Power system Analysis: I. J.Nagrath, D. P. Kothari,McGraw Hill Education
4. Power System Analysis: HadiSaadat, McGraw Hill Education India Pvt Ltd
5. Power System Analysis and Design: J. Duncan Glover, Thomas J. Overbye, Mulukutla S. Sarma, Cengage Learning India Pvt. Ltd.
6. Power System Analysis: John J. Grainger, William D. Stevenson Jr.,McGraw Hill Education

Open e-Resource:

Courses available through NPTEL.
- website: nptel.ac.in
- https://www.scilab.org/
- https://www.powerworld.com/download-purchase/demo-software/simulator-demodownload
- https://swayam.gov.in/nd1_noc19_ee61/preview
- https://swayam.gov.in/nd1_noc19_ee62/preview
- http://vp-dei.vlabs.ac.in/Dreamweaver/list.html

List of Suggested Experiments:

1. To write computer program for plotting instantaneous voltage, current and power in a single phase ac circuit.
2. To write computer program and obtain voltage regulation and efficiency of short transmission line for different specified set of receiving end quantities (different load at leading, unity and lagging power factor).
3. To write computer program and obtain voltage regulation and efficiency of short transmission line for different specified set of sending end quantities (sending end leading, unity and lagging power factor).
4. To write computer program and obtain voltage regulation and efficiency of a Medium transmission line (using π model& T model) for different specified set of receiving end quantities (different load at leading, unity and lagging power factor).
5. To write computer program and obtain voltage regulation and efficiency of a Medium transmission line (using π model& T model) for different specified set of sending end quantities (sending end leading, unity and lagging power factor).
6. To write computer program to calculate voltage regulation and efficiency of a Long transmission line using distributed capacitance model for different specified set of receiving end quantities (different load at leading, unity and lagging power factor) and compare the results with results obtained with program for equivalent π model.
7. To write computer program to calculate voltage regulation and efficiency of a Long transmission line using distributed capacitance model for different specified set of sending end quantities (sending end leading, unity and lagging power factor) and compare the results with results obtained with program for equivalent π model
8. To analyses the performance of long transmission line for specified load impedance.
9. To obtain voltage profile and load ability curve for a transmission line.
10. To compute shunt reactor compensation and performance of open circuited line.
11. To compute shunt capacitor compensation and performance of loaded line.
12. To compute series capacitor compensation and performance of loaded line.
13. To develop program for formulation of ZBUS matrix through ZBUS building algorithm.
14. To simulate transient in series R-L circuit with special attention to change in DC offset current for application of excitation at different instant.
15. Dynamic simulation of three phase fault on terminal of unloaded synchronous generator. The simulation should show the waveforms of all three-line current for fault at different instant on voltage wave of phase A.

16. To develop program to transform three phase unbalanced phasor into its symmetrical components.
17. To develop program to transform symmetrical components into its original phasors.
18. To analyze line to line fault in power system (Using program/simulation).
19. To analyze line to ground fault in power system (Using program/simulation).
20. To analyze double line to ground fault in power system (Using program/simulation).
21. To write a computer program for animation of travelling waves of a long transmission line with different operating conditions.

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 5

Subject Code: 10030503	**Subject Title: Microprocessor and Microcontroller**
Pre-requisite:	

Course Objective:

(1) Microcontrollers Are The Most Useful Electronic Chips Which Are Used To Design Computer Based Automatic Smart Electronics Systems For Home And Industry Application.

(2) 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

(3) The Students Learn Programming Language (Both Assembly And Embedded C) Used For Microcontrollers

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Microprocessor Based Systems:** Digital Computer, Microprocessor, Microcomputer, Microcontroller, Van Neumann and Harvard Architecture, CISC and RISC Processors	2	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.	6	15

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.	8	15
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.	8	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.	5	15
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	4	5
7	**External Memory Interfacing:** Memory address decoding, interfacing 8031/8051 with ROM/EPROM and Data ROM **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	10	25
8	**ARM Processor Fundamentals:** Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts and Vector Table, Core Extensions, Architecture Revisions, Arm Processor Families	4	5

Course Outcome:

CO1: Describe 8085 microprocessor and microcontroller architecture of MCS51 family.
CO2: Develop assembly language/ embedded C- language code for a given problem
CO3: Configure a given microcontroller/ microprocessor-based system for timer-counter/serial communication/interrupt operation in assembly/embedded C

CO4: Interface appropriate peripheral devices, memory with microcontroller for given application/problem

List of Text Books:

1. The 8051 Microcontroller & Embedded Systems using Assembly and C By K. J. Ayala, D. V. Gadre (Cengage Learning, India Edition).
2. 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)

List of Reference Books:

3. Microprocessor Architecture, Programming, and Applications with the 8085, By Romesh Gaonkar, Penram International Publishing (India) LTD.
4. ARM System Developer's Guide, Designing & Optimizing System Software, by Andrew Sloss, Dominic Symes, Chris Wright, Elsevier Publications.

Open e-Resource:

List of Open Source Software/learning website:

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

List of Suggested 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

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 5

Subject Code: 10030504	**Subject Title: Advanced Power Electronics**
Pre-requisite:	

Course Objective:

(1) The Course Is Aimed To Provide Exposure Of Some Power Electronic Converters That Are Utilized By The Industries.

(2) Student can understand about FACTS devices.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Switching Voltage Regulators Introduction:** Linear power supply (voltage regulators); Switching voltage regulators; Review of basic dc-dc voltage regulator configurations -Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode; Other converter configurations like Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter, C'uk converter, Sepic Converter; Design criteria for SMPS; Multi-output switch mode regulator	10	40
2	**Resonant Converters Introduction:** Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, zerovoltage switching dc-dc	5	10

	converters, zero current switching dc-dc converters, clamped voltage topologies.		
3	**Multi-level converters:** Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded H-bridge multilevel Converters configurations; Features and relative comparison of these configurations applications, Introduction to carrier based PWM technique for multi-level converters.	5	10
4	**FACTS devices** Importance of reactive power compensation, Flow of power in AC system and conventional control mechanisms, Definition of Flexible ac Transmission Systems (FACTS) and brief description, possible benefits from FACTS, Thyristor- Controlled Reactor (TCR), Fixed Capacitor Thyristor-Controlled Reactor (FC-TCR), Thyristor-Switched capacitor and Reactor, Thyristor-Switched capacitor-Thyristor-Controlled Reactor (TSCTCR), STATCOM configuration and operating principle, Static characteristics of SVC and STATCOM Comparison of SVC and STATCOM, Principle of series compensation, Introduction to Static Synchronous Series Compensator, Advantages and limitation of SSSC, Introduction to UPFC and operating principle.	10	40

Course Outcome:

CO1: Evaluate different dc-dc voltage regulators
CO2: Simulate and analyze resonant converters.
CO3: Evaluate various multi-level inverter configurations.
CO4: Compare various FACTS devices for VAR compensation

List of Text Books:

1. P.C.Sen, "Modern Power Electronics ", S. Chand and Co. Ltd., New Delhi, 2000.
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India,3rd ed., 2009.

List of Reference Books:

3. Bin Wu, "High Power Converters and AC Drives", John Willey & sons, Inc., 2006.
4. Derek A. Paice "Power Electronic Converter Harmonics – Multipulse Methods for Clean Power", IEEE Press, 1996.
5. Muhammad H. Rashid , "Power Electronics Handbook", Elsevier, 3rd ed., 2011.

Open e-Resource:

1. MIT OPEN COURSEWARE by Massachusetts Institute of Technology –
   website: https://ocw.mit.edu/
2. Courses available through NPTEL. –
   website : https://nptel.ac.in/

List of Suggested Experiments:

1. Simulate/Design a circuit for a Buck Converter with ZVS/ZCS to regulate the output voltage Vo with a given input voltage Vin.

2. Evaluate the performance and operating modes of SLR/PLR dc-dc converter with the change in switching frequency.

3. Carrier based Sine PWM control of a CHB multilevel inverter and study of harmonic spectrum.

4. Study the operation and performance of half-bridge, full-bridge, push-pull converters etc.

6. Study the operation and performance of fourth order converters like C'uk or Sepic converters

7. Evaluate the performance of STATCOM/SVC as a shunt compensator.

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 5

Subject Code: 10030505	**Subject Title: Electromagnetic Field Theory**
Pre-requisite:	

Course Objective:

(1) Study of electromagnetic fields is basically concerned with study of charges at rest and in motion.
(2) Electromagnetic principles serve as basic fundamentals for detailed and in-depth study of electrical engineering and are indispensable for analysis of various electrical, electro-mechanical and electronic systems.
(3) This subject would cover the behavior of static and dynamic, electric and magnetic fields.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Review of Vector Analysis:** Introduction, scalars and vectors, unit vector, vector addition and subtraction, position and distance vectors, dot product, cross product, scalar triple product, vector triple product, components of a vector, Cartesian co-ordinate system, Circular cylindrical co-ordinate system, Spherical co-ordinate system, transformation from one co-ordinate to other coordinate systems	3	10
2	**Static Electric Fields:** Coulomb's law, Electric field intensity, Electric field due to point and line charges, Line surface and volume charge distributions, Gauss' law and its applications, Divergence theorem, Absolute Electric potential, Potential	6	20

	difference, Potential gradient, Calculation of potential difference for different configurations, Electric dipole, Electrostatic energy and energy density		
3	**Conductors, Dielectrics and Capacitance:** Current and current density, Ohm's law in point form, Continuity equation, Conductor dielectric boundary condition, Dielectric-dielectric boundary condition, Polarization in dielectrics, Capacitance, Capacitance of two wire line	5	20
4	**Poisson's and Laplace's equations:** Poisson's equation, Laplace's equation, Uniqueness theorem, Solution of Poisson's and Laplace's equation, Application of Poisson's and Laplace's equations	3	10
5	**Steady Magnetic Fields:** Biot Savart's law, Ampere's law, Curl operation, Stoke's theorem, Magnetic flux and magnetic flux density, Scalar and vector magnetic potentials, Steady magnetic field produced by current carrying conductors	6	20
6	**Magnetic forces, materials and inductance:** Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and Permeability, Magnetic boundary conditions, Magnetic circuit, Inductance and mutual inductances	5	10
7	**Time varying fields and Maxwell's equations:** Faraday's law, Transformer and motional electromotive forces, Displacement current, Maxwell's equations in integral and point form, Time varying potentials	4	5
8	**Introduction to Electromagnetic Compatibility:** Preamble of EMI & EMC, Sources of EMI, EMI-EMC Standards, EMI-EMC Measurements-I, Designing for EMC, EMI Control Techniques-I, System Level EMC, EMC Checklist/Summary, EMI-EMC Test Facilities	4	5

Course Outcome:

CO1: Apply vector calculus to electric and potential fields due to various charge distributions.
CO2: Compute potential, Electric fields, Electric flux density, Capacitance using Poisson's and Laplace's equations.
CO3: Derive forces and torques in magnetic fields, forces due to current carrying conductors and their inter-relationship with magnetic field.
CO4: Analyze Maxwell's equations in different forms (point & integral) and apply them to diverse engineering problems.

List of Text Books:

1. W. H. Hayt, J. A. Buck, "Engineering Electromagnetics", McGraw Hill Education
2. A. Pramanik, "Electromagnetism-Problems with Solutions, PHI, 2012

List of Reference Books:

3. M.N.O. Sadiku, S.V. Kulkarni, “Principles of Electromagnetics”, 6 th edition, Oxford University Press
4. A Pramanik, “Electromagnetism- Theory and Applications” PHI Learning Pvt. Ltd. ,New Delhi, 2009.
5. S.P. Seth, “Elements of Electromagnetic fields”, Dhanpat Rai & Co, 2013

Open e-Resource:

1. https://nptel.ac.in/downloads/108104087/ by Prof. Pradeep Kumar, IIT, Kanpur
2. https://nptel.ac.in/downloads/115101005/ by Prof. D.K. Ghosh, IIT , Bombay
3. https://nptel.ac.in/downloads/115104088/ by Prof. Manoj K. Harbola, IIT, Kanpur
4. Transcripts and video lectures of Prof. Harishankar Ramachandran, IIT, Madras https://nptel.ac.in/courses/108106073/
5. MATLAB experiments manual by Dr. M. H. Bakr http://www.ece.mcmaster.ca/faculty/talia/EM_2FH3_downloads/assignments/Matlab_Manual_2FH3_Bakr.pdf

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 5

Subject Code: 10030507	**Subject Title:** Electrical Power Utilization and Safety
Pre-requisite:	

Course Objective:

1. This subject assumes importance in view of the fact that a technician has to work in a wide spectrum of activities wherein he has to make collections from alternative schemes from technical and economic considerations i.e. to plan and design using basic principles and handbooks, to select equipment, processes and components in different situations.
   To orient the subject matter in
2. the proper direction, visits to industrial establishments are recommended in order to familiarize the students with the new developments in different areas.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	0	3	70	30	0	0	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Electric Heating and Welding** Advantages of electric heating, resistance heating, types of furnaces, induction heating, types of induction furnaces, dielectric heating, types of welding- arc and resistance	8	20
2	**Refrigeration and Air Conditioning:** Introduction to refrigeration and air-conditioning, principles of a refrigerator, domestic refrigerator, electrical circuit of refrigerator, need of voltage regulator, water cooler, air conditioner, thermo-electric refrigeration, air purification, central air conditioning systems	6	10

3	**Illumination Scheme** Basic terms used in illumination scheme, Electric lamps, Recommended levels of illumination, types of lighting schemes, design of lighting schemes, factory lighting, street lighting, F flood lighting	7	15
4	**Electrical Installation, Estimating and Costing** Types of load, Load assessment, Electrical supply systems, wiring systems, Permissible voltage drops and conductor size calculations, Estimating and costing for residential and commercial service connections (single phase and three phase)	8	20
5	**Power Factor** Effects of power factor, causes of low power factor, disadvantages of low power factor, methods of improving power factor, most economical power factor.	5	10
6	**Electrical Safety, Earthing System and Protective Devices** Electrical shock mechanisms, factors influencing the electric shock, body current thresholds (tolerable body current limit), thevenin's concepts and accidental equivalent circuits (step and touch potentials), protection against electric shock, purpose of earthing, IS rules for earthing of electrical installations, factors governing the resistance of earth electrode, methods of earthing, measurement of earth resistance, methods of reducing earth resistance, fuse, miniature circuit breakers (MCB) and earth leakage circuit breakers (ELCB)	11	25

Course Outcome:

CO1: infer the importance various parameters in electrical system
CO2: suggest and apply suitable electric heating, welding, refrigeration and air conditioning for a system
CO3: analyze and design illumination scheme, electrification, earthing system and protection system for an application.

List of Text Books:

1. G. C. Garg, Utilization of Electric Power and Electric Traction, Khanna Publishers, Delhi.
2. R. K. Rajput, Utilisation of Electrical Power, Laxmi Publications (P) Ltd., New Delhi.

List of Reference Books:

1. E. Openshaw Taylor, Utilisation of Electrical Energy, Universities Press.
2. H. Partab, Art and Science of Utilisation of Electrical Energy, Dhanpat Rai & Co.
3. J. B. Gupta, Utilization of Electric Power and Electric Traction, S. K. Kataria & Sons, New Delhi.
4. N. V. Suyranarayana, Utilisation of Electric Power Including Electric Drives and Electric Traction, New Age Publishers, New Delhi.

5. J. B. Gupta, A Course in Electrical Installation Estimating and Costing, S. K. Kataria & Sons, New Delhi.
6. Dr. J. G. Jamnani, Elements of Electrical Design, Mahajan Publishing House

Open e-Resource:

http://uotechnology.edu.iq/dep-production/lectures/WL.pdf
http://www.elektra.eu/pdf_en/content/elektra_guide_book.pdf
https://tstuition.wikispaces.com/file/view/6+-+Electrolysis+and+Its+Uses.pdf
http://www.nrel.gov/docs/fy06osti/40605.pdf

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 6

Subject Code: 10030601	**Subject Title:** Interconnected Power System
Pre-requisite:	

Course Objective:

(1) It also briefs the students about the modeling of power systems networks for steady state analysis.
(2) 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.
(3) 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 Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction:** Concept of Interconnection, Hierarchical Grid arrangements, Regulatory framework Cascade Tripping, Islanding, Load dispatch center,	3	5
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	5
3	**Load flow studies:** Introduction, Bus Classifications, formation of Static Load Flow Equations (LFE), Approximate method of solution of LFE, Application of Numerical	12	25

	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,		
4	**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.	6	20
5	**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.	8	20
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	25

Course Outcome:

CO1: 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.

CO2: Define the actual power system structure scenario and its operating mechanism in a state and country with major entities and their functions.

CO3: 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.

CO4: Demonstrate the methods used for voltage and frequency regulation in electrical power network by mathematical analysis.

List of Text Books:

1. Power System Analysis and Stability, S.S. Vadhera, Khanna Publication.

2. Elements of Power System Analysis by William D. Stevenson McGraw-Hill

List of Reference Books:

3. Modern Power System Analysis, D. P. Kothari, I. J. Nagrath, Tata McGraw-Hill Education,
4. Power System Analysis, Hadi Saadat, Tata McGraw-Hill Education
5. Computer Aided Power System Analysis, G.L. Kusic, © 1986

Open e-Resource:

List of Open Source Software/learning website:
https://nptel.ac.in

List of Suggested Experiments:

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

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 6

Subject Code: 10030602	**Subject Title:** Switchgear and Protection
Pre-requisite:	

Course Objective:

(1) The safety of equipment and human beings is the major concern for every protection scheme.
(2) They are also required to carry out remedial measures for faults/abnormalities in machines/equipment in the power system using appropriate diagnostic instruments/devices
(3) This course attempts to develop these skills in students and hence it is a core course for all electrical engineers.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Fundamentals of Power System Protection:** Introduction to Protective Relaying, Function of the Protective Relaying, Faults and Abnormal Operating Conditions, Desirable Qualities and Terms of Protective Relaying, System Transducers, Basic Tripping Mechanism of a relay, Types and operating principles of various protective relays, Simple Differential Protection, Zone of Protection and Actual Behavior of Simple Differential Protection, Percentage Differential Protection, Earth Leakage Protection	6	10
2	**Distance Protection of Transmission Line:** Introduction to Distance Protection, Types of Distance Relay, Impedance, Reactance, MHO Relay, Performance of Distance Relay During Normal Load	7	20

	and Power Swing, Effect of Arc Resistance on Reach of Distance Relays, Comparison of Distance Relays, Distance Protection of Transmission line, Reasons for Inaccuracy of Distance Relay Reach, Three Step Protection, Trip contact configuration, 3-step protection of double end fed lines		
3	**Overcurrent Protection of the Transmission Line:** Introduction, Thermal Relays, Over Current Relays, Types of Relay Characteristics, Application of Definite Time & IDMT O.C. Relays for Protection of Feeder, Relay Coordination, Directional Over Current Relay, Limitations of O.C. Relays	5	10
4	**Bus-zone Protection:** Non-Unit Protection by Back-up Relays, Differential Protection of Busbars, External and Internal Fault, Protection of Three-phase Busbars	5	10
5	**Transformer Protection:** Faults and Abnormal Conditions in Transformer, Non-electrical Protection, Overcurrent Protection, Earth Fault Protection, Inter-turn Protection, Differential Protection	6	10
6	**Generator Protection:** Various faults & abnormal operation conditions in a Generator, Stator & rotor faults, Transverse differential protection of a Generator, Unbalanced loading, Over speeding, Loss of excitation, Loss of prime mover	6	10
7	**Induction Motor Protection:** Various faults & abnormal operation conditions in an Induction Motor, Starting of induction motor, Protection of small & large induction motor	6	10
8	**Circuit Breaker:** Classification of switchgear and fields of application and relative merits. Theories of current interruption, Energy balance and recovery rate theories, Air Circuit Breaker(ACB), Air Blast Circuit Breaker (ABCB), Practical systems of arc quenching in oil circuit breakers, Construction and operation of bulk oil, Minimum Oil Circuit Breakers, Recent trends in H.V. Circuit Breakers, Sulphur Hexafluoride Circuit Breaker (SF6), Vacuum Circuit Breaker (VCB), Rating of Circuit Breakers, Testing of Circuit Breakers, Miniature Circuit Breakers, Earth Leakage Circuit Breakers	7	15
9	**Modern Trends in Power System Protection** Introduction to static and digital relays, Introduction to adaptive relays	2	5

Course Outcome:

CO1: Acquire the knowledge of various abnormal conditions that could occur in electrical system and protective relays.
CO2: Knowledge of various conventional relays, their design and latest developments.
CO3: Ability to understand and design various protective devices in power system for protecting equipment and personnel.
CO4: Knowledge of various types of instrument transformers, circuit breakers with their design and constructional details..

List of Text Books:

1. Power System Protection & Switchgear by B. Ram, McGraw Hill.
2. Power System Protection- Static Relays by T.S.M. Rao Tata McGraw Hill.

List of Reference Books:

3. Fundamentals of Power System Protection –Y. G. Parithankar & S. R. Bhide, 2nd edition, PHI
4. Power System Protection and Switchgear by Badari Ram , D.N Viswakarma, TMH Publications
5. Power system protection and switchgear by Oza, Nair, Mehta, Makwana
6. Protection and switchgear, by Bhavesh Bhalja, R.P.Maheshwari, Nilesh hotani,1st edition, 2011, Oxford Publication
7. Power System Protection and Switchgear –B. Ravindranath and M. Chander

Open e-Resource:

Courses available through NPTEL.

NPTEL https://nptel.ac.in/courses/108/101/108101039/
SWAYAM https://onlinecourses.nptel.ac.in/noc20_ee80/preview

List of Software:

MATLAB
PSCAD
EMTP

List of Suggested Experiments:

1. To check performance/ study of a 3-Phase Differential Relay.
2. To check performance/ study of an over current Relay.
3. To check performance/ study of the Numerical Protection of induction motor.
4. To obtain the operating characteristics of an IDMT relay.
5. To study the operating characteristics of directional over current relay.

6. To check performance/ study of the operating characteristics of the transformer percentage differential relay.
7. To study the magnetic inrush current in a transformer and its protection.
8. To study radial feeder protection using two overcurrent and one Earth fault relay.
9. To obtain and study the magnetization characteristic of CT.
10. To study the protection schemes for different abnormal conditions in an alternator.
11. To study Buchholz relay for transformer protection.
12. To study generalized block diagram of Numerical Relay

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 6

Subject Code: 10030603	**Subject Title:** Electric Drives
Pre-requisite:	

Course Objective:

(1) The development of compact power converters has made this possible.

(2) This course enables to develop the basics of electric drives and advantage over conventional speed control methods.

(3) In the era of renewable energy and electric vehicle the efficient electric drive required for DC and AC motors.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
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.	3	5
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	4	5

	waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.		
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.	12	25
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	20
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.	8	20
6	**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.	12	25
7	**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.		

Course Outcome:

CO1: Understand the characteristics of dc motors and induction motors.
CO2: Understand the power electronic converters used for dc motor and induction motor speed control.
CO3: Understand the principles of speed-control of dc motors and induction motors
CO4: Compare conventional control and drives control for dc/ac motor.

List of Text Books:

1. G. K. Dubey, "Fundamentals of Electrical Drives", CRC Press, 2002.
2. W. Leonhard, "Control of Electric Drives", Springer Science & Business Media, 2001.

List of Reference Books:

3. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1989.
4. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall, 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

Open e-Resource:

List of Open Source Software/learning website:
https://nptel.ac.in

List of Suggested Experiments:

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

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 6

Subject Code: 10030604	**Subject Title:** Signals and Systems
Pre-requisite:	

Course Objective:

(1) Automation in industries and domestic level has made engineers to understand about various systems and signals.
(2) The interfacing of the machines with the different controllers specifically needs to calculate and estimate the basics about the signals and systems.
(3) Every domain expects engineers to be fundamentally clear about the signals and systems.
(4) This subject clear mainly the classification of the signals and systems with their various time and frequency domain analysis for future applications.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
2	0	2	3	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to Signals and Systems:** Signals and systems everyday life, biomedical, instrumentation domestic and industries. Representations of Signals, Classifications of Signals – Continuous time, Discrete time, comparison among Analog, Digital and Discrete Signals, Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, and the complex exponential. System properties:	6	20

	linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.		
2	**Mathematical operations on Signals and Systems:** Addition, subtraction, multiplication and division of the signals, parallel and series combinations of the systems, cascading of the systems, impulse response characterization and convolution integral for CT- LTI system, signal responses to CTLTI system, properties of convolution, LTI system response properties from impulse response, Examples. Impulse response characterization and convolution sum, Causal signal response to DT-LTI systems. Properties of convolution summation, Impulse response of DT-LTI system. DT-LTI system properties from Impulse response. System analysis from difference equation model, examples.	8	15
3	**Fourier, Laplace and z-transforms:** Representation of periodic functions, Fourier series, Frequency spectrum of aperiodic signals, Fourier Transform, Relation between Laplace Transform and Fourier Transform and its properties. Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.	11	40
4	**Applications based on IoT:** Introduction of the Internet of Things, Types of sensors, Types of actuators, Introduction of Arduino Interfacing of the sensors and actuators with Arduino. Programming in Arduino. Signals storage and its analysis using Arduino, Design of a minor project based on Arduino.	7	25

Course Outcome:

CO1: Describe the type of system and signal in Industries and Domestic level for Interfacing.
CO2: Derive mathematical model of the systems and signals for the applications.
CO3: Analyze the response of system for the efficient usage of the systems.
CO4: Design of the system from the available input signals and expected output signals of the industrial model.

List of Text Books:

1. Signals and Systems by Alan V. Oppenheim, Alan S. Wilsky and Nawab, Prentice Hall
2. Signals and Systems by K. Gopalan, Cengage Learning (India Edition)

List of Reference Books:

3. Signals and Systems by Michal J. Roberts and Govind Sharma, Tata Mc-Graw Hill Publications
4. Signals and Systems by Simon Haykin and Bary Van Veen, Wiley- India Publications
5. Linear Systems and Signals by B.P.Lathi, Oxford University Press
6. Signal, Systems and Transforms by Charles L. Philips, J. M. Parr and E. A. Riskin, Pearson Education

Open e-Resource:

- http://www.scilab.org/
- http://www.gnu.org/software/octave/
- http://www.vlab.co.in
- http://www.arduino.cc/

List of Suggested Experiments:

1. Generations and capturing various continuous time signals from sensors.
2. Generation and capturing of discrete time signals and plot them.
3. Discretization using different sampling rate and observing aliasing effect.
4. Observing the effects of lower sampling rate and higher sampling rate on CT signal.
5. Performing various operations on the signal using circuits and computational software.
6. Using digital circuit building block to perform operations on signals.
7. Simulation of continuous time LTI system.
8. Simulation of discrete time LTI systems.
9. Obtaining impulse response of the systems.
10. Computing FT and DTFT of the CT signals and DT sequences.
11. Interfacing of the IR sensors and measurement of distance using Arduino.
12. Automation of single-phase load using Arduino.

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 6

Subject Code: 10030606	**Subject Title:** HIGH VOLTAGE ENGINEERING
Pre-requisite:	

Course Objective:

1. The subject deals with HV test generating devices, measurement devices, over voltages including lightning and non-destructive testing as well.
2. Electrical power transmission is trending towards higher and higher voltages.
3. the conceptual understanding related to insulation, testing the HV devices is must for every electrical engineer.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Electrostatic fields and field stress control:** Electrical field distribution and breakdown strength of insulating materials - fields in homogeneous, isotropic materials - fields in multi-dielectric, isotropic materials.	4	8
2	**Numerical analysis of electrical fields in high voltage equipment:** numerical methods - Charge simulation method (CSM), Finite Difference Method (FDM), Finite Element Method (FEM), The boundary-element method, Comparative summary, Formulation of the finite-element equations in two and three dimensions - Forming the functional equation, The energy functional illustrated, Numerical representation.	5	12

3	**Electrical breakdown in gases:** Gases as insulating media - ionization and decay processes, Townsend first ionization coefficient, photo ionization, ionization by interaction of metastable with atoms, thermal ionization, deionization by recombination, deionization by attachment–negative ion formation, examples - cathode processes – secondary effects, photoelectric emission, electron emission by positive ion and excited atom impact, thermionic emission, field emission, Townsend second ionization coefficient, secondary electron emission by photon impact, examples - transition from non-self-sustained discharges to breakdown, the Townsend mechanism, examples - the streamer or 'kanal' mechanism of spark, examples - the sparking voltage– Paschen's law, penning effect.	7	18
4	**Breakdown in liquid and solid dielectrics:** Liquid as insulators, breakdown in liquids - electronic breakdown, suspended solid particle mechanism, cavity breakdown, examples - static electrification in power transformers. transformer oil filtration, transformer oil test, alternative liquid insulations like vegetable oils, esters and silicon oils - breakdown in solids, intrinsic breakdown, streamer breakdown, electromechanical breakdown, edge breakdown and treeing, thermal breakdown, erosion breakdown, tracking - breakdown of solid dielectrics in practice, partial discharges in solid insulation.	7	18
5	**Generation of high voltages:** Generation of high direct voltages, half and full wave rectifier circuits, voltage multiplier circuits, Van de Graff generators, electrostatic generators, examples - generation of alternating voltages, testing transformers, cascaded transformers, resonant transformers, examples - impulse voltages, Standard lightning and switching surge and associated parameters and their corrections, design and construction of impulse voltage generator circuits, Marx circuit, operation, examples - impulse current generator.	6	16
6	**Measurement of high voltages:** High direct voltage measurement, peak voltage measurements by spark gaps, sphere gaps, reference measuring systems, uniform field gaps, rod gaps, factors affecting sphere gap measurements, examples - electrostatic voltmeters - ammeter in series with high ohmic resistors and high ohmic resistor voltage dividers - generating voltmeters and field sensors - the measurement of peak voltages, the Chubb–Fortescue method, high- voltage capacitors for measuring circuits - voltage dividing systems and impulse voltage measurements. Numericals	4	8
7	**Non-destructive test techniques:** Insulation: Measurement of d.c. resistivity - dielectric loss and capacitance measurements, the Schering bridge, current comparator bridges, Tan Delta measurement, Partial-discharge (PD) measurements - the basic PD test circuit, Dissolved gas analysis - Key gas method, Duval's triangle. Machine winding:	5	12

	Frequency Response Analysis Method (FRA)- Introduction, Sweep Frequency Response Analysis (SFRA), procedure, methods of interpretation of signature.		
8	**Over voltages, and insulation coordination:** The lightning mechanism, energy in lightning, nature of danger - examples - insulation coordination, insulation level, statistical approach to insulation coordination, correlation between insulation and protection levels.	4	8

Course Outcome:

CO1: Apply numerical methods for engineering problem.
CO2: Classify insulation test techniques.
CO3: Recall breakdown mechanism for dielectric materials in solid, liquid and gaseous state.
CO4: Conclude about correctness of design and manufacturing of high voltage insulations after performing tests.
CO5: Examine methods for generation of test high voltage and as well for its measurement.

List of Text Books:

1. Naidu M. S. and Kamaraju V., "High Voltage Engineering", fourth Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi,2009.
2. Hugh M. Ryan, "High Voltage Engineering and Testing", 2nd edition, The Institution of Electrical Engineers, London, United Kingdom,2001.

List of Reference Books:

3. M. Khalifa, "High Voltage Engineering-Theory and Practice", Marcel Dekker, Inc. New York and Basel,1990.
4. Dieter Kind, Kurt Feser, "High Voltage Test Techniques", Reed educational and professional publishing ltd. (Indian edition), NewDelhi-2001
5. A. Haddad, D. Warne, "Advances in High Voltage Engineering", IET Power and Energy, Series 40, 2007.
6. Sivaji Chakravorti, Debangshu Dey, BiswenduChatterjee,"Recent Trends in the Condition Monitoring of Transformers",Springer, 2013.
7. Alston L L, High Voltage Technology, Oxford University Press, 2008
8. Rakosh Das Begamudre, "High Voltage Engineering, Problems and Solutions", New Age International Publishers, New Delhi,2010.

Open e-Resource:

Open source software:

1. Finite Element Method Magnetics FEMM
2. LTSpice for circuit simulation,
3. KiCAD for CAD application

Web-based tools for design:

1. http://www.fairchildsemi.com/support/design-tools/power-supply-webdesigner/
2. http://www.ti.com/lsds/ti/analog/webench/overview.page
3. Circuit Lab:
4. https://www.circuitlab.com/editor/

Open source Math Tools:

1. http://maxima.sourceforge.net/
2. http://www.sagemath.org/
3. http://www.scilab.org/
4. http://www.gnu.org/software/octave/

Online Experiment Portal

1. http://vlab-ee1.iitkgp.ernet.in

List of Suggested Experiments:

1. Trace the field through electrolytic tank.
2. Testing of transformer oil according to IS:6792
3. Generation High A. C. voltages and measurement through sphere gaps.
4. Generation of High A. C. voltages through cascaded transformers.
5. Testing of solid insulation with tape electrodes.
6. Generation High D.C. Voltages and measurement through sphere gaps.
7. Impulse voltage generation through Marx generator.
8. Impulse voltage generation though simulation.
9. A report on visit to high voltage laboratory.
10. Generation and visualization of corona in corona cage.
11. Capacitance and loss factor measurement.

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 6

Subject Code: 10030608	**Subject Title:** Energy Management And Audit
Pre-requisite:	

Course Objective:

(1) To understand energy scenario and general aspects of energy audit, learn about methods

(2) concept of energy audit and understand the energy utilization pattern including wastage andits management.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	0	3	70	30	00	00	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**General Aspects:** Review of energy scenario in India, General Philosophy and need of Energy Audit and Management, Basic elements and measurements - Mass and energy balances – Scope of energy auditing industries - Evaluation of energy conserving opportunities, Energy performance contracts, Fuel and Energy substitution, Need for Energy Policy for Industries, National & State level energy Policies	7	20
2	**Energy Audit Concepts:** Need of Energy audit - Types of energy audit – Energy management (audit) approach - understanding energy costs - Bench marking – Energy performance - Matching energy use to requirement - Maximizing system efficiencies -	8	20

	Optimizing the input energy requirements - Duties and responsibilities of energy auditors - Energy audit instruments - Procedures and Techniques		
3	**Principles and Objectives of Energy Management:** Design of Energy Management Programmes - Development of energy management systems – Importance - Indian need of Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Monitoring and targeting, some case study and potential energy savings.	8	20
4	**Thermal Energy Management:** Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery - Thermal insulation - Heat exchangers and heat pumps – HVC industries-Building Energy Management.	8	20
5	**Electrical Energy Management:** Supply side Methods to minimize supply-demand gap -Renovation and modernization of power plants - Reactive power management – HVDC - FACTS - Demand side - Conservation in motors - Pumps and fan systems – Energy efficient motors	8	20

Course Outcome:

CO1: Understand the basic concepts of energy audit, energy management and learn energy audit procedures, techniques and usage of energy audit instruments.

CO2: Apply the knowledge to identify energy saving potential of thermal and electrical systems for maximizing and optimizing system efficiency.

CO3: Analyze energy management systems, prepare and present energy audit reports

List of Text Books:

1. Murphy, W. R. (2007), Energy Management (1st edition), Elsevier India Private Limited.
2. De, B. K., (2010), Energy Management audit & Conservation, (2nd Edition), VrindaPublication.

List of Reference Books:

3. Turner, W. C., Doty, S. and Truner, W. C., (2009), Energy Management Hand book, (7thedition), Fairmont Press.
4. L.C. Witte, P.S. Schmidt, D.R. Brown, (1988) Industrial Energy Management and Utilisation, (1stedition) Hemisphere Publication, Washington.
5. Elias P. Gyftopoulos, (1982) Industrial Energy Conservation Manuals, (1st edition) MIT Press
6. Patrick, Patrick, Fardo (1993), Energy Conservation guide book, (1st edition) Prentice hall.

Open e-Resource:

- https://beeindia.gov.in/content/energy-auditors
- https://nptel.ac.in/courses/112105221

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 7

Subject Code: 10030701	**Subject Title:** Power System Practice And Design
Pre-requisite:	

Course Objective:

(1) The course also includes power system earthing and insulation co-ordination.
(2) students will learn basic concepts of generation, planning, transmission and distribution planning.
(3) This subject focuses on the mechanical and electrical design aspects of important power system components

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Transmission Line Design:** Electrical design of transmission line Design philosophy, voltage level selection and choice of conductors, spacing of conductor and corona, insulators and SIL, design problem. Mechanical design of transmission line: Considerations, loading on conductors, span, sag and tension clearance, stringing, problems. Transmission line tower design: Location of tower, earth wires, reduction of tower footing resistance, design of tower, examples. EHV transmission line design: Considerations, selection, spacing of conductors, corona and radio interference, shunt and series compensation, tuned power	10	20

	lines, insulation coordination and different types of EHV towers, EHV systems in India.		
2	**AC and DC Low Tension Distribution Design:** Types of distribution systems: arrangements, selection and size of feeders using Kelvin's law, design of cables in distribution systems considering ampere capacity, voltage drop during starting and running load, primary distribution design, secondary distribution design. HV distribution design concept, load balancing Distribution substation, Calculation of distributor size and its examples, calculation of voltage drops and size of distributor in ring system. Voltage regulation and lamp flicker.	10	20
3	**Substation Design:** Determination of voltage regulation and losses in power system, shifting of distribution transformer centre, Substation layout, sizes and locations of sub stations, Substation equipments specifications ratings and its operation from design view point, Cathodic Protection, Gas Insulated Substation (GIS).	6	10
4	**Power System Earthing - Power Station and Sub Station Earthing:** Objectives, definitions, tolerable limits of body currents, soil resistivity, measurement of soil resistivity, earth resistance, measurement of earth resistance, tolerable step and touch voltage, actual step and touch voltage, design of earthing grid, impulse behavior of earthing system.	5	10
5	**Design of Power Station:** Introduction, selection of sizes and location of generating stations, interconnections issues with wind and Solar PV.	3	5
6	**Insulation Coordination and Location of Lightning Arrestor:** Introduction, definitions, insulation-co-ordination curves, determination of line insulation, Basic Insulation level (BIL), Insulation levels of substation equipments, Lightning arrestor selection and location, Selection of arrestor voltage rating, arrestor discharge voltage and arrestor discharge current, protective margin.	5	10
7	**HVDC Transmission:** Merits and demerits of HVDC transmission, one line diagram, types of DC link, necessary equipments, operation and control, applications, recent advances, HVDC in India.	3	5

Course Outcome:

CO1: Design transmission line (electrical and mechanical aspects)
CO2: Design primary and secondary distribution.
CO3: Selection of sizes and location of generating stations, substations.
CO4: Explain the basic concepts of power system earthing and measurement of earthing resistance.
CO5: Explain the basic concepts of insulation co-ordination.

List of Text Books:

1. Electrical Power System Design – B. R. Gupta, S. CHAND
2. Substation Design – Satnam & Gupta, Dhanpat Rai and Co.

List of Reference Books:

1. Electrical Power System Design – M. V. Deshpande, TMH publication
2. Electrical Power System Planning – A. S. Pabla, TMH publication
3. A course in Electrical Power- Soni,,Gupta and Bhatnagar, Dhanpat Rai & Sons

Open e-Resource:

- https://law.resource.org/pub/in/bis/ (useful website to download Indian standards) - http://www.electrical-engineering-portal.com/
- nptel.ac.in/ course.php

List of Suggested Experiments:

1. Design of transmission line.
2. Visit of substation and draw its lay out plan.
3. Design of transmission line towers.
4. Survey of rural electrification and draw Single Line Diagram.
    - Visit to a village.
    - Supply is taken from pole mounted transformer and distributed in various part of village.
    - Load calculation, loading capacity of different equipments.
    - Verification of 3-phase balanced loading.
    - Finding transformer rating based on loading.
    - Making drawing sheet representing Single line diagram of three phase distribution.
5. Survey of industrial distribution system and draw Single Line Diagram SLD. 6. Study pipe earthing and plate earthing.

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 7

Subject Code: 10030701	**Subject Title:** TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENTS
Pre-requisite:	

Course Objective:

(1) It is required to carry out/supervises installation, commissioning and maintenance of various electrical equipments in power stations, substations and industry.
(2) This course will enable the students to understand the concepts, principles and acquire basic skills of installation, commissioning and maintenance of electrical equipments in power stations, substations and industry.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Safety Management:** Objectives, Safety Management during Operation and Maintenance, Clearance and Creepages, Electric Shock, need of Earthing, different methods of Earthing, factors affecting the Earth Resistance, methods of measuring the Earth Resistance, Equipment Earthing and System Grounding, Earthing Procedure - Building installation, Domestic appliances, Industrial premises, Earthing of substation, generating station and overhead line.	10	20
2	**Installation of Electrical Equipment:**	10	20

	Inspection of Electrical Equipment at site, Storage Electrical Equipment at site, Foundation of Electrical Equipment at site, Alignment of Electrical Machines, Tools/Instruments necessary for installation, Technical report, Inspection, storage and handling of transformer, switchgear and motors.		
3	**Testing of Transformer, Plant and Equipment:** General Requirements for Type, Routine and Special Tests, Measurement of winding resistance; Measurement of voltage ratio and check of voltage vector relationship; Measurement of impedance voltage/short-circuit impedance and load loss; Measurement of no-load loss and current; Measurement of insulation resistance; Dielectric tests; Temperature-rise, insulation and HV test, dielectric absorption, switching impulse test. testing of Current Transformer and Voltage Transformer, power transformer, distribution transformer, CVT and special transformer with reference to Indian Standard (IS). Drying out procedure for transformer. PI index, Commissioning steps for transformer, Troubleshooting & Maintenance of transformer.	6	10
4	**Installation and Commissioning of Rotating Electrical Machines:** Degree of protection, cooling system, degree of cooling with IP- IC code (brief discussion), enclosures, rating of industrial rotating electric machine, installation, commissioning and protection of induction motor and rotating electric machine, drying out of electric rotating machine, insulation resistance measurement, site testing and checking, care, services and maintenance of motors, commissioning of synchronous generator, protection and automation of synchronous generator, synchronous motor, D.C. generator and motor with reference to Indian Standard (IS).	5	10
5	**Transmission line:** Commissioning of A.C transmission line and HVDC transmission, galvanize steel structure, towers and insulator for transmission and distribution line, tower footing resistance, substation equipment, bus bar system, power cable, low power control cable, Contactor, GIS.	3	5

Course Outcome:

CO1: Preparation of maintenance schedule of different equipment and machines
CO2: Trouble shooting chart for various electrical equipment, machines and domestic appliances.
CO3: Procedure of different types of earthing for different types of electrical installations
CO4: Familiar about electrical safety regulations and rules during maintenance.

List of Text Books:

1. Philip Kiameh, “Electrical Equipment Handbook: Troubleshooting and Maintenance”, McGrawHill, 2003.

2. Rao, S., “Testing, commissioning, operation and maintenance of electrical equipment”, 6/E., Khanna Publishers, New Delhi

List of Reference Books:

1. Paul Gill, “Electrical power equipment maintenance and testing”, CRC Press, 2008.
2. Singh Tarlok, "Installation, commissioning and maintenance of Electrical equipment", S.K. Kataria and Sons, New Delhi,
3. Relevant Indian Standards (IS Code) and IEEE Standards for-Installation, maintenance and commissioning of electrical equipments/machines.

Open e-Resource:

- http://www.bis.org.in/index.asp

List of Suggested Experiments:

1. Interpret IE rules pertaining to safety, Show the action to be taken when a person comes in contact with a live wire, undertake drill operation for using fire extinguisher for safety against fire
2. Measure insulation resistance of a winding/cables/wiring installation
3. Types of earthing & Measurement of earth resistance of installation of building and appliances by different methods
4. Study of Power Quality and Harmonics due to various type of load using Power Analyzer.
5. To study of drying out process of Transformer and the procedure of drying out of electrical equipment
6. Perform various tests on insulating oil
7. To study various Test of Induction Motor and their significance
8. To study various Test of Synchronous Machine and their significance
9. To carry out routine tests on a given contactor used in the 3-phase supply
10. To find out Phase shift in a transformer
11. To find out reflection of fault current on opposite side of the transformer

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 7

Subject Code: 10030703	**Subject Title:** HVDC Transmission Systems
Pre-requisite: Electrical Power system I and II. The knowledge of Power Electronics I and II is additionally required.	

Course Objective:

(1) This subject is offered at higher UG level to study the various operating as well as configurational aspects of HVDC transmission system.

(2) 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.

(3) Students will be able to enhance their learning domain by distinguishing the requirement of HVDC system over HVAC system.

(4) 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 Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**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 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	20
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	15
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	20
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

Course Outcome:

CO1: Understand the advantages of dc transmission over ac transmission.
CO2: Analysis of Line Commutated Converters and Voltage Source Converters in HVDC Transmission System**.**

CO3: Application of suitable control strategies used for LCC and VSC based HVDC transmission system.
CO4: Evaluation of Power system angular, voltage and frequency stability using simulation models for various configuration of an HVDC system.

List of Text 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.

List of Reference Books:

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.

Open e-Resource:

- https://nptel.ac.in

List of Suggested Experiments:

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.

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 7

Subject Code: 10030704	**Subject Title:** Electrical Machine Design
Pre-requisite:	

Course Objective:

(1) The objective of this course is to equip students with the fundamental knowledge and practical skills required to design electrical machines, such as transformers, induction motors, and synchronous machines.

(2) The course emphasizes the understanding of magnetic circuits, thermal and mechanical design considerations, material selection, and performance evaluation to ensure efficiency, reliability, and cost-effectiveness of machines in real-world applications.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**GENERAL ASPECTS** Insulating Materials & Classifications, heating of electrical machines , Cooling of Transformer and rotating machines , Electrical and Magnetic Loading , output coefficient , factor affecting size of machines , selection of B av & ac , Duty cycle and equivalent ratings	5	10
2	**DESIGN OF THREE PHASE TRANSFORMER:** Types of transformers, position of HV and LV windings, core and yoke cross-sectional area, importance of mitered joints., Different types of transformers windings. Different methods for cooling of transformer, Different positions of	12	30

	tapings. Output equation for 3 phase transformers, window space factor, factors affecting window space factor. Relation between emf per turn and transformer rating, factors affecting constant K, stacking factor, examples. Selection of flux density and current density, Window dimensions, Yoke dimensions and overall core dimension calculations, examples. Design of HV and LV windings (No. of turns and area of cross section). Estimation of operating characteristics. Primary and secondary winding resistance. Leakage reactance calculation of only cylindrical coil with equal height, Leakage reactance of unequal windings and heights, only formula. No load current calculations for 3 phase transformers. Temperature rise of transformer, design of tank with tubes, calculation of dimension of tank, examples. Optimum design Design for minimum cost. Design for minimum loss. Variation of output and losses in transformer with linear dimensions. Dry transformer, high frequency transformer		
3	**DC MACHINE DESIGN** Introduction, output equation, mmf calculation Selection of Number of poles, core length, armature diameter, Carter's fringing curves, length of air gap, examples on above topics costing **ARMATURE DESIGN** Choice of armature winding, armature conductor, number of armature slots, slot dimensions, slot loading, design of armature core, Problems on above topics, costing **DESIGN OF FIELD SYSTEMS** Pole design, design of field winding of shunt, series and compound machines, examples Design of interpole, effects and minimization armature reaction Design of commutator and brushes, Improvement in commutation ,Performance calculation & Design consideration for large machines, HV machines and miniature DC motors	20	50
4	**DESIGN OF CURRENT TRANSFORMERS** Introduction, construction Design principles OF C.T & P.T. , winding design, Behavior of transformer under normal and abnormal condition.	5	10

Course Outcome:

CO1: Design Three Phase Transformer
CO2: Design Dc Machine Design , Armature Design And Design Of Field Systems
CO3: Design Of Current Transformers

List of Text Books:

1. A course in electrical machine Design – A. K. Sawhney

List of Reference Books:

2. Electrical Machine Design – R. K. Agrawal
3. Design of Electrical Machine- V. N. Mittle

Open e-Resource:

- https://law.resource.org/pub/in/bis/ (useful website to download Indian standards) - http://www.electrical-engineering-portal.com/
- nptel.ac.in/ course.php

List of Suggested Experiments:

1. Design of three phase transformer
2. Drawing sheet of three phase transformer
3. Design of DC machines
4. Drawing Sheet of DC machine components.
5. Tutorial on General aspects and C.T. , P.T.

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 7

Subject Code: 10030705	**Subject Title:** Advanced Electric Drives
Pre-requisite: Power Electronics	

Course Objective:

(1) Electric motor is inevitable part of industries. High precision Control of this electric motors for various industrial applications are needed.

(2) Electric drive using power electronic converters with suitable control strategy can control the speed and torque of electric motor precisely.

(3) The course is aimed to provide exposure about the commonly used power electronic converters for electric drive applications and various control strategies used for the purpose of motion control.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Power Converters for AC drives** PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.	10	20
2	**Induction motor drives** Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control (DTC).	10	20
3	**Synchronous motor drives**	7	15

	Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.		
4	**Permanent magnet motor drives** Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.	6	15
5	**Switched reluctance motor drives** Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.	6	15
6	**DSP based motion control** Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.	6	15

Course Outcome:

CO1: Select appropriate power electronic converters for drive applications.
CO2: Analyze the vector control strategies for ac motor drives.
CO3: Select appropriate control strategies for electric drives.
CO4: Evaluate performance of electric drives under different control strategies.

List of Text Books:

1. H. A. Taliyat and S. G. Campbell, "DSP based Electromechanical Motion Control", CRC press, 2003.
2. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press, 2009..

List of Reference Books:

3. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.
4. P.C. Krause, O. Wasynczuk and S.D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013

Open e-Resource:

- E-materials available at the website of NPTEL- http://nptel.ac.in/

List of Suggested Experiments:

1. PWM inverter fed three phase induction motor control using PSPICE/MATLAB/PSIM software
2. VSI fed induction motor drive analysis using MATLAB/PSPICE/PSIM software
3. Study of V/f control operation of three phase induction motor
4. Study of vector controlled three phase induction motor drive.
5. Study of permanent magnet synchronous motor drive fed by PWM inverter using simulation software.
6. Study of BLDC motor drive fed by PWM inverter using simulation software.
7. Study of SRM motor drive fed by PWM inverter using simulation software.
8. Regenerative/ Dynamic breaking operation for AC motor using simulation software

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 7

Subject Code: 10030707	**Subject Title:** Power Quality and Facts
Pre-requisite: Power Electronics, Power systems	

Course Objective:

(1) The objective of this course is to provide students with an in-depth understanding of power quality issues and the role of Flexible AC Transmission Systems (FACTS) in improving the performance, reliability, and efficiency of power systems.

(2) The course aims to develop analytical and practical skills to identify, analyze, and mitigate power quality problems such as voltage sags, swells, harmonics, and interruptions. Additionally, it introduces FACTS devices and their applications in voltage control, reactive power compensation, and power flow enhancement in modern power grids.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	0	3	70	30	00	00	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Power Quality** Introduction, Importance of Power Quality, Common Disturbances in Power Systems, Short-Duration Voltage Variation, Long-Duration Voltage Variations, Transients, Impulsive Transients, Oscillatory Transients, Voltage Imbalance, Harmonics, Interharmonics, DC Offset, Notching, Noise, Voltage Fluctuations, Power Frequency Variations, Solutions to Power Quality Problems, Ambiguous Terms CBEMA and ITI Curves, Features of Voltages in Power Systems, Grounding, Ground Electrodes, Ground Rods, Ground Rings,	06	15

	Plates Signal Reference Ground (SRG), Single-Point and Multipoint Grounding, Ground Loops, Isolated Ground, Electrochemical Reactions Due to Ground Grids, Reactive Power in Power Systems with Harmonic Distortion, Single-Phase Systems, Reliability, Power Quality Data Collection .		
2	**Static Var Compensators** Introduction, Different Static Var Compensators, Increase in Transient Stability Margin, Damping of Power Oscillations, Voltage Support, Static Var Compensator Systems Versus Synchronous Condensers, Capacitors, and Reactors, Shunt and Series Compensation, Fundamentals of Load Compensation, Reactive Power Relationships Between Wye- and Delta-Connected Systems, Static Var Compensators for Transmission Systems, SVC Using a TCR and an FC, SVC Using a TCR and TSC, STATCOM (SVC Using Self-Commutated Inverters), SVC Using a Saturated Reactor (SR), Comparison of Static Var Systems, Specification of SVCs, FACTS Technology, Types of FACTS Controllers, Series Controllers, Shunt Controllers, Combined Series and Shunt Controllers, Case Study, Importance Three-Phase Power Flow Studies for PQ.	09	15
3	**Control of Static Var Compensators** Introduction, Control Systems for SVCs in Transmission System Applications, Voltage Regulation, Gain Supervision, Reactive Power Control and Coordination, Control Signals for System Transient Stability, Power Oscillation Damping, and Sub synchronous Resonance Damping Enhancement, Control Systems for SVCs in Traction Applications, Load Compensation, Voltage Regulation and Balancing, Measurement of Sequence Components, Phase-Locked Oscillator Control System.	06	15
4	**Harmonics** Introduction, Converter Harmonics, Effect of Transformer Connections, Harmonics When There Is Overlap in the Commutation Process, Direct-Voltage Harmonics, Imperfect System Conditions, Single-Phase Power Supplies, DC Drives, AC Drives, Pulse-Width Modulation (PWM), Telecontrol Signals, Cycloconverters, Transformers, Harmonics in No-Load Exciting Current, Harmonics due to Inrush Current, DC Magnetization, Harmonics in Rotating Machines, Harmonics in Arc Furnace Loads, Harmonics in a Thyristor-Controlled Reactor, TheK-Factor.	06	15
5	**Utility Harmonics Regulations and Standards** Introduction, Undesirable Effects of the Harmonics, Specification of the Harmonic Limits, Philosophical Differences between IEEE 519-1992 and IEC 61000-Series Standards, IEEE 519-1992, IEC 61000-Series Standards, Assessment Procedure (Harmonic Limits), Summation Laws for Combining Harmonics, General Comments on the Standards, Allocation of Harmonic	06	10

	Voltage or Current or Both Limits to the Customers, Empirical Nature of the Standards, Legal Responsibility for Damages due to Harmonic Problems, Application of the Standards, Application of Standards—B.C. Hydro's Approach, Examples of the Harmonic Studies.		
6	**Harmonic Filters** Introduction, Undesirable Effects of Harmonics, Harmonic Sources, Types of Filters, Types of Damped Filters, AC Network Impedance, Overhead Lines, Underground Cables, Transformers, Rotating Machines, Passive Loads, Electronic Loads, Norton Equivalents of Residential Loads, Design of Single-Tuned Filters, Filter Performance Evaluation, Design of Damped Filters, Comparison of Tuned and Damped Filters, Filter Component Ratings, Filter Capacitors, Tuning Reactors, Outline of Filter Design.	06	15
7	**Monitoring Power Quality** Introduction, Site Surveys, Spectrum Analyzers, Special-Purpose Power System Harmonic Analyzers, Transient-Disturbance Analyzers, Combination Disturbance and Harmonic Analyzers, Flicker Meters, Transducers, Measurement of the Frequency Response of Instrument Transformers, Description of the Instrument Transformers' Tests, Summary of the Conclusions from the Tests, Voltage Transformers, IEC-Recommended Measurement Techniques for Harmonics, Harmonics, RMS Value of a Harmonic Group, RMS Value of a Harmonic Subgroup, Total Harmonie Distortion (THD), Group Total Harmonic Distortion (THDG), Subgroup Total Harmonic Distortion (THDS), Partial Weighted Harmonic Distortion (PWHD), Interharmonics, RMS Value of an Interharmonic Component, RMS Value of an Interharmonic Group, RMS Value of an Interharmonic-Centered Subgroup, Relative and Absolute Harmonic Phase Angle Measurement, Necessity for the Measurement of Harmonic Voltages and Currents, Harmonic Monitoring System, Continuous Harmonic Analysis in Real Time, Presentation of Harmonic Measurements, Case Study, Flicker, IEC Flicker Meter, Short-Term Flicker Evaluation, Flicker Standards	06	15

Course Outcome:

CO1: Explain Various Power Quality terms of Electrical Power System
CO2: Analyze the application of Static Var Compensators for reactive power compensation in power systems.
CO3: Analyze the causes of Harmonics, its effect on various equipment and its mitigation techniques.
CO4: Evaluate performance of power systems (in regards to Power Quality Issues) under various power quality polluting devices using appropriate power quality monitoring tools.

List of Text Books:

1. R. Sastry Vedam, Mulukulta S Sarma “Power Quality VAR Compensation in Power Systems” CRC Press Indian Edition Indian reprint 2013

List of Reference Books:

2. C.Sankaran, “Power Quality”, First Indian reprint, CRC press
3. T. K. Nagsarkar and M. S. Sukhija “Power System Analysis” Oxford University Press

Open e-Resource:

https://nptel.ac.in/courses/108/106/108106025/

Gandhinagar Institute of Technology
B.Tech Electrical Engineering
Semester 7

Subject Code: 10030701	**Subject Title:** Power System Practice And Design
Pre-requisite:	

Course Objective:

(1) The course also includes power system earthing and insulation co-ordination.
(2) students will learn basic concepts of generation, planning, transmission and distribution planning.
(3) This subject focuses on the mechanical and electrical design aspects of important power system components

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	0	2	4	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Transmission Line Design:** Electrical design of transmission line Design philosophy, voltage level selection and choice of conductors, spacing of conductor and corona, insulators and SIL, design problem. Mechanical design of transmission line: Considerations, loading on conductors, span, sag and tension clearance, stringing, problems. Transmission line tower design: Location of tower, earth wires, reduction of tower footing resistance, design of tower, examples. EHV transmission line design: Considerations, selection, spacing of conductors, corona and radio interference, shunt and series compensation, tuned power	10	20

	lines, insulation coordination and different types of EHV towers, EHV systems in India.		
2	**AC and DC Low Tension Distribution Design:** Types of distribution systems: arrangements, selection and size of feeders using Kelvin's law, design of cables in distribution systems considering ampere capacity, voltage drop during starting and running load, primary distribution design, secondary distribution design. HV distribution design concept, load balancing Distribution substation, Calculation of distributor size and its examples, calculation of voltage drops and size of distributor in ring system. Voltage regulation and lamp flicker.	10	20
3	**Substation Design:** Determination of voltage regulation and losses in power system, shifting of distribution transformer centre, Substation layout, sizes and locations of sub stations, Substation equipments specifications ratings and its operation from design view point, Cathodic Protection, Gas Insulated Substation (GIS).	6	10
4	**Power System Earthing - Power Station and Sub Station Earthing:** Objectives, definitions, tolerable limits of body currents, soil resistivity, measurement of soil resistivity, earth resistance, measurement of earth resistance, tolerable step and touch voltage, actual step and touch voltage, design of earthing grid, impulse behavior of earthing system.	5	10
5	**Design of Power Station:** Introduction, selection of sizes and location of generating stations, interconnections issues with wind and Solar PV.	3	5
6	**Insulation Coordination and Location of Lightning Arrestor:** Introduction, definitions, insulation-co-ordination curves, determination of line insulation, Basic Insulation level (BIL), Insulation levels of substation equipments, Lightning arrestor selection and location, Selection of arrestor voltage rating, arrestor discharge voltage and arrestor discharge current, protective margin.	5	10
7	**HVDC Transmission:** Merits and demerits of HVDC transmission, one line diagram, types of DC link, necessary equipments, operation and control, applications, recent advances, HVDC in India.	3	5

Course Outcome:

CO1: Design transmission line (electrical and mechanical aspects)
CO2: Design primary and secondary distribution.
CO3: Selection of sizes and location of generating stations, substations.
CO4: Explain the basic concepts of power system earthing and measurement of earthing resistance.
CO5: Explain the basic concepts of insulation co-ordination.

List of Text Books:

1. Electrical Power System Design – B. R. Gupta, S. CHAND
2. Substation Design – Satnam & Gupta, Dhanpat Rai and Co.

List of Reference Books:

1. Electrical Power System Design – M. V. Deshpande, TMH publication
2. Electrical Power System Planning – A. S. Pabla, TMH publication
3. A course in Electrical Power- Soni,,Gupta and Bhatnagar, Dhanpat Rai & Sons

Open e-Resource:

- https://law.resource.org/pub/in/bis/ (useful website to download Indian standards) - http://www.electrical-engineering-portal.com/
- nptel.ac.in/ course.php

List of Suggested Experiments:

1. Design of transmission line.
2. Visit of substation and draw its lay out plan.
3. Design of transmission line towers.
4. Survey of rural electrification and draw Single Line Diagram.
    - Visit to a village.
    - Supply is taken from pole mounted transformer and distributed in various part of village.
    - Load calculation, loading capacity of different equipments.
    - Verification of 3-phase balanced loading.
    - Finding transformer rating based on loading.
    - Making drawing sheet representing Single line diagram of three phase distribution.
5. Survey of industrial distribution system and draw Single Line Diagram SLD. 6. Study pipe earthing and plate earthing.

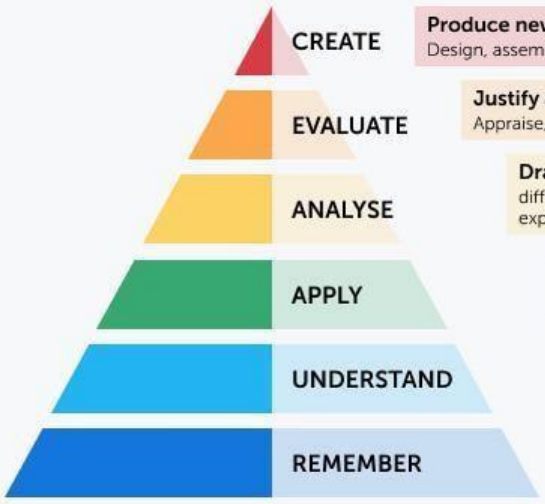
APPENDIX – A

Department Activity Scheduled

Sr. No.	Name of Activity	Tentative Month of Activity
1	**Electrical Engineering Technical Quiz / Group Discussion** on Current Trends in Power Systems and E-Mobility	August
2	**Technical Wall Magazine / Article Display** on Electrical Engineering Themes, such as Smart Grids, Wireless Power Transfer, and Energy Conservation	September
3	**Relevant Substation / Industry Visit** with Report Submission	October – November
4	**Mini Innovative Project / Working Hardware Model** (e.g., Motor Control Circuits, Renewable Energy Harvesters, or Home Automation)/ **Poster Presentation** on Emerging Electrical Engineering Technologies	January- February

APPENDIX – B
Bloom Taxonomy

Bloom's Taxonomy



Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate

Justify a stand or decision
Appraise, argue, defend, judge, select, support, value, critique, weigh

Draw connections among ideas
differentiate, organise, relate, compare, contrast, distinguish, examine, expertiment, question, test

Use information in new situation
Execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

Explain ideas or concepts
Classify, discribe, discuss, explain, identify, locate, recognize, report, select, translate

Recall facts and basic concepts
define duplicate, list, memorise, repeat, state