Gandhinagar Institute of Technology

Academic Regulation & Curriculum

for

M.Tech

in

ENERGY ENGINEERING

***w.e.f.* 2026-27**

Preamble

The Mechanical Engineering Department, Gandhinagar Institute of Technology, Gandhinagar University, is committed to fostering academic excellence, applied research, professional ethics, and industry-oriented learning across the disciplines of Mechanical Engineering, Robotics & Automation, and Energy Engineering. The programmes offered by this department are designed in alignment with AICTE guidelines, NEP 2020, Outcome-Based Education (OBE), and Choice-Based Credit System (CBCS) principles, with the goal of preparing skilled, adaptable, and innovation-driven engineers and technologists for India's rapidly evolving industrial and technological landscape.

Under the NEP 2020 framework, the department embraces a flexible, multidisciplinary, and learner-centric approach to engineering education. The Choice-Based Credit System (CBCS) enables students to exercise academic autonomy by selecting elective courses aligned with their interests, career goals, and emerging industry needs. The Outcome-Based Education (OBE) philosophy ensures that every course, every laboratory exercise, and every project activity is purposefully designed to achieve defined Programme Outcomes (POs), Programme Educational Objectives (PEOs), and Course Outcomes (COs), making the learning process transparent, measurable, and continuously improvable.

The department offers Ten programmes spanning undergraduate and postgraduate levels: D.Tech in Mechanical Engineering, D.Tech in Robotics & Automation, B.Tech in Mechanical Engineering, B.Tech in Robotics & Automation, B.Tech in Energy Engineering, B.Tech in Robotics and Artificial Intelligence, M.Tech in Energy Engineering, M.Tech in Thermal Engineering, and M.Tech in Energy Engineering, M.Tech in Robotics and Artificial Intelligence. Together, these programmes form a cohesive academic ecosystem that addresses the full spectrum of mechanical sciences — from classical thermodynamics and manufacturing to advanced robotics, intelligent automation, and sustainable energy systems.

The curriculum integrates core engineering domains including Machine Design, Fluid Mechanics, Thermodynamics, Manufacturing Processes, Mechatronics, Control Systems, Robotics, Energy Engineering, Finite Element Analysis, Renewable Energy, and Artificial Intelligence applications in engineering. Special emphasis is placed on Industry 4.0 technologies, smart manufacturing, embedded systems, energy transition, and computational design tools that are shaping the future of engineering practice in India and globally.

Through a balanced pedagogy of classroom instruction, laboratory experimentation, industry internships, live projects, design challenges, and research activities, the department aims to develop engineers who are not only technically proficient but also capable of critical thinking, independent problem-solving, and responsible innovation. The postgraduate programmes in ENERGY ENGINEERING, Thermal Engineering, and Energy Engineering are designed to deepen specialization, advance research capability, and prepare graduates for leadership roles in industry and academia.

The department continuously reviews and updates its curriculum through feedback from industry partners, academic peers, alumni, and students, ensuring that its graduates remain relevant, competitive, and equipped to contribute meaningfully to India's manufacturing sector, energy future, and the global engineering community.

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1. Institutional Vision & Mission

1.1 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.

1.2 Mission:

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

2. Departmental Vision Mission

2.1 Vision:

Impart outcome-based education to engrave mechanical engineers having a successful future with productive capabilities and progressive/innovative approach to meet the social and economical needs of society.

2.2 Mission:

To sensitize mechanical engineering students for a conquering profession/future with the subjective information of diverse technical components through vital mechanical engineering abilities with the superb mindset and fruitful teamwork with the aid of making them able to think out of the box using the state of the art laboratory facilities and resources.

3. Program Educational Objectives

PEO 1:

Graduates will acquire in-depth knowledge of energy engineering and apply advanced analytical, computational, and engineering techniques to address complex challenges in energy generation, conversion, storage, and utilization.

PEO 2:

Graduates will conduct independent research and develop innovative solutions for improving the performance, reliability, and sustainability of energy systems through scientific investigation and technological advancement.

PEO 3:

Graduates will contribute to the development and implementation of energy-efficient and environmentally responsible technologies that support sustainable growth and responsible resource utilization.

PEO 4:

Graduates will demonstrate effective leadership, communication, teamwork, and project management skills while working in multidisciplinary environments within industry, academia, and research organizations.

PEO 5:

Graduates will engage in lifelong learning and professional development to adapt to emerging energy technologies, evolving industry requirements, and global energy challenges.

4. Program Details

4.1 Program Structure & Duration

- Duration & Intake : 2 Years & 9 Seats
- Semesters: 4
- Mode: Full Time
- Credit Structure: As per NEP/University norms
- Medium of Instruction: English

4.2 Eligibility Criteria for Admission

Candidates who have passed B.E. / B.Tech in Mechanical / Production / Industrial / Automobile / Manufacturing / Mechatronics Engineering or an equivalent discipline from a recognised university, with a minimum of 50% aggregate marks (45% for reserved category candidates as per applicable norms), shall be eligible for admission to the programme. Candidates holding a valid GATE score in a relevant discipline shall be given preference as per prevailing admission rules.

4.3 Admission Procedure

Admission to the M.Tech Energy Engineering programme may be granted either through the Admission Committee for Professional Courses (ACPC), Government of Gujarat, based on the prevailing postgraduate / GATE admission norms, or through the direct admission process conducted by the University as per applicable rules and eligibility criteria.

4.4. Credit Summary

Component	Credits	Sem I	Sem II	Sem III	Sem IV
Professional Core	26	15	11	0	0
Program Electives (I–IV)	12	3	9	0	0
MLC – Research Methodology & IPR	3	3	0	0	0
Audit Courses	0	0	0	0	0
Dissertation / Internal Review / Seminar	32	0	0	16	16
Total	**73**	**21**	**20**	**16**	**16**

Definition of Credit (as per UGC):

- 1 Hour Lecture (L) per Week = 1 Credit
- 1 Hour Tutorial (T) per Week = 1 Credit
- 2 Hours Practical / Lab / Fieldwork per Week = 1 Credit

5. Curriculum Structure

GANDHINAGAR UNIVERSITY

Gandhinagar Institute of Technology (01)

Program Name: Masters of Technology (02)														Branch Name (Code): Energy Engineering (161)				
Semester / Year : First Year / Semeter I														Effective From Academic Year:2025-26				
NCrF LEVEL	Subject Code	Course Type	Subject Name		Bleaded With	Credit	Hours per week				Theory (Marks)		Practical (Marks)		Total (Marks)
							L	T	P	Total	University Assessme	Continuous	University Assessmen	Continuous	
NCR - 6.5	10080103	Professional Core	Applied Mathematics for Engineers			4	4	0	0	4	60	40	0	0	100
	10030101	Professional Core	Advanced Therodynamics & Heat Transfer			4	3	0	2	5	60	40	30	20	150
	11610101	Professional Core	Renewable Energy System			4	3	0	2	5	60	40	30	20	150
	11610102	Professional Core	Thermal Energy System			3	3	0	0	3	60	40	0	0	100
	10000151	MLC	Research Methodology and IPR			3	1	1	2	4	0	0	80	20	100
		Program Elective-I	Elective-I			3	3	0	0	3	60	40	0	0	100
						21	**17**	**1**	**6**	**24**					**700**
	Elective-I														
	11610111	Program Elective-I	Fluidized Bed Systems												
	11610112	Program Elective-I	Hydro Power Systems												
	11610113	Program Elective-I	Energy Generation and Waste Management												

Program Name: Masters of Technology (02)														Branch Name (Code): Energy Engineering (161)				
Semester / Year : First Year / Semeter II														Effective From Academic Year:2025-26				
NCrF LEVEL	ubject Cod	Course Type	Subject Name		Bleaded With	Credit	Hours per week				Theory (Marks)		Practical (Marks)		Total (Marks)
							L	T	P	Total	University Assessme	Continuous	University Assessmen	Continuous	
NCR - 6.5	10000251	MLC	Technical Writing			0	2	0	0	2	0	50	0	0	50
	10030202	Professional Core	Energy Management in Thermal System			4	4	0	0	4	60	40	0	0	100
	10030203	Professional Core	Research Review and Seminar			3	0	0	6	6	0	0	100	0	100
	11610201	Professional Core	Fuels and Combustion			4	3	1	0	4	60	40	0	0	100
		Program Elective-II	Elective-II			3	3	0	0	3	60	40	0	0	100
		Program Elective-III	Elective-III			3	3	0	0	3	60	40	0	0	100
		Program Elective-IV	Elective-IV			3	3	0	0	3	60	40	0	0	100
				Total		**20**	**18**	**1**	**6**	**25**					**650**
	Elective-II				**Elective-III**						**Elective-IV**				
	11610211	Program Elective-II	Battery and Fuel Cells	11610221	Program Elective-III	Environmental Engineering and Pollution Control					11610231	Program Elective-IV	Alternative Fuels		
	11610212	Program Elective-II	Energy Efficient Buildings	11610222	Program Elective-III	Hydrogen Energy Systems					11610232	Program Elective-IV	Wind Energy Engineering		
	11610213	Program Elective-II	Nuclear Energy Technology	11610223	Program Elective-III	Solar Energy Engineering					11610233	Program Elective-IV	Bio Energy Technology		

GANDHINAGAR UNIVERSITY

Gandhinagar Institute of Technology (01)

Institute Name (Code): Gandhinagar Institute of Technology (01)	**G U - 4th Batch - Year - 2025 - 26**
Program Name: Masters of Technology (02)	**Branch Name (Code): Energy Engineering (161)**
Semester / Year : Second Year / Semeter III	**Effective in Academic Year - 2026 - 27 (July - Dec)**

NCrF LEVEL	Subject Code	Course Type	Subject Name	Credit	Blende With	Hours per week				Theory (Marks)		Practical (Marks)		Total (Marks)
						L	T	P	Total	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
NCF - 7.0	1011610301	Internal Review	Internal Review - I	2		0	0	4	4	0	0	100	0	100
	1011610302	Dissertation Phase	Dissertation Phase - I	14		0	0	28	28	0	0	100	0	100
			Total	**16**		**0**	**0**	**32**	**32**					**200**

Institute Name (Code): Gandhinagar Institute of Technology (01)	**G U - 4th Batch - Year - 2025 - 26**
Program Name: Masters of Technology (02)	**Branch Name (Code): Energy Engineering (161)**
Semester / Year : Second Year / Semeter IV	**Effective in Academic Year - 2026 - 27 (July - Dec)**

NCrF LEVEL	Subject Code	Course Type	Subject Name	Credit	Blende With	Hours per week				Theory (Marks)		Practical (Marks)		Total (Marks)
						L	T	P	Total	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
NCF - 7.0	1011610401	Internal Review	Internal Review - II	2		0	0	4	4	0	0	100	0	100
	1011610402	Dissertation Phase	Dissertation Phase - II	14		0	0	28	28	0	0	100	0	100
			Total	**16**		**0**	**0**	**32**	**32**					**200**

6. Teaching, Learning & Evaluation

6.1 Teaching Methodology

The program shall adopt: Classroom Teaching · Case Studies · Industry Interaction · Site Visits · Workshops · Energy Auditing · Research Projects · Seminars & Literature Review · AI-based Learning Tools · Blended and Digital Learning.

6.2 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 practicals, seminars, and dissertation work.

6.3 Examination and Evaluation System

6.3.1 Evaluation Components The evaluation may consist of Continuous Internal Evaluation (CIE) and End Semester Examination (ESE). CIE may include: Mid-Semester Examination · Assignments · Presentations · Software/Lab Work · Class Test · AI Quiz & Viva Voce · Seminar · Dissertation Review.

6.4 Weightage

- Continuous Internal Evaluation: 40%
- End Semester Examination: 60%

6.5 Passing Standards

A student shall be declared to have successfully passed a course subject to fulfilling the minimum passing criteria prescribed by the University from time to time. The passing criteria for the M.Tech Energy Engineering programme shall generally include:

- Minimum 40% marks in the End Semester Examination (ESE) where applicable.
- Minimum 50% aggregate marks considering all evaluation components including continuous internal evaluation and end semester examination.

- Separate passing criteria may be applicable for theory, practical, laboratory, seminar, and dissertation components as prescribed by the University.

Students must fulfil all academic, practical, attendance, and evaluation requirements for successful completion of the course and the programme. The University reserves the right to revise the evaluation and passing criteria from time to time as per academic regulations and statutory guidelines.

6.6 Grading System

The program shall follow Gandhinagar University grading norms.

6.6.1 Grade Table

Grade	Grade Points	From Marks	To Marks
AA	10	80	100
AB	9	75	79
BB	8	70	74
BC	7	65	69
CC	6	60	64
CD	5	55	59
DD	4	50	54
FF	0	0	49

6.7 Dissertation / Project Work

The dissertation is the principal component of the M.Tech Energy Engineering programme, spanning Semesters III and IV through Internal Review and Dissertation Phases I and II. Requirements may include: Proposal Presentation · Periodic Review (Internal Review I & II) · Final Report Submission · Viva Voce Examination. The dissertation shall be evaluated by internal and external examiners. Students are encouraged to align their dissertation with current research problems, industry challenges, or publishable work in Energy Engineering and allied computational design and manufacturing domains.

7. Rules and Regulations

7.1 Rules for Promotion

A student enrolled in the M.Tech Energy Engineering programme shall be promoted to the subsequent semester in accordance with the academic regulations and promotion rules prescribed by the University from time to time, subject to fulfilment of minimum attendance requirements, academic performance criteria, and completion of prescribed credits.

7.2 Maximum Duration for Completion

The maximum duration for completion of the M.Tech Energy Engineering programme shall be four academic years from the date of admission, or as prescribed by the University and applicable regulatory authorities from time to time.

7.3 Internship / Research Engagement Guidelines

Students are encouraged to undertake research internships, industry-oriented dissertation work, or experiential learning relevant to Energy Engineering. Such engagement may be carried out in: Energy Engineering and Design Companies · Manufacturing and Production Industries · Automobile and Aerospace Industries · Robotics and Automation Industries · Product Development and Tooling Organizations · Research and Development Organizations · Government and Public Sector Engineering Units · MSMEs and Industrial Workshops.

Students may be required to submit: Internship / Research Report · Work Diary / Logbook · Completion Certificate · Presentation / Viva Voce · Project or Dissertation-linked Report, wherever applicable.

7.4 Discipline Rules

Students shall maintain discipline, professional ethics, safety standards, and proper conduct within the institution, laboratories, industrial visits, internships, examinations, technical events, and all academic activities associated with the programme.

Students are expected to: attend classes, laboratories, and seminars regularly; follow institutional rules, regulations, and safety practices; respect faculty members, staff, fellow

students, and institutional property; maintain academic honesty and integrity in assignments, projects, practical work, dissertation, and examinations; and properly use laboratory equipment, software, machines, and computing facilities.

Any form of misconduct, indiscipline, ragging, use of unfair means in examinations, plagiarism in dissertation work, damage to institutional property, harassment, or unsafe laboratory practices shall be treated seriously and may result in disciplinary action including warning, suspension, cancellation of examination, withholding of results, or expulsion from the programme as per University rules, AICTE norms, and UGC regulations.

7.5 Anti-Ragging Policy

The programme shall strictly comply with: UGC Anti-Ragging Regulations · AICTE Anti-Ragging Guidelines · Anti-Ragging Affidavit requirements · Institutional disciplinary procedures. Ragging in any form is strictly prohibited and shall invite strict disciplinary action as per applicable regulations.

7.6 Ethical Use of Technology and AI Tools

Students enrolled in the **M.Tech. in Energy Engineering** program are encouraged to utilize modern technological tools and digital platforms to enhance learning, research, innovation, and professional practice. Advanced software applications, simulation environments, and artificial intelligence-based technologies play an important role in the analysis, design, optimization, and management of energy systems and processes. Students may use energy system modeling and simulation software, engineering analysis tools, renewable energy assessment platforms, programming and automation environments, artificial intelligence and machine learning applications, data analytics and visualization software, smart grid and energy management systems, virtual laboratories, digital libraries, and research databases to support their academic and research activities.

The use of technology and AI tools shall be guided by the principles of academic integrity, professional ethics, transparency, and responsible conduct. These tools are intended to assist students in learning, problem-solving, design, research, and innovation while ensuring that the intellectual contribution and critical thinking demonstrated in academic work remain their

own. Students are expected to use AI-assisted technologies responsibly and acknowledge their use whenever required by institutional guidelines.

Students shall not engage in plagiarism, unauthorized copying, misrepresentation of ideas, fabrication or manipulation of experimental, simulation, or research data, or any other form of academic misconduct. AI-generated content must not be presented as entirely original work without appropriate disclosure. The use of technology to obtain unfair advantages in examinations, assessments, project evaluations, or research activities is strictly prohibited. Students must also comply with applicable software licensing agreements, copyright laws, data privacy requirements, and professional standards while using digital resources.

All assignments, project reports, dissertations, publications, and research outcomes submitted under the program must reflect genuine understanding, independent analysis, and authentic scholarly contribution. The institution reserves the right to verify the originality and authenticity of submitted work and to take appropriate action in cases involving unethical use of technology or AI tools. Adherence to these principles will help students develop the professional responsibility, ethical awareness, and technological competence expected of graduates in the field of Energy Engineering.

8. Student Support

8.1 Industry Collaboration

The department shall actively promote collaboration with manufacturing industries, automobile industries, robotics and automation companies, energy and power sector industries, production and design organizations, research institutions, MSMEs, public sector undertakings, and professional engineering bodies to enhance practical exposure and industry relevance of the M.Tech Energy Engineering programme. Such collaborations may include industrial internships, plant exposure, expert lectures, live industry projects and consultancy assignments, joint research and innovation activities, skill development programs, entrepreneurship support, and placement initiatives. The institution may establish MoUs with industries and research organizations for collaborative research, technology transfer, and industry-oriented learning.

8.2 Research and Consultancy

The department shall encourage faculty members and students to actively engage in research, innovation, consultancy, product development, and applied engineering studies related to manufacturing, thermal engineering, design engineering, robotics, automation, energy systems, materials, industrial engineering, sustainable technologies, and emerging engineering domains.

Students may undertake:

- Research and innovation projects in renewable and sustainable energy
- Solar, wind, and hybrid energy system design and development
- Energy audit and energy management studies
- Thermal system analysis and simulation
- IoT-based smart energy monitoring projects
- Energy storage and battery technology studies
- Industry-oriented technical problem-solving assignments

8.3 Library and Laboratory Facilities

Adequate library, laboratory, workshop, and digital learning facilities shall be made available to support effective teaching, practical training, research, innovation, and skill development under the M.Tech Energy Engineering programme.

The department shall facilitate access to:

- Engineering textbooks and reference books in energy and thermal domains
- National and international journals on renewable energy and sustainability
- Research publications and e-resources
- Standards, manuals, and technical databases
- Digital learning platforms and virtual laboratories
- Energy simulation software and computational tools

Necessary laboratories, workshops, computing facilities, internet access, manufacturing tools, machines, measuring instruments, automation systems, robotics platforms, and fabrication facilities required for practical and project-based learning shall also be provided to enhance technical competency, research capability, and industry readiness among students.

8.4 Student Support and Mentoring

A structured system for student support, academic mentoring, and professional guidance shall be implemented. The department shall facilitate academic counselling and mentoring, career and higher-education guidance, technical skill development, research and innovation support, entrepreneurship guidance, and professional development initiatives. Students may interact with industry experts and participate in workshops, seminars, industrial visits, technical competitions, and innovation challenges to enhance employability, leadership, communication, teamwork, and overall development.

8.5 Placement and Career Development

The department shall actively promote placement assistance and career development activities through industry interaction, internships, professional networking, industrial collaborations, and campus engagement initiatives.

Efforts shall be made to establish linkages with:

- Thermal and Power Plant Industries
- Renewable Energy and Solar Energy Companies
- Wind Energy and Turbine Manufacturing Industries
- Oil and Gas Industries
- Energy Audit and Energy Management Firms
- Electrical Utilities and Power Distribution Companies
- Hydrogen and Fuel Cell Technology Organizations
- Green Building and Energy Efficiency Companies
- Electric Vehicle and Battery Technology Industries
- Research and Development Organizations
- Government and Public Sector Energy Units
- MSMEs and Startup Ecosystems in Clean Energy

Career development activities such as aptitude training, resume preparation, interview preparation, soft skill development, technical certification programs in energy engineering domains, entrepreneurship guidance, 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 M.Tech. Energy Engineering programme is designed to develop skilled professionals and researchers with advanced knowledge in renewable energy systems, thermal engineering, energy storage, smart grids, hydrogen technologies, sustainable energy management, and emerging energy technologies aligned with Industry 4.0 and global sustainability goals.

The programme emphasizes advanced theoretical learning, research, innovation, and practical problem-solving skills required to address complex energy challenges. It prepares students for careers in research and development, academia, industry, consultancy, entrepreneurship, and multidisciplinary engineering domains.

The curriculum is delivered by experienced faculty members and supported through advanced laboratories, simulation platforms, research projects, industrial collaborations, and project-based learning. Modern tools such as energy simulation software, computational methods, AI-based analytics, IoT-enabled monitoring systems, automation technologies, and data-driven optimization techniques are integrated to enhance technical competency and research capability.

Students are encouraged to participate in research, publications, innovation projects, internships, conferences, startup initiatives, and interdisciplinary activities to develop technical expertise, leadership qualities, and professional skills. The programme also promotes collaboration with industries, research organizations, professional bodies, and technology partners through industrial training, expert lectures, workshops, consultancy projects, and certification programmes, ensuring strong industry exposure and application-oriented learning.

9.2 Scope and Career Opportunities

Graduates of the M.Tech. Energy Engineering programme may pursue career opportunities in thermal and power generation industries, renewable energy companies, solar and wind energy sectors, oil and gas industries, energy auditing and management organizations, electrical

utilities, smart grid and energy storage companies, hydrogen and fuel cell technology organizations, electric vehicle and battery industries, green building and energy efficiency firms, research and development institutions, government and public sector energy enterprises, MSMEs, and energy engineering consultancy services. They may also engage in advanced research, innovation-driven startups, higher studies, and academic careers in the field of energy engineering and sustainable technologies.

9.3 Potential Job Roles

Graduates of the M.Tech. Energy Engineering programme may work in roles such as Energy Engineer, Thermal Engineer, Renewable Energy Engineer, Solar Energy Engineer, Wind Energy Engineer, Energy Audit Engineer, Power Plant Engineer, Energy Management Specialist, Smart Grid Engineer, Hydrogen and Fuel Cell Engineer, HVAC and Building Energy Engineer, Energy Storage Engineer, Environmental and Sustainability Engineer, Research and Development Engineer, Project Engineer, Technical Consultant, and Energy Policy and Planning Analyst. They may also contribute to advanced research, technology development, system design, energy optimization, sustainability initiatives, and strategic planning in the energy sector.

9.4 Higher Study & Professional Opportunities

Students graduating from the M.Tech. Energy Engineering programme may pursue Ph.D. programmes in Energy Engineering, Thermal Sciences, Renewable Energy, Sustainable Technologies, and other interdisciplinary engineering domains. They may also engage in advanced research and innovation-oriented studies, postdoctoral research opportunities, specialized professional certification programmes in energy management, renewable energy systems, smart grids, hydrogen technologies, sustainability, and advanced computational tools. Graduates may further pursue entrepreneurship and technology-based startup ventures in clean energy and sustainable development sectors, as well as participate in national and international research, consultancy, and professional development programmes.

10. Collaborative Field Work / Experimental Work

The M.Tech. Energy Engineering programme emphasizes advanced practical learning, research exposure, and application-oriented education through laboratory work, simulation studies, industrial training, field investigations, and research-based projects. Students are encouraged to participate in industrial visits, power plant and renewable energy facility exposure, advanced thermal and energy system experiments, energy auditing and management studies, smart grid and energy storage projects, hydrogen and fuel cell technology investigations, and AI- and IoT-enabled energy monitoring applications.

The programme promotes involvement in research projects, innovation challenges, technical workshops, national and international conferences, internships, consultancy assignments, and industry-sponsored projects in collaboration with energy industries, utilities, research organizations, and technology partners. Through these activities, students develop advanced analytical skills, research aptitude, problem-solving ability, teamwork, leadership, technical communication, and professional competency required for modern energy engineering and sustainable technology development.

11. Market Survey

11.1 Executive Summary

India is experiencing rapid growth in renewable energy, smart grids, energy storage, hydrogen technologies, sustainable infrastructure, and advanced energy management systems, driven by the global energy transition, climate commitments, technological advancements, and increasing investments in clean energy. Gujarat, particularly Ahmedabad and Gandhinagar, has emerged as a significant center for renewable energy development, industrial energy management, power generation, and sustainable technology initiatives.

Industry interactions and market assessments involving energy companies, power utilities, research organizations, renewable energy developers, and technical experts indicate a growing demand for highly qualified professionals with advanced knowledge in energy systems, renewable technologies, energy analytics, smart grids, energy storage, and sustainable engineering solutions. Stakeholders emphasized the need for research capability, innovation, computational skills, industry exposure, and interdisciplinary problem-solving abilities to address emerging challenges in the energy sector.

The findings demonstrate that the M.Tech. Energy Engineering programme is academically rigorous, research-oriented, industry-relevant, and well aligned with current and future requirements of the energy sector. The programme is expected to contribute significantly to the development of skilled professionals, researchers, and innovators capable of supporting national energy goals and global sustainable development initiatives.

11.2 Market Demand & Industry Trends

The energy sector is undergoing rapid transformation globally and in India due to the increasing adoption of renewable energy, energy storage technologies, smart grids, electric mobility, hydrogen energy systems, and sustainable infrastructure. Government initiatives, climate action commitments, technological advancements, and growing investments in clean energy are creating significant demand for highly skilled energy professionals and researchers.

Major growth areas include solar and wind energy systems, energy storage and battery technologies, smart grids and advanced energy management systems, hydrogen and fuel cell technologies, electric vehicles and charging infrastructure, thermal power plant modernization, industrial energy efficiency, green buildings, carbon reduction technologies, biomass and waste-to-energy systems, and digital energy solutions enabled by artificial intelligence and the Internet of Things.

Industries, research organizations, utilities, and technology companies are increasingly seeking professionals with advanced technical knowledge, research capability, computational and analytical skills, practical exposure to modern energy systems, and the ability to develop innovative and sustainable solutions for emerging energy challenges. The M.Tech. Energy Engineering programme is designed to address these evolving industry requirements and support the growing demand for specialized expertise in the energy sector.

11.3 Skill Gap Identified by Industry

Industry interactions and market analysis have identified several competency gaps among engineering graduates entering the energy sector. These include limited exposure to advanced energy system modeling and simulation, insufficient practical experience with renewable energy technologies, energy storage systems, smart grids, and modern energy management practices, as well as inadequate familiarity with industry-standard software tools, instrumentation, testing methodologies, and data-driven decision-making techniques.

Industries also highlighted the need for stronger research and analytical capabilities, proficiency in computational tools and energy analytics, understanding of hydrogen and emerging clean energy technologies, and greater experience in multidisciplinary project execution. In addition, gaps were observed in technical communication, project management, innovation, leadership, and professional problem-solving skills required for addressing complex energy challenges.

The M.Tech. Energy Engineering programme has been designed to bridge these gaps through advanced coursework, laboratory experimentation, simulation-based learning, industry collaboration, research projects, internships, and exposure to emerging technologies. The programme aims to develop technically competent professionals and researchers capable of

making immediate and meaningful contributions to the energy, renewable energy, and sustainable technology sectors.

11.4 Employment Opportunities & Industry Support

Graduates of the M.Tech. Energy Engineering programme will have diverse career opportunities in renewable energy industries, power generation and utility sectors, energy storage and battery industries, smart grid companies, hydrogen and fuel cell technology organizations, energy management and consultancy firms, research and development institutions, government agencies, public sector enterprises, MSMEs, and emerging clean energy startups. The programme also prepares graduates for careers in academia, advanced research, technology development, and innovation-driven enterprises.

Industry stakeholders have expressed strong support for the programme through opportunities for internships, industrial training, collaborative research projects, consultancy assignments, expert lectures, workshops, technical certification programmes, industrial visits, and participation in innovation challenges and technology development initiatives. Industries and research organizations have also indicated their willingness to support student projects, dissertation work, skill development activities, and placement assistance.

The programme is expected to play a significant role in developing highly skilled professionals and researchers equipped with advanced technical knowledge, research capability, practical competence, innovation aptitude, and professional skills required to support India's energy transition, sustainable development goals, and the evolving global energy sector.

12. Review and Revision of Regulation

The University reserves the right to interpret, modify, revise, amend, or update any provision, regulation, curriculum structure, evaluation scheme, academic requirement, or operational guideline related to the M.Tech. Energy Engineering programme in accordance with University policies, statutory requirements, technological advancements, industry expectations, and academic developments.

Considering the dynamic nature of energy technologies, renewable energy systems, smart energy networks, hydrogen technologies, energy storage solutions, and sustainable engineering practices, the curriculum and academic regulations of the programme shall be reviewed periodically to ensure continued relevance, research excellence, industry alignment, and academic quality. Such revisions may be undertaken based on emerging developments in energy engineering and clean technologies, feedback from industry experts, alumni, students, and academic stakeholders, changes in AICTE, UGC, and other regulatory guidelines, national and international energy policies, advancements in engineering software and computational tools, and recommendations arising from academic audits, accreditation processes, and quality assurance reviews.

In the event of any ambiguity or dispute regarding the interpretation of any provision of this manual, the decision of the University or the 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 M.Tech. Energy Engineering programme.

Annexure I: Detail Syllabus

GANDHINAGAR UNIVERSITY

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

GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 1st SEMESTER

COMPUTER ENGINEERING (SOFTWARE ENGINEERING)
MECHANICAL ENGINEERING (THERMAL ENGINEERING/CAD-CAM/ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 10000151	**Subject Title:** Research Methodology and IPR (MLC)
Pre-requisite: Zeal to learn	

Course Objective:

- To give an overview of the research methodology and explain the technique of defining a research problem.
- To explain the functions of the literature review in research.
- To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- To explain various research designs and their characteristics.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
1	1	2	3	0	0	80	20	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Understanding of Research:** Find what is expected of you - Identify specific requirements for evaluation/review and what constitutes the completion of your work, Find where the source is available, Establish proper methods for finding the relevant material from the source Analyse the question - Identify key areas in your field, Determine the nature and extension of papers that you should read	6	22

w.e.f. AY 2022-23

	Identify the gaps - Learn to Critique existing knowledge and how to find the gap Formulate the Problem Statement - Understand what should be the key aspects of your problem statement, your problem statement, examples of effective and ineffective Titles Validation - Identify a problem and experimental/theoretical data for comparison with your model, Learn how to extrapolate/scale data for validation, Find what is the acceptable level of error		
2	**Finding Good Literature** Decide which sources you will need - Differentiate between journals, conferences, books, magazines and their quality, Understand how to establish their quality and authenticity Finding Information - How to conduct effective searches, How to find relevant papers related to your area of research, How to capture critical information Identify main ideas in scholarly literature - Understand and identify the bias, theoretical position and evidence produced Write notes to organize your ideas - Compare ideas and concepts from different papers	6	22
3	**Writing and Presenting your Work** Effective technical writing - How to write Report, Paper, Developing a Research Proposal, Format of research proposal Build your argument - Recognize the importance of emphasizing your point, Distinguish between your point and the evidence available, Acknowledge the evidence Review and finalize your work - Know and follow the Process of reviewing and proofreading your work, Use feedback to improve your work Check the logistics of your presentation- Identify the key message of your presentation, Understand the expectations and what will be the key review points Develop the structure of your presentation - Understand the key components of an oral presentation, Know the usual structure of a good presentation Prepare for delivery of your Oral presentation- Rehearse and time your presentation, prepare to answer questions from the audience: Fundamental	7	26

	concepts should be spoken from memory as the reviewer will be looking for evidence of your thorough understanding., Read more than the content you are presenting; keep sources ready on hand for reference		
4	**Intellectual Property** Patents, Designs, Trade and Copyright - Process of Patenting and Development: Technological research innovation, patenting, development International Scenario - International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT Patent Rights - Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications New Developments in IPR - Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies	8	30

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

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

List of References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974
7. Asimov, "Introduction to Design", Prentice Hall, 1962.

8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Open e-Resource:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc19_ge21/preview
2. NPTEL: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 1st SEMESTER

MECHANICAL ENGINEERING (THERMAL ENGINEERING / CAD-CAM/ ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 10080109	Subject Title: Applied Mathematics for Engineers (Core-1)
Pre-requisite:- Basic Mathematics	

Course Objective:

- Enrich the knowledge in various advanced mathematical techniques.
- Fundamental concepts for model the engineering problems.

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	0	4	60	40	-	-	100

Subject Contents			
Sr. No	Topic	Total Hours	Weight (%)
1.	**Matrix Theory:** The Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Least squares method - Singular value decomposition.	13	25
2.	**Calculus of Variations:** Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functional dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems - Direct methods : Ritz and Kantorovich methods.	12	23
3.	**Probability and Random Variables:** Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.	13	25
4.	**Laplace Transform Techniques for Partial Differential Equations:** Laplace transform - Definitions - Properties – Transform error function - Bessel's function - Dirac delta function - Unit step functions – Convolution	14	27

	theorem – Inverse Laplace transform: Complex inversion formula – Solutions to partial differential equations: Heat equation - Wave equation.		

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

- Apply various methods in matrix theory to solve systems of linear equations.
- Maximizing and minimizing the functional that occur in various branches of engineering disciplines.
- Computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
- Application of Laplace and Fourier transforms to initial value, initial–boundary value and boundary value problems in Partial Differential Equations.

List of References:

1. Andrews L.C. and Shivamoggi, B. "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
2. Bronson, R. “Matrix Operations”, Schaum’s outline series, 2nd Edition, McGraw Hill, 2011.
3. James, G., “Advanced Modern Engineering Mathematics ", 3rd Edition, Pearson Education, 2004.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
5. O'Neil, P.V., "Advanced Engineering Mathematics ", Thomson Asia Pvt. Ltd., Singapore, 2003.
6. Sankara Rao, K., “Introduction to Partial Differential Equations”, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.

Open e-Resource:

1. https://nptel.ac.in/courses/111102133

GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 1st SEMESTER

MECHANICAL ENGINEERING (THERMAL ENGINEERING / ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 10090101	**Subject Title: Advance Thermodynamics and Heat Transfer (Core-2)**
Pre-requisite: - Basic Thermodynamics and Het Transfer	

Course Objective:

- Enhance the understanding of thermodynamics principles.
- Experience in applying thermodynamic principles to predict physical phenomena.

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	60	40	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Entropy: A Measure of Disorder:** Increases of entropy principle and its application, Tds relation, entropy change of solid, liquid and ideal gas, entropy transfer with heat transfer, entropy generation in open and closed system, entropy balance **Exergy: A Measure of Work Potential:** Exergy transfer by heat, work & mass, decrease of exergy principle and exergy destruction, applications of Gouy–Stodola theorem, exergy balance for steady flow and closed processes, second law efficiency Law of Corresponding States	11	25
2	**Conduction:** Conduction Rate Equation, Heat Diffusion Equation, Boundary and Initial Conditions, General conduction Equation, Conduction with Heat Generation, Extended Surfaces with Uniform and Non-Uniform Cross Sections, Two-Dimensional Steady State Conduction: Mathematical, Graphical and Numerical Analysis of Two-Dimensional Heat Conduction Unsteady State Conduction: Lumped Parameter Analysis, Numerical Solutions, Heisler and Semi Analytical Analysis	12	28

3	**Convection:** Different Types of Flow and Boundary Layers, Flow Through Tubes, Flow Over Flat Plates, Cylinders, Spheres and Tube Blanks, Free Convection on Flat Surfaces, Cylinders, Spheres and Enclosed Spaces **Heat Transfer during Phase Transformation:** Boiling: Pool Boiling and its Correlations, Forced Convection Boiling, Condensation: Laminar and Turbulent Film Condensation, Film Condensation in Radial Surfaces and Horizontal Tubes, Heat Pipe	12	28
4	**Radiation:** Radiation Intensity, Blackbody Radiation, Emission from Real Surfaces Radiation Combine with Conduction and Convection, Radiation Exchange with Participating Media, Radiative exchange and overall heat transfer in furnaces	**7**	19

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

- Apply entropy principle to various thermal engineering applications
- Apply the concept of second law efficiency and exergy principle to various thermal engineering applications
- Analyze steady state and transient heat conduction problems of real-life thermal systems
- Analyze extended surface heat transfer problems and problems of phase change heat transfer like boiling and condensation
- Analyze radiation heat transfer problems of various thermal systems
- Use of software (like EES) for solving thermodynamic and heat transfer problems

List of References:

1. Thermodynamics – An Engineering Approach by Yunus Cengel & Boles, McGraw-Hill Publication, New Delhi
2. Fundamentals of Thermodynamics by Sonntag, Borgnakke & Van Wylen, John Wiley & Sons (Asia) Pvt. Ltd
3. Engineering Thermodynamics by P.K. Nag, McGraw-Hill , New Delhi
4. Fundamentals of Heat and Mass Transfer, by Incropera, Dewitt, John Wiley & Sons (Asia) Pvt. Ltd
5. Heat Transfer by J P Holman, McGraw-Hill Publication, New Delhi
6. A Heat Transfer Textbook by J H Lienhard, Phlogiston Press

Open e-Resource:

1. https://nptel.ac.in/courses/112103313

List of Suggested Tutorials:

1. Conduction heat transfer in composite wall.
2. Conduction heat transfer in metal rod.
3. Conduction heat transfer in through insulating powder.
4. Conduction heat transfer from a Pin fin.
5. Convection heat transfer in forced convection.
6. To study unsteady state heat transfer by the lumped capacitance
7. To study of heat transfer in the process of condensation.
8. To determine the value of Stefan Boltzmann constant for radiation heat transfer.
9. To measure the emissivity of test plate.
10. To study the pool boiling phenomena and measure the critical heat flux.

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 1st SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610101	**Subject Title:** Renewable Energy System
Pre-requisite: Zeal to learn	

Course Objective:

- To understand the global and national renewable energy scenario.
- To explore various renewable energy technologies and their applications.
- To examine the environmental impacts of conventional and renewable energy sources.
- To understand the working principles, design aspects, and feasibility of implementing renewable energy 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	**Introduction -** World energy use; Reserves of energy resources; Environmental aspects of energy utilization; Renewable energy scenario in India – potentials, achievements, and applications.	7	15
2	**Solar Energy -** Solar thermal: flat plate and concentrating collectors; Solar heating and cooling; Desalination; Solar pond; Solar cooker; Solar thermal power plant; Solar photovoltaic systems – cells, applications.	10	22
3	Wind Energy - Wind data and energy estimation; Types of wind energy systems; Wind turbine generator performance; Safety and environmental aspects of wind energy.	10	22
4	**Biomass Energy -** Direct combustion; Gasifiers; Biogas plants; Ethanol and biodiesel production; Cogeneration systems; Biomass-based applications.	9	20
5	**Other Renewable Energy Sources** - Tidal and wave energy; Ocean Thermal Energy Conversion (open and closed cycle); Small hydro systems; Geothermal energy; Fuel cell systems.	9	21

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

- Understand and critically assess various renewable energy technologies and their suitability for different applications.

- Analyze the environmental, technical, and economic feasibility of deploying renewable energy systems.
- Design and evaluate basic components of solar, wind, and biomass energy systems.
- Explore emerging and hybrid technologies in the renewable energy sector.
- Understand the status of renewable energy in India and contribute to its expansion and optimization.

List of Experiment:

1. To study and measure the solar radiation on horizontal and tilted surface using solar radiation measuring instruments.
2. To evaluate the performance of solar liquid flat plate collector.
3. To evaluate the performance of solar air heater.
4. To evaluate the performance of concentrating collectors.
5. To evaluate the performance of solar still.
6. To evaluate the performance of box type solar cooker.
7. To study the various types of wind mill and evaluate the performance parameter of wind. mill.
8. To study the various types of gasifier and biogas plant.
9. To study the ocean energy, wave energy, geothermal energy conversion systems.
10. 10) To estimate the economics of the solar energy conversion equipment.

List of References:

1. Rai, G.D. (1999). *Non-Conventional Energy Sources*, Khanna Publishers.
2. Sukhatme, S.P. (1997). *Solar Energy*, Tata McGraw-Hill, New Delhi.
3. Godfrey Boyle (1996). *Renewable Energy: Power for a Sustainable Future*, Oxford University Press.
4. Twidell, J.W., & Weir, A. (1986). *Renewable Energy Sources*, EFN Spon Ltd.
5. Tiwari, G.N. (2002). *Solar Energy Fundamentals, Design, Modeling, and Applications*, Narosa Publishing House.
6. Freris, L.L. (1990). *Wind Energy Conversion Systems*, Prentice Hall.
7. Johnson, Gary L. (1985). *Wind Energy Systems*, Prentice Hall.

Open e-Resource:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc25_ch40/preview
2. IEA: https://www.iea.org/energy-system/renewables

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 1st SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610102	**Subject Title:** Thermal Energy System
Pre-requisite: Knowledge of Engineering Thermodynamics and Power Plant Engineering	

Course Objective:

- Provide a comprehensive understanding of steam-based thermal power generation systems.
- Cover steam production technologies and components.
- Explore the functioning of nozzles and turbines.
- Analyze turbine blade designs and governing mechanisms.
- Examine the economic aspects of thermal power plants.
- Emphasize design, analysis, and economic operation of modern 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	0	3	70	30	00	00	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Steam Generation -** Steam generation overview; Classification of boilers; Modern high-pressure boilers; Thermal power plant layout and subsystems – Fuel handling, reheaters, superheaters, economizers, condensers, and cooling towers.	9	20
2	**Steam Nozzles -** Nozzle functions; Forms and isentropic flow relations; Effects of friction; Supersaturated flow; Introduction to simple design and performance problems.	9	20
3	**Steam Turbines** - Steam turbine types; Impulse and reaction principles; Compounding methods; Introduction to performance analysis with simple problems.	9	20
4	**Turbine Blade Profile & Governing -** Blade profiles for impulse and reaction turbines; Calculation of blade width, pitch, height, and angles; Losses in turbines; Turbine governing methods.	9	20
5	**Power Plant Economics -** Economic considerations in power generation; Load curve definitions; Fixed and operating costs; Variable load operations; Off-peak pricing.	9	20

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

- Understand and classify different types of steam generation and thermal power systems.

- Analyze flow through nozzles and its effects on turbine efficiency.
- Distinguish between different turbine types and apply basic performance calculations.
- Design and evaluate turbine blade profiles and governing mechanisms.
- Assess the economics of power plant operation and cost optimization strategies.

List of References:

1. Fredrick J. Morse (1953). Power Plant Engineering, East - West Press Pvt. Ltd.
2. Wakil, M.M. Power Plant Technology, McGraw Hill Book Company.
3. Kadambi, V. and Manohar Prasad (1984). An Introduction to Energy Conservation, Wiley Eastern Limited.
4. Archie W. Culp (1985). Principles of Energy Conservation, McGraw Hill Kogakusha Ltd.
5. Hussain (1985). Steam Turbines, Tata McGraw Hill Book Co.

Open e-Resource:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc23_me31/preview
2. NPTEL: https://onlinecourses.nptel.ac.in/noc24_hs77/preview

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M.TECH 1st SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610111	**Subject Title:** Fluidized Bed System
Pre-requisite: Basics of thermodynamics and heat transfer	

Course Objective:

- To understand the behaviour of fluidized bed, modes of heat transfer in fluidized bed, combustion and gasification.
- To understand the design of fluidize bed system and industrial application of FBD.

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	**Fluidized Bed Behaviour -** Fluidization Phenomena - Regimes of Fluidized Bed Behaviour - Characterization of Fluidized Particles - Two Phase and Well Mixed Theory of Fluidization - Solids Mixing - Particle Entrainment and Carryover.	9	20
2	**Heat Tansfer -** Different Modes of Heat Transfer in Fluidized Bed - Use of Immersed Tubes - Finned Tubes – Heat Recovery Systems.	9	20
3	**Combustion and gasification** - Fluidized Bed Combustion and Gasification,Pressurised Systems, Sizing of Combustion and Gasification Systems, Start-up Methods, Fast Fluidized Beds, Different Modes of Heat Transfer in Fluidized Beds.	9	20
4	**System Design -** Design of Distributors, Fluidized Bed Furnaces for Fossil and Agricultural Fuels, Fluidized Bed Heat Recovery Systems, Fluid Bed Dryers.	9	20
5	**Industrial Applications -** Sulpher Retention - Nitrogen Emission Control - Furnaces, Dryers, Heat Treatment, etc. pollution Control and Environmental Effects - Cost Analysis	9	20

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

- Analyze fluidized bed behavior, identifying regimes (bubbling, circulating, fast beds), using fluid dynamics theories (two-phase, well-mixed), and characterizing particle properties, entrainment, and solids mixing.
- Design heat transfer systems for fluidized beds, selecting appropriate immersed or finned tube configurations and heat recovery mechanisms to optimize thermal performance.
- Evaluate combustion and gasification in fluidized beds, including pressurized systems, sizing, startup, and mode selection (fixed, bubbling, circulating) for efficient gas–solid reactions
- Develop fluidized bed system designs, covering distributor plates, combustion/gasification furnaces for various fuels, heat recovery units, and fluid bed dryers.
- Apply industrial applications and control strategies, addressing SO_2/N_x retention, environmental impacts, fatigue stress, cost analysis, and pollutant control in furnaces, dryers, heat-treatment units, and complete fluidized systems

List of References:

1. Howard, J.R.(1983) Fluidized Bed Technology: Principles and Applications, Adam Hilger
2. Geldart, D.(1986) Gas Fluidization Technology, John Wiley & Sons
3. Howard, J.R.(Ed),(1983) Fluidized Beds: Combustion and Applications, Applied Science Publishers
4. Yates, J.G.(1983) Fundamentals of Fluidized bed Chemical Processes, Butterworths
5. Reed, T.B.,(1981) Biomass Gasification: Principles and Technology, Noyes Data Corporation

Open e-Resource:

1. NPTEL: https:// nptel.ac.in/courses/103/103/103103132

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 1st SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610112	**Subject Title:** Hydro Power Systems
Pre-requisite: Basics of thermodynamic cycles and power generation	

Course Objective:

- To understand the construction, maintenance and operation of hydro power station.
- To understand the concept and need of reservoir in hydro power station.
- To understand the use of information technology in hydro 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	0	3	70	30	00	00	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction -** Overview of Hydropower Systems — Preliminary Investigation — Determination Requirements — Preparation of Reports and Estimates — Review of World Resource Cost of Hydroelectric Power — Basic Factors in Economic Analysis of Hydropower Projects — Project Feasibility — Load Prediction and Planned Development.	9	20
2	**Development of Prototype Systems -** Advances in Planning, Design and Construction of Hydro electric Power Stations — Trends Development of Generating Plant and Machinery — Plant Equipment for Pumped Store Schemes — Some aspects of Management and Operation — Uprating and Refurbishing of turbines.	9	20
3	**Power Station Operation & Maintenance** - Governing of Water Turbines - Function of Turbine Governor - Condition for Governing stability - Surge Tank Oscillation and Speed Regulative Problem of Turbine Governing Future.	9	20
4	**Reservoirs -** Problem of Management - Maintenance of Civil Engineering Works - Maintenance of electrical Engg.Works.	9	20
5	**Information Technology in Hydropower Systems -** Development of Software .Computer Aided Hydropower System Analysis - Design - Execution – Testing - Operation and Control and Monitoring of Hydropower Services.	9	20

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

- Evaluate hydropower site potential, including preliminary studies, report preparation, economic analysis, load forecasting, and determining project feasibility for planned development.
- Plan and design hydropower installations, covering prototype station components, pumping schemes, uprating/refurbishment strategies, and mechanical/equipment selection for modern hydro plants.
- Operate and maintain hydropower systems, ensuring stability through turbine governance, surge tank analysis, and comprehensive civil and electrical maintenance of reservoirs and structures.
- Utilize IT for hydropower management, applying software tools for analysis, design, execution, testing, control, and monitoring of hydropower services.
- Integrate environmental, technical, and economic factors, managing civil and mechanical structures, optimizing performance, ensuring regulatory compliance, and supporting sustainable operation.

List of References:

1. Monition, L., M. Lenir and J. Roux,(1984) Micro Hydro Electric Power Station
2. Alen R. Inversin,(1986) Micro Hydro Power Source Book
3. Tyler G. Hicks (1988), Power Plant Evaluation and Design

Open e-Resource:

1. NPTEL: https://nptel.ac.in/courses/112107291
2. http://www.digiserve.com/inship
3. http://www.siemens.de
4. www.tva.gov/power

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 1st SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610113	**Subject Title:** Energy Generation and Waste Management
Pre-requisite: Basic understanding of environmental science and waste management principles	

Course Objective:

- To understand the sources, composition, and characteristics of various solid wastes.
- To study collection, transfer, minimization, and recycling techniques for municipal waste.
- To learn about different treatment and disposal methods including composting, incineration, and landfilling.
- To explore the management of hazardous waste and its environmental impact.
- To evaluate the potential for energy generation from waste using biochemical and thermochemical processes.

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	**Solid Waste -** Definitions; Sources and types; Composition and properties of solid waste (municipal, physical, chemical, biological); Waste collection; Transfer stations; Waste minimization and recycling.	8	18
2	**Waste Treatment -** Size reduction; Aerobic composting; Incineration – furnace types and design; Medical/pharmaceutical waste incineration; Environmental impacts and mitigation measures.	8	18
3	**Waste Disposal** - Landfill methods of solid waste disposal; Classification, types, methods, siting considerations; Layout and design of landfills; Leachate and gas generation and control; Environmental monitoring systems.	8	18
4	**Hazardous Waste Management -** Definition and identification; Sources and characteristics; Environmental impact; Control, minimization, and recycling; Hazardous site assessment; Underground tank construction, installation, and closure.	10	23
5	**Energy Generation from Waste -** Biochemical and thermochemical conversion; Sources: industrial waste, agro-residues; Anaerobic digestion, biogas production and plant types; Gasification and types of gasifiers; Briquetting and applications.	11	23

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

- Identify types and properties of solid waste and apply appropriate collection and recycling techniques.
- Analyze treatment methods and assess environmental impacts of waste processing.
- Design safe and sustainable landfill systems.
- Evaluate hazardous waste management strategies.
- Apply energy conversion technologies to recover energy from waste materials.

List of References:

1. Parker, Colin & Roberts (1985). Energy from Waste: An Evaluation of Conversion Technologies, Elsevier Applied Science.
2. Shah, Kanti L. (2000). Basics of Solid & Hazardous Waste Management Technology, Prentice Hall.
3. Manoj Datta (1997). Waste Disposal in Engineered Landfills, Narosa Publishing House.
4. Rich, Gerald et al. (1987). Hazardous Waste Management Technology, Podvan Publishers.
5. Bhide, A.D. & Sundaresan, B.B. (1983). Solid Waste Management in Developing Countries, INSDOC, New Delhi.

Open e-Resource:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc20_ch16/preview
2. NPTEL: https://nptel.ac.in/courses/103107125

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 2nd SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610232	**Subject Title:** Wind Energy Engineering
Pre-requisite: Basics of renewable energy system	

Course Objective:

- To understand measurement & instrumentation, structures and standards in the context of energy generated by windmill.
- To understand the characteristics of wind turbines and its design criteria.
- To understand the concept of wind energy storage 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	0	0	3	70	30	00	00	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Measurement and Instrumentation -** Instrumentation – Beau fort number - Gust parameters – wind type – power law index -Betz constant - Terrain value.	9	20
2	**Windmill Structures and Standards -** Energy in wind– study of wind applicable Indian standards – Steel Tables, Structural Engineering	9	20
3	**Variables in Wind Energy Conversion Systems** - Variables in wind energy conversion systems – wind power density – power in a wind stream– wind turbine efficiency – Forces on the blades of a propeller – Solidity and selection curves.	9	20
4	**Wind Turbines and Characteristics -** HAWT, VAWT– tower design-power duration curves- wind rose diagrams- study of characteristics – actuators and controls – Blade Element Theory-small wind turbines.	9	20
5	**Wind Energy Storage -** Grid-combination of diesel generator, Battery storage – wind turbine circuits- Wind farms—fatigue stress – Hybrid Systems	9	20

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

- Measure and assess wind resource parameters—including Beaufort number, gust characteristics, wind types, power-law index, Betz limit, and terrain effects—to evaluate site potential using instrumentation.
- Design structurally sound windmill systems according to Indian and international standards (e.g., IEC 61400), incorporating steel tables and structural engineering principles for towers and foundations.
- Analyze wind energy conversion variables, calculating wind power density, turbine efficiency, blade forces, solidity, and applying selection curves for optimal design decisions.
- Differentiate turbine types and performance, understanding HAWT vs. VAWT designs, tower design, power-duration curves, wind rose diagrams, actuators, controls, and small turbine blade-element theory.
- Develop wind-hybrid and storage systems, including grid-diesel-battery integration, farm-level wind circuits, fatigue analysis, and hybrid system planning for reliable energy supply.

List of References:

1. Burton , T et.al, (2011)Wind Energy Handbook,2nd Edition, John Wiley and Sons
2. Manwell, J.F. et.al,(2009)Wind Energy Explained,2nd Edition, John Wiley and Sons
3. Spera, D. A. (2009)Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, 2nd Edition, ASME Press
4. William W. Peng ,(2008)Fundamentals of turbomachinery, John Wiley and Sons
5. Mukund. R. Patel,(2006)Wind and solar power systems 2nd Edition, Taylor & Francis
6. Rao, S. & Parulekar,B. B. (2005) Energy Technology, 4th edition, Khanna publishers,
7. Anna Mani,(1990) India. Dept. of Non-conventional Energy Sources, Wind energy resource survey in India , Allied Publishers
8. IEEE Journals for Power, Energy, & Industry Applications

Open e-Resource:

1. NPTEL: https://nptel.ac.in/courses/103103206

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 2nd SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610233	**Subject Title:** Bio Energy Technology
Pre-requisite: Basics of renewable energy system	

Course Objective:

- To understand biomass and fuel conversion from it.
- To understand the phases of biogas production and combustion.
- To understand the concept of gasification, pyrolysis and carbonization.

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	**Introduction -** Biomass: types – advantages and drawbacks – Indian scenario – characteristics – carbon neutrality – conversion mechanisms – fuel assessment studies	9	20
2	**Biomethanation -** Microbial systems – phases in biogas production – parameters affecting gas production – effect of additives on biogas yield – possible feed stocks. Biogas plants – types – design – constructional details and comparison – biogas appliances – Burner, illumination and power generation – effect on engine performance.	9	20
3	**Combustion** - Perfect, complete and incomplete combustion – equivalence ratio – fixed Bed and fluid Bed combustion– fuel and ash handling – steam cost comparison with conventional fuels. Briquetting: Types of Briquetting – merits and demerits – feed requirements and pre-processing – advantages – drawbacks.	9	20
4	**Gasification -** Types – comparison – application – performance evaluation – economics – dual fuel engines – 100 % Gas Engines – engine characteristics on gas mode – gas cooling and cleaning systems.	9	20
5	**Pyrolysis and Carbonization -** Types – process governing parameters – thermo gravimetric analysis – differential thermal analysis – differential scanning calorimetry – Typical yield rates.	9	20

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

- Identify and classify biomass resources, evaluating their types, characteristics, carbon neutrality, and suitability through fuel assessment studies.
- Explain biomethanation processes, including microbial phases, feedstock selection, design of biogas plants, and performance of burners and engines using biogas.
- Analyze combustion systems and briquetting techniques, understanding complete/incomplete combustion, combustion modes, fuel handling, and cost assessments relative to conventional fuels.
- Evaluate gasification technologies, comparing fixed-bed, fluidized-bed, and dual-fuel engines; designing gas cleanup and cooling systems for optimal performance.
- Understand pyrolysis and carbonization dynamics, including process parameters, thermogravimetric/DTA/DSC analysis, and interpretation of yield data for biochar, bio-oil, and syngas.

List of References:

1. David Boyles,(1984) Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester
2. Khandelwal, K.C, Mahdi, S.S. (1986) Biogas Technology – A Practical Handbook, Tata McGraw Hill
3. Mahaeswari, R.C.(1997) Bio Energy for Rural Energisation, Concepts Publication
4. Tom B Reed,(1981) Biomass Gasification – Principles and Technology, Noyce Data Corporation, Best Practises Manual for Biomass Briquetting, I R E D A, 1997
5. Eriksson S. and M. Prior, (1990) The briquetting of Agricultural wastes for fuel, FAO Energy and Environment paper
6. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S

Open e-Resource:

1. NPTEL: https://nptel.ac.in/courses/103103206

GANDHINAGAR INSTITUTE OF TECHNOLOGY

M. TECH. 2nd SEMESTER

COMPUTER ENGINEERING (SOFTWARE ENGINEERING)

MECHANICAL ENGINEERING (THERMAL ENGINEERING/CAD-CAM)

DOC NO: 4061

Subject Code: 10000251	**Subject Title: Technical Writing (Audit Course)**
Pre-requisite: Basic Language Skills	

Course Objective:

- Technical Writing focuses on planning and preparation of word choices and sentences and focuses on vocabulary building and helps them to be an effective communicator.
- Students will be able to produce a set of documents related to writing in the workplace and will be able to improve their ability to write clearly and accurately.

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	0	0	0	50	0	0	50

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring	4	10
2	Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4	10
3	Sections of a paper – Title, abstract, introduction, etc. review of the literature, writing - methods, results, discussion, conclusions and final check	6	20
4	Organization of technical report: Title, Authors, Affiliation, Abstract,	4	20
5	Three pass reading. Effective communication– Teacher/Student perspective. Listening – Hearing Vs. Listening. Notes Taking. Elevator Pitch. Technical writing.	4	20
6	Useful phrases and punctuation, in-text citation and bibliography– MLA/APA styles	4	20

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

- Understand how to improve your writing skills and level of readability.
- Learn about what to write in each section.

- learn various skills necessary that are necessary for doing research.
- Ensure the good quality of paper at very first-time submission.

List of References:

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press ,2006
3. Raman, Meenakshi and Sangeeta Sharma, "Technical Communication: Principle and Practice", Oxford University Press.
4. Goldbort R. Writing for Science, Yale University Press, 2006

Open e-Resource:

1. https://nptel.ac.in/courses/109107172

GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 2nd SEMESTER

MECHANICAL ENGINEERING (THERMAL ENGINEERING)

DOC NO: 4061

Subject Code: 10090202	**Subject Title: Energy Management in Thermal Systems (Core-5)**
Pre-requisite: Basic of Energy	

Course Objective:

- Basic understanding of energy audit and management Conventional methods of heat exchanger analysis.
- To provide theoretical and practical knowledge of energy conservation, energy management.
- Different approaches of energy conservation in industries, economic aspects of energy conservation project and energy audit.

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	60	40	0	0	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Fuel Analysis:** Proximate Analysis, Ultimate Analysis, Calorific Value. Combustion: Theoretical Air Requirement, Efficiency Estimates, Combustion Control, Stability in Flames. **Furnaces:** Classification, Excess Air and Heat Distribution Losses, Temperature Control, Draft Control. **Insulation and Refractory:** Insulation Type and Application, Refractory-Types, Selection and Application of Refractory	10	24
2	**Boilers:** Types, Analysis of Losses, Performance Evaluation, Feed Water Treatment, Blow Down, Energy Conservation Opportunities, AFBC, CFBC, PFBC Boilers, Condensing Boilers, Saving Potential. **Steam System:** Properties of Steam, Assessment of Steam Distribution Losses, Steam Leakages, Steam Trapping, Condensate and Flash Steam Recovery System.	12	28

	Cogeneration: Need, Applications, Advantages, Topping Cycles, Bottoming Cycles, Combined Cycles, Steam Tracking Mode, Electricity Tracking Mode, Saving Potential, Case Studies.		
3	**Waste Heat Recovery:** Commercially Viable Heat Recovery Devices, Saving Potential, Case Studies, HVAC and Refrigeration System, Vapor compression Refrigeration Cycle, Refrigerants, Factors Affecting Refrigeration and Air Conditioning System Performance and Savings Opportunities. **Cooling Towers:** Types and Performance Evaluation, Efficient System Operation, Flow Control Strategies and Energy Saving Opportunities, Case Studies.	10	24
4	**Motors:** Energy Saving Opportunities in Motors, Motor Selection, Energy Efficient Motors, Speed Control of AC Induction Motors, Soft starter with energy savers, Variable Speed Drives (VFD). **Compressed Air Systems:** Types of air compressors, compressor efficiency, efficient compressor operation, compressed air systems components, capacity assessment, and leakage test, factors affecting the performance and Efficiency, energy savings opportunities. Energy Saving Opportunities in Fans & Blowers, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities	10	24

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

- Learn how to calculate heat distribution losses.
- Learn to analyze the losses, performance evaluation, feed water treatment, blow down, energy conservation opportunities.
- Become aware of different opportunity of waste heat recovery.
- Understand the compressed air systems.

List of References:

1. G. L. Witte, Phillips S.Scbmidt and Daid R. Brown, Industrial Energy Management and Utilization, Hemisphere Publishing Corporation, Washington.
2. Carig,B. Saith, Energy Management Principles, Applications, Bnefit and Saving, Per Press, New York
3. F. W. Pyne, P gm Energy Conservation Manual, Fairmont Proem, INC.P.O. Box 14227 Atlanta,GA 30224
4. D. Patrick and S.W. Fardo, Energy U-sent and Conservation, Prentice Hall, INC Engleweek Cliffs (NJ) 7632.

5. Davida , Fuels Of Opportunity , Characteristics and Uses In Combustion Systems, Edition-2004 Publisher- ELSEVIER LTD. UK
6. O.P. Gupta, Element Of Fuel Furnaces And Refractories, Edition-Second
7. Savings Electricity in Utility Systems of Industrial Plants by B.G. Desai, B.S. Vaidya D.P. Patel and R. Parman.
8. Electrical Power Distribution in Industrial Plants by M.D. Parmar.
9. Energy Conservation in Electrical Systems, a reading material prepared by D. Buddhi. Smalensky , Electrical Machines , Vol-3, MIR Publishers MOSCOW
10. Igor J. Karassik , Pump Hand Book , Third Edition 2001 , Mcgrawn-Hill
11. B.R. Gupta, Generation of Electrical Energy Edition 2005, Eurasia Publishing House (PVT.) LTD. Ram Nagar
12. National Technical Information Services U. S. Deptt. Of Commerce Springfield, VA 22161.
13. Energy Auditing, The Fairmont Press Inc. Published by Atlanta, Georgia
14. Albert Thumann, P.E., C.E.M. , Plant engineers & Managers Guide To Energy Conservation 8th edition-2002, Published By The Fairmont Press , Inc 700 Indian Trail Liburn, GA30047
15. BEE VolumeI –Second Edition 2005
16. G.G. Ranjan: Optimizing Energy Efficiencies in Industry, Edition-2003 McGraw Hill

Open e-Resource:

1. https://nptel.ac.in/courses/108106022

List of Suggested Tutorials:

1. To study analysis of fuel properties.
2. To study different types of furnace and insulations.
3. To study the different types of boilers and cogeneration method.
4. Design and analysis of waste heat recovery system.
5. Design and analysis of cooling tower.
6. To study and perform compressed air system and their efficiency.

GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 2nd SEMESTER

MECHANICAL ENGINEERING (THERMAL ENGINEERING)

DOC NO: 4061

Subject Code: 10090209	Subject Title: Research Review & Seminar
Pre-requisite: Zeal to learn	

Course Objective:

- To Learn and present the research in public to a general audience.
- Students would receive regular feedback and advice on their research projects in specific field.
- The progress of our students would be regularly monitored and they would receive formal, regular feedback.
- A high rate of participation in such a visible research-oriented activity could help build the intellectual "atmosphere" of the department.
- Increased knowledge of one another's research would facilitate intergroup interactions.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory		Practical		
Lecture	Tutorial	Practical	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	Total
0	0	6	3	0	0	0	100	100

Content:

This course will help the scholars for their dissertation phase by motivation and encouraging in quality research. Research review will help them to boost their skills and widen their horizon of thinking for the domain. Research review and seminar is a hands-on course designed to impart soft skills by the foundational methods and techniques for academic research in THERMAL engineering. Scholars will examine to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, report writing, and presentation. Once equipped with this knowledge, scholars would be well-placed to conduct disciplined research in field of THERMAL engineering. In addition to their application in an academic setting, many of the methodologies discussed in this course would be similar to those deployed in professional research environments. The details of course includes sampling techniques, research designs and techniques of analysis which will be helpful in designing of components and performing experiments in areas of THERMAL engineering Students will have a semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the latest literature available. End semester presentation should be done along with the report and the

methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution

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

1. To develop understanding of the basic framework of research review process and able to write technical report.
2. To identify various sources of information for literature review and data collection.
3. Study and develop elicit, analyze, and document skills in the form of a requirements specification.
4. Evaluate traceability between requirements, design, and implementation artefacts for the research work.
5. Develop skills to present and defend their work in front of a technically qualified audience.

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 2nd SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610201	**Subject Title:** Fuels and Combustion
Pre-requisite: Zeal to Learn	

Course Objective:

- To understand and characterize fuels by determining their properties.
- To evaluate solid and liquid fuels.
- To analyze **gaseous fuels**, covering classification, composition, calorific value estimation.
- To apply combustion stoichiometry and kinetics by different mechanisms.
- To understand the combustion equipment

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	**Charecterization -** Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination - Calorific Value - Gross & Net Calorific Values - Flue gas Analysis - Orsat Apparatus - Fuel & Ash Storage & Handling - Spontaneous Ignition Temperatures.	9	20
2	**Solid Fuels & Liquid Fuels-** Solid fuels- Types Coal Family Properties Calorific Values ROM, DMMF, DAG and Bone Dry Basis Ranking Bulk & Apparent Density Storage Washability Coking & Caking Coals Renewable Solid Fuels Biomass Wood Waste Agro Fuels Manufactured Solid Fuels. Liquid Fuels - Types Sources Petroleum Fractions- Classification Refining Properties Of Liquid Fuels Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number etc, - Alcohols and Biodiesel- Tar Sand Oil Liquefaction Of Solid Fuels.	9	20
3	**Gaseous Fuels** - Classification Composition & Properties Estimation Of Calorific Value Gas Calorimeter. Rich & Lean Gas Wobbe Index Natural Gas Dry & Wet Natural Gas Stripped NG Foul & Sweet NG LPG CNG Methane Producer Gas - Gasifiers Water Gas Town Gas Coal Gasification Gasification Efficiency Non-Thermal Route Biogas Digesters Reactions Viability Economics.	9	20

4	**Combustion Stoichiometry & Kinetics** - Stoichiometry Mass Basis & Volume Basis Excess Air Calculation Fuel & Flue Gas Compositions Calculations Rapid Methods Combustion Processes Stationary Flame Combustion Explosive Combustion. Mechanism Of Combustion Ignition & Ignition Energy Spontaneous Combustion- Flame Propagation Solid, Liquid & Gaseous Fuels Combustion Flame Temperature Theoretical, Adiabatic & Actual Ignition Limits Limits Of In flammability.	9	20
5	**Combustion Equipments -** Coal Burning Equipments Types Pulverized Coal Firing Fluidized Bed Firing Fixed Bed & Recycled Bed Cyclone Firing Spreader Stokers Vibrating Grate Stokers Sprinkler Stokers, Travelling Grate Stokers. Oil Burners Vaporizing Burners Air Aspiration Gas Burners, Burners Classification-Flame Structures Factors Affecting Burners & Combustion	9	20

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

- Characterize solid, liquid, and gaseous fuels via proximate/ultimate analysis, calorific value, ignition temperature, and flue-gas composition.
- Select and evaluate solid/liquid fuels—coal, biomass, petroleum fractions, biodiesel, alcohol—based on density, storage, and quality (flash point, octane/cetane).
- Analyze gaseous fuels like natural gas, LPG/CNG, producer gas, biogas—assessing composition, calorific value, Wobbe index, and system economics.
- Apply combustion stoichiometry and kinetics to compute air/fuel ratios, flame temperatures, efficiencies, flame propagation, ignition energy, and flammability limits.
- Design and assess combustion systems, including coal, oil, and gas burners, flame structure, and emission controls for industrial use.

List of References:

1. Samir Sarkar,(1990) Fuels & Combustion, 2nd Edition, Orient Logman,latest Edition
2. Bhatt,Vora(1984) Stoichiometry,2nd Edition, tata Mcgraw Hill
3. Blokh AG,(1988) Heat Transfer in Steam Boiler Furance, Hemisphere Publishing Corpn
4. Civil Davies, (1966) Calculations in Furnace Technology, Pergamon Press, Oxford
5. Sharma SP,Mohan Chander, (1984) Fuels & Combustion, Tata Mcgraw Hill**Open e-Resource:**

1. NPTEL: https:// nptel.ac.in/courses/103/105/103105110

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 2nd SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610211	**Subject Title:** Battery and Fuel Cells
Pre-requisite: Zeal to Learn	

Course Objective:

- To learn the working principle of various batteries and fuel cells and its 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	0	3	70	30	00	00	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Batteries -** Battery -Storage Cell Technologies-Storage cell fundamentals-Characteristics- Emerging trends in batteries.	9	20
2	**Ttpes of Batteries-** Specifications - Storage cell definitions & specifications, Carbon-zinc & alkaline cells, Mercury, zincair, & silver oxide button cells, Lead acid, Edison, Nicad & Nimh cells, Lithium technology	9	20
3	**Applications of Batteries** - Applications- Storage cell summary, Applications of storage cell- Industrial Applications.	9	20
4	**Fuel Cells -** Fuel cell fundamentals, The alkaline fuel cell, Acidic fuel cells, SOFC- Emerging areas in Fuel cells	9	20
5	**Fuel Cell Applications -** Fuel cell outlook, Sources, comments, & revision history, Applications Industrial and commercial.	9	20

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

- Understand the fundamentals and emerging trends in batteries.
- Understand the different types of batteries.
- Understand the application of batteries in industry.
- Understand and learn the fundamentals of fuel cells.
- Understand the commercial as well as industrial application of fuel cells.

List of References:

1. Hand Book of Batteries and Fuel cells, 3rd Edition, Edited by David Linden and Thomas. B. Reddy, McGraw Hill Book Company, N.Y. 2002.
2. Principles of Fuel Cells, by Xianguo Li, Taylor & Francis, 2006.
3. Fuel Cells, Principles and Applications, Viswanathan, B. and Scibioh, Aulice M, Universities Press, 2006.

Open e-Resource:

1. NPTEL: https://nptel.ac.in/courses/113105102

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 2nd SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610212	**Subject Title:** Energy Efficient buildings
Pre-requisite: Zeal to Learn	

Course Objective:

- To learn the energy efficient building, energy audit in building and the landscape elements for energy conservation.

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	**Introduction -** Architecture- Building Science and its significance. Indoor Environment. Components of Indoor Environment. Quality of Indoor Environment.	9	20
2	Human Comfort-Thermal, Visual, Acoustical and Olfactory comfort. Concept of Sol-air temperature and its significance. Ventilation and is significance.	9	20
3	Cooling and heating concepts, Passive concepts appropriate for the various climatic zones in India. Classification of building materials based on energy intensity.	9	20
4	Energy Management of Buildings and Energy Audit of Buildings. - Energy management matrix monitoring and targeting.	9	20
5	Energy Efficient Landscape Design -Modification of microclimate through landscape elements for energy conservation.	9	20

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

- Explain core building science principles, covering architecture, indoor environment components, and the significance of sol–air temperature and ventilation for occupant comfort.
- Assess human comfort factors, including thermal, visual, acoustic, and olfactory aspects, and their influence on indoor environmental quality.
- Evaluate passive heating and cooling strategies, applying climate-specific passive design methods and selecting building materials based on embodied energy for various Indian zones.

- Conduct building energy management, including energy audits, monitoring & targeting using energy management matrices to optimize operational efficiency.
- Design energy-efficient landscapes, leveraging microclimate modification through strategic planting and landscape elements to reduce building energy demand..

List of References:

1. Bureau of Indian Standards, I.S. 11907 –1986 Recommendations for calculation of Solar Radiation Buildings, 1986.
2. Givoni,B., ”Man, Climate and Architecture”, Elsevier, Amsterdam, 1986.
3. Smith, R. J., Phillips, G.M. and Sweeney, M. “Environmental Science”, Longman Scientific and Technical, Essex, 1982.

Open e-Resource:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc23_ce51/preview

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 2nd SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610213	**Subject Title:** Nuclear Energy Technology
Pre-requisite: Zeal to Learn	

Course Objective:

- To understand basic nuclear reactions, nuclear fuel cycles and materials.
- To Understand reprocessing process.
- To understand the separation of reactor products, waste disposal and radiation 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	0	3	70	30	00	00	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Nuclear Reactions -** Mechanism of Nuclear Fission and Fusion - Nuclides - Radioactivity - Decay Chains – Neutron Reactions - the Fission Process - Reactors - Types of Fast Breeding Reactors - Design and Construction of Nuclear reactors - Heat Transfer Techniques in Nuclear Reactors - Reactor Shielding.	9	20
2	**Nuclear Fuel Cycles & Materials -** Nuclear Fuel Cycles - Characteristics of Nuclear Fuels - Uranium - Production and Purification of Uranium - Conversion to UF4 and UF6 - Other Fuels like Zirconium Thorium - Berylium	9	20
3	**Reprocessing** - Nuclear Fuel Cycles - Spent Fuel Characteristics - Role of Solvent Extraction in Reprocessing – Solvent Extraction Equipment.	9	20
4	**Seperation of Reactor products -** Process to be Considered - Fuel Element Dissolution - Precipitation Process - Ion Exchange - Redox - Purex - TTA - Chelation - U235 - Hexone - TBP and Thorax Processes - Oxidative Slaging and Electrochemical refining - Isotopes - Principles of Isotope Separation	9	20
5	**Waste Disposal and Radiation protection -** Types of Nuclear Wastes — Safety Control and Pollution Control and Abatement — International Convention on Safety Aspects — Radiation Hazards Prevention.	9	20

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

- Explain nuclear fission/fusion and reactor operations, including decay chains, neutron reactions, heat transfer, and radiation shielding methods.
- Describe nuclear fuel cycles and materials, from uranium production and conversion to alternative fuels like thorium, zirconium, and beryllium.
- Evaluate spent fuel reprocessing processes, emphasizing solvent extraction (e.g., PUREX), equipment, safety, and the economics of material recovery.
- **Apply separation techniques for reactor outputs**, including fuel dissolution, ion exchange, chelation, electrochemical refining, and isotope separation.
- **Assess nuclear waste disposal and radiation protection**, covering waste classification, safety controls, pollution abatement, and compliance with international safety standards.

List of References:

1. Lamarsh, J.R.(1966) Introduction to Nuclear Reactor Theory, Wesley
2. Duderstadt, J.J. and Hamilton, L.J. (1976) Nuclear Reactor Analysis John Wiley
3. Walter, A.E. and Reynolds, A.B.(1981) Fast Breeder Reactors, Pergamon Press
4. Glasstone, S. and Sesonske, A. (1981) Nuclear Reactor Engineering (3r Edition), Von Nostrand
5. Winterton, R.H.S. (1981) Thermal Design of Nuclear Reactors—Pergamon Press

Open e-Resource:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc21_me54/preview

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 2nd SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610221	**Subject Title:** Environmental Engineering and Pollution Control
Pre-requisite: Zeal to Learn	

Course Objective:

- To learn the different environmental pollution, its causes and effect.
- To protect human health and the environment by preventing and mitigating pollution.
- To create a sustainable environment that supports both human well-being and ecological balance.

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	**Introduction -** Global atmospheric change green house effect Ozone depletion, natural cycles, mass and energy transfer material balance environmental chemistry and biology impacts environmental. Legislations	9	20
2	**Air Pollution-** Pollutants, sources and effect air pollution meteorology atmospheric dispersion indoor air quality, control methods and equipments, issues in air pollution control air sampling and measurement.	9	20
3	**Water Pollution** - Water resources, water pollutants, characteristics quality, water treatment systems waste water treatment, treatment, utilization and disposal of sludge, Monitoring compliance with standards	9	20
4	**Waste management -** Sources and Classification Solid waste Hazardous waste, Characteristics, Collection and Transportation, Disposal Processing and Energy Recovery Waste minimization	9	20
5	**Other types of pollution from industries -** Noise pollution and its impact, oil pollution , pesticides, instrumentation for pollution control, water pollution from tanneries and other industries and their control environment impact assessment for various projects case studies..	9	20

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

- **Describe** major atmospheric processes, greenhouse effect, ozone depletion, natural cycles and assess their environmental chemistry and biological impacts.

- **Identify** sources and effects of air pollutants; learn sampling, dispersion, indoor air quality, and control technologies.
- Analyze water pollution types and water treatment methods, including wastewater systems, sludge management, and quality monitoring.
- **Evaluate** solid and hazardous waste generation, collection, transportation, disposal, treatment, energy recovery, and minimization techniques.
- Apply legislation and impact assessment tools to industrial pollution (noise, oil, pesticides, tanneries), with environmental policy and case study insights.

List of References:

1. Masters, G. (2003) Introduction to Environmental Engineering and Science, Prentice Hall of India Pvt Ltd
2. Rao, C .S.(2006) Environmental Pollution Control Engineering, 2nd Edition, New AgeInternational Publishers.
3. Ludwig, H., Evans, W (1991) Manual of Environmental Technology in Developing Countries, International Book Company, Absecon Highlands
4. Arcadio P Sincero and Sincero, G. A.(2002) Environmental Engineering A Design Approach, Prentice Hall of India Pvt Ltd

Open e-Resource:

1. NPTEL: https://nptel.ac.in/courses/103107084

GANDHINAGAR UNIVERSITY

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

M.TECH 2nd SEMESTER

MECHANICAL ENGINEERING (ENERGY ENGINEERING)

DOC NO: 4061

Subject Code: 11610231	**Subject Title:** Alternative Fuels
Pre-requisite: Knowledge of Fuels	

Course Objective:

- Gain a working understanding of the engineering issues and perspectives affecting fuel and engine development.
- Examine future trends and development, including hydrogen as an internal combustion engine fuel.
- Explore further fuel specification and performance requirements for advanced combustion 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	0	3	70	30	00	00	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction -** Availability, Suitability, Properties, Merits and Demerits of Potential Alternative Fuels Ethanol, Methanol, Diethyl ether, Dimethyl ether, Hydrogen, Liquefied Petroleum Gas, Natural Gas, Bio-gas and Bio-diesel.	12	26
2	**Liquid Fuels for S.I. Engine-** Requirements, Utilisation techniques Blends, Neat form, Reformed Fuels, Storage and Safety, Performance and Emission Characteristics.	9	20
3	**Liquid Fuels for C.I. Engine** - Requirements, Utilisation techniques - Blends, Neat fuels, Reformed fuels, Emulsions, Dual fuelling, Ignition accelerators and Additives, Performance and emission characteristics.	8	18
4	**Gaseous Fuels for S.I. Engine -** Hydrogen, Compressed Natural gas, Liquefied Petroleum gas, and Bio gas in SI engines Safety Precautions Engine performance and emissions.	8	18
5	**Gaseous Fuels for C.I. Engine -** Hydrogen, Biogas, Liquefied Petroleum gas, Compressed Natural gas in CI engines. Dual fuelling, Performance and emission characteristics.	8	18

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

- Understand the availability, sustainability and properties of different alternative fuels.
- Understand and classify liquid fuels of S.I and C.I. engine.
- Understand and classify gaseous fuels of S.I. and C.I.engine.

List of References:

1. Osamu Hirao and Richard K Pefley, Present and Future Automotive Fuels, John Wiley and Sons,1988
2. Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE Publications,1990.
3. Automotive Lubricants Reference Book,

Open e-Resource:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc23_me31/preview
2. NPTEL: https://onlinecourses.nptel.ac.in/noc24_hs77/preview

GANDHINAGAR UNIVERSITY

GANDHINAGAR INSTITUTE OF TECHNOLOGY

Master of Technology

Energy Engineering

Subject Code: 1011610301	**Subject Title:** Internal Review-1
Pre-requisite: --	

Course Objective:

1. Initiate independent research through systematic literature review.
2. Identify research problems and formulate a relevant dissertation topic.
3. Align topics with emerging research trends in the respective field.
4. Conduct in-depth analysis and review of existing methods.
5. Establish a structured research foundation for further dissertation development.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
0	0	4	2	0	0	0	100	100

Course Outcomes (COs):

Upon successful completion of this course, students will be able to:

1. Understand the chosen research topic and define its relevance and associated challenges.
2. Identify and interpret quality literature from reputed journals to validate the problem statement.
3. Conduct a comparative review of existing methods and highlight research gaps or scope for improvement.
4. Evaluate previous approaches using relevant datasets and appropriate performance metrics.
5. Propose a hypothesis or research direction with suitable algorithms, methods, or modeling approaches.

Course Structure and Work Plan

- Week 1–2: Finalization of research domain and title approval in consultation with guide.
- Week 3–5: Extensive literature survey (minimum 20 papers, including 10 recent journal articles).
- Week 6–8: Identification of research gaps and statement of problem.
- Week 9–11: Comparative analysis of existing methodologies.
- Week 12–14: Initial data collection, feasibility study or conceptual framework.
- Week 15–16: Preparation of draft report and internal presentation.

Deliverables:

1. Synopsis/Concept note approved by faculty guide
2. Literature review summary with annotated bibliography
3. Problem statement and research objectives

4. Comparative analysis table or benchmarking matrix
5. Internal presentation before a departmental review panel
6. Progress report (typed and signed by guide)

Evaluation Components:

Component	Weightage (Marks)
Literature Review Quality	15
Clarity of Problem Statement	10
Identification of Research Gap	10
Comparative Analysis / Review Matrix	10
Presentation and Communication	15
Viva by Panel / Review Committee	40
Total	**100**

GANDHINAGAR UNIVERSITY

GANDHINAGAR INSTITUTE OF TECHNOLOGY

Master of Technology

Energy Engineering

Subject Code: 1011610302	**Subject Title:** Dissertation Phase-1
Pre-requisite: --	

Course Objective:

1. To enable students to independently identify, analyze, and define a research problem in their chosen engineering domain, applying relevant analytical and/or experimental methodologies.
2. To conduct a comprehensive literature review, establish research objectives, define the scope, and outline the preliminary work for the dissertation project.
3. To facilitate the development of a structured research report, documenting the findings, methodology, and analysis, while proposing solutions and future work based on the project's results.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
0	0	28	14	0	0	100	0	100

Course Outcomes (COs):

Upon successful completion of this course, students will be able to:

1. Choose a domain of project work related to their engineering specialization.
2. Discover appropriate literature and define the objectives & scope of the project work.
3. Solve the designated problem through analysis, design, and/or experimentation.
4. Create and discuss the project report.

Syllabus:

The Dissertation Phase-1 is designed to train students in independently analyzing and addressing problems in their engineering field. The project may involve analytical and/or experimental work, focusing on the latest advancements in the chosen engineering domain.

The project report should include:

- Objective of study and scope of work.
- Critical literature review related to the project.
- Preliminary work conducted in the domain, including analytical and/or experimental components.

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GANDHINAGAR INSTITUTE OF TECHNOLOGY

Master of Technology

Energy Engineering

Subject Code: 1011610401	**Subject Title:** Internal Review-2
Pre-requisite: --	

Course Objective:

1. Initiate students into independent research with a focus on data collection, evaluation, and hypothesis testing.
2. Guide students in applying methodologies, validating solutions, and evaluating performance.
3. Enable students to communicate research outcomes effectively.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
0	0	4	2	0	0	0	100	100

Course Outcomes (COs):

Upon successful completion of this course, students will be able to:

1. Apply ethical standards in data collection and analysis.
2. Test and validate hypotheses using qualitative/quantitative methods.
3. Evaluate methodologies and solutions using performance metrics.
4. Analyze experimental data and derive meaningful conclusions.
5. Present and communicate research outcomes clearly.

Course Structure and Work Plan

- Week 1–2: Complete data collection and hypothesis testing.
- Week 3–6: Validate methodology and perform comparative analysis.
- Week 7–9: Analyze experimental data and finalize conclusions.
- Week 10–12: Prepare final report and presentation.

Deliverables:

1. Final Research Report: Document methodology, analysis, results.
2. Presentation Slides: Showcase research findings and methodology.
3. Experimental Data: Include experiments, analysis, and performance evaluation.
4. Internal Presentation: Final presentation for internal review.

Evaluation Components:

Component	Weightage (Marks)
Literature Review & Problem Statement	20
Hypothesis & Methodology Validation	25
Experimental Work & Data Analysis	30

Final Report & Presentation	25
Total	**100**

GANDHINAGAR UNIVERSITY

GANDHINAGAR INSTITUTE OF TECHNOLOGY

Master of Technology

Energy Engineering

Subject Code: 1011610402	**Subject Title:** Dissertation Phase-2
Pre-requisite: --	

Course Objective:

1. Independently execute the identified research problem, applying advanced analytical and experimental methodologies.
2. Design a comprehensive experimental or simulation setup to validate the research hypothesis.
3. Complete a detailed analysis of the results, interpret the findings, and propose future work based on the outcomes.
4. Prepare a final dissertation report summarizing the work conducted, methodologies used, and outcomes achieved.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
0	0	28	14	0	0	100	0	100

Course Outcomes (COs):

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

1. Select and define a research problem relevant to their field of specialization.
2. Conduct a thorough literature review and establish clear research objectives and scope.
3. Apply suitable analytical, design, or experimental methods to solve the research problem.
4. Compile a comprehensive project report detailing methodology, analysis, conclusions, and recommendations.

Syllabus:

This phase of the dissertation is a continuation of Dissertation Phase-1, where students will:

- Carry forward the preliminary work from Phase-1, refining the problem statement, objectives, and scope.
- Implement advanced methodologies for research, including data collection, modeling, simulation, or experimental setup.
- Analyze data from experiments or simulations and interpret the results within the context of the research problem.
- Propose solutions based on the findings, along with future work recommendations.
- Document the entire research process in a structured dissertation report.