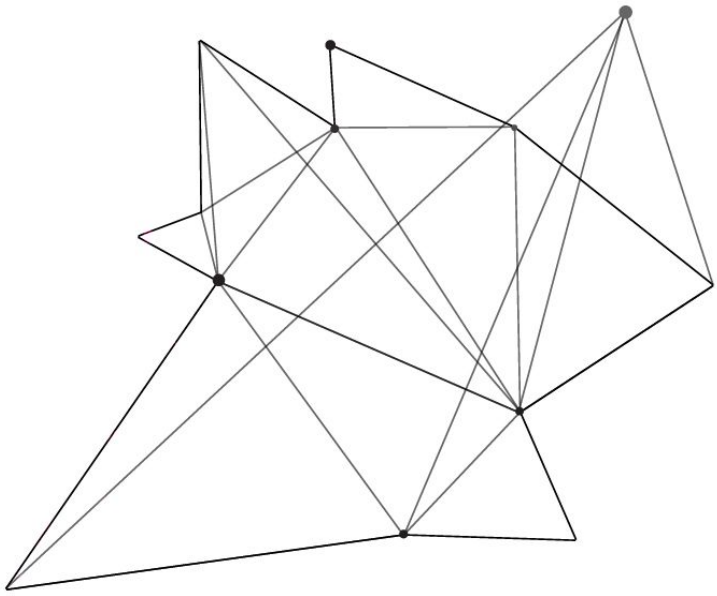
(DEEMED TO BE UNIVERSITY)

CATEGORY 1 UNIVERSITY BY MHRD, Govt. of India

KL ACCREDITED BY NAAC WITH A++ GRADE

nirf 2024 NATIONAL INSTITUTIONAL RANKING FRAMEWORK RANKED 22 AMONG ALL UNIVERSITIES

44 YEARS OF EDUCATIONAL LEADERSHIP



MASTER OF TECHNOLOGY

THERMAL ENGINEERING

PROGRAM HANDBOOK 2024

For Students Admitted in Academic Year 2024-25

(DEEMED TO BE UNIVERSITY)

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This Program Handbook is approved in

XLI Academic Council, dated: 18/06/2024

Dr. T. Vijaya Kumar	Prof. Hari Kiran Vege
BoS chairman	Dean (Addl.) Academics

Dr. K Raja Sekhar Rao	Dr. G.P.Saradhi Varma	Dr. K. Subba Rao
Pro-VC Academics	Vice Chancellor	Registrar

VISION

To be a globally renowned university.

MISSION

To impart quality higher education and to undertake research and extension with emphasis on application and innovation that cater to the emerging societal needs through all-round development of students of all sections enabling them to be globally competitive and socially responsible citizens with intrinsic values.


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AWARDS

Koneru Satyanarayana,

Chancellor

Sri Koneru Satyanarayana, BE, FIE, FIETE, MIEEE graduated in Electronics and Communication Engineering in the year 1977. Along with Sri Koneru Lakshmaiah, he is the co-founder of the Institute which was established in the year 1980. He is an educationist of eminence and also an industrialist of great repute. He runs a number of industries in and around Vijayawada.

Dr. K S Jagannatha Rao

Pro Chancellor

Prof. K. S. Jagannatha Rao was one of the leading scientists in neuroscience research in globe. He was the Director on Institute for Scientific Research and Technological Advances (INDICASAT AIP), Republic Panama and contributed lot in building innovation in higher education and research in Panama since 2010. He played a key role in building PRISM (Panamanian Research Institutes of Science and Medicine) in Latin America. Dr. Rao has his research area on Brain Research and established Alzheimer's Centre and published 165 papers in leading Biochemistry and Neuroscience Journals, supervised 19 Ph.D students. He is also adjunct faculty of Biomedical Informatics of UTHS, Houston, and Advisory Board Member of UT- El Paso Minority Health NIH program, USA and Adjunct Faculty, Methodist Research Institute, Houston, USA. He was elected Member of Panamanian Association for the Advancement of Science (APANAC) - Considered as National Science Academy of Panama. He received his undergraduate and Ph.D degrees from Sri Venkateswara University, Tirupati. Later, joined in Central Food Technological Research Institute, Mysore. He received Sir C. V. Raman Award by Karnataka State Council of Science and Technology, 2003.

Prof. G P S Varma

Vice Chancellor

Prof. G P S Varma, Vice-Chancellor, KLEF, is one of the most widely experienced leaders in Indian higher education, known for his commitment to expanding student opportunity, catalyzing academic innovation, and encouraging university's civic engagement and service to society. He adorned the position of Chairman, ISTE (Indian Society for Technical Education)- AP State, TSEMCET Test Committee Member-2021 nominated By Telangana State Govt, APEAMCET Admission Committee Member in 2016 by Andhra Pradesh State Council of Higher Education, Govt. of Andhra Pradesh. He has been a very farsighted Peer Team Visit Member for National Assessment and Accreditation Council (NAAC), Expert Committee Member for University Grants Commission (UGC) Autonomous Visits. He has been an Advisory Council Member for (CEGR) Centre for Education Growth, and Research India International Centre, New Delhi, and Board Member for Big-Data Analytics Forum.

Dr. K Rajasekhara Rao

Pro-Vice Chancellor

Dr. Kurra Rajasekhara Rao, Pro-Vice Chancellor is a professor of Computer Science and Engineering (C.S.E.) having more than 35 years of teaching and research as well as administrative experience. His current research interests include topics related to Embedded Systems, Software Engineering, Software Testing, Data Sciences, Image Processing and Knowledge Management. He has authored a book and has more than 240 research publications in various International/National Journals and Conferences. Dr. KRR is a recognized as 'Research Guide' in many reputed universities and 32 doctorates were awarded under his guidance till now.

Prior to this, he discharged duties in various organizations, as a Director, Usha Rama College of Engineering & Technology (Autonomous), Telaprolu, A.P, Director, Sri Prakash College of Engineering (SPCE), Tuni and as a faculty member in various positions in KLCE/K.L.University, Andhra Pradesh for over 20 years. He contributed as a Member in Board of Studies for CSE & IT, at various prestigious institutions like Acharya Nagarjuna University, Krishna University, Sree Vidyaniketan Engineering College, Tirupathi and Bapatla Engineering College, Bapatla. He extended his services to K.L. University as Member in Board of Management, Dean's Council, Academic Council, Standing Committee, Research Board & Board of Studies [CSE].

Dr. KRR' s outstanding contributions have been honoured by various organizations. He received the "Patron Award" from Computer Society of India (CSI), India's prestigious professional society in the years 2011 (Ahemadabad) and 2020 (Bhuvaneswar). Recognising his administrative capabilities, Association of Scientists, Developers and Faculties (ASDF) through Puducherry CM honoured him with the "Best Dean" award in the year 2012. He was felicitated with the "Aacharya Ratna" from Indian Servers, IMPACT and Lions Club in the year 2019. Received "Bhishmacharya" Award in 2022 by Bharath Educational Excellence Awards. He got honoured as "Global Faculty" by AKS Education awards in 2023 and "Lifetime Achievement Award" by AIMER Society for the year 2024.

Dr. N Venkatram

Pro-Vice Chancellor

Dr. Venkatram Nidumolu, Pro-Vice Chancellor is High performing, strategic thinking professional with more than 15years of administration experience and 20 years of teaching experience in KLEFand 30 years overall experience in the higher education sector. He graduated in B.Tech (ECE) from Acharya Nagarjuna University, pursued M.S degree from BITS, PILANI in software Systems. He received Ph.D award from Acharya Nagarjuna University. He held the positions like HOD, Joint Register, Principal, and Dean-Academics before becoming Pro-Vice Chancellor. He was core member of all NBA, NAAC, & other accreditations since 2004 and he has good experience in handling of quality issues and assessment related practices.

Dr. A V S Prasad

Pro-Vice Chancellor

Dr. A. V. S. Prasad, M.E and Ph.D from JNTU, Hyderabad is a professor in Civil Engineering. He has a rich experience of 33 years in academics which includes 26 years in administration at various cadres ranging from Head of Department, Dean, Principal, Director and Pro-Vice Chancellor. He has served as Director of Audisankara group of institutions and Narayana Group of Institutions for 18 years and was instrumental in getting these institutions accredited by NAAC, NBA, Autonomous and gained many laurels from the State Government, JNTU etc. He has served as Pro-Vice Chancellor of KL University for 3 years.

He has extensive knowledge of administrative system, maintaining statutory norms of bodies like AICTE, UGC etc and has a good understanding of NBA, NAAC procedures and norms. He served as Member, Chairman of Board of Studies at JNTU(A), KLCE(Autonomous) and KL University.

OFFICE OF DEAN ACADEMICS

Hari Kiran Vege
Dean (Addl) Academics

Dr. V N Sailaja
Associate Dean Academics
(Curricular Aspects)

Dr. P Kasi Visweswara Rao
Associate Dean Academics
(Curricular Aspects)

Dr. M Kameswara Rao
Associate Dean Academics
(Academic Registrations)

Dr. M Venkata Naresh
Associate Dean Academics
(Strategic Planning & Policy Making)

Dr. K Uday Kiran
Associate Dean Academics
(Academic Registrations)

Dr. N V K Ramesh
Associate Dean Academics
(Teaching & Learning Process)

Dr. Padmanabhan K
Associate Professor, CSE

Dr. Aravindhan Alagarsamy
Associate Dean Academics
(Teaching & Learning Process)

Dr. B Chaitanya Krishna
Associate Dean Academics
(OBE & Evaluation)

Dr. S Balaji
Associate Dean Academics
(Off-campus Operations)

Dr. E Vamsidhar
Associate Dean Academics
(OBE & Evaluation)

Dr. P Vidya Sagar
Associate Dean Academics
(Projects, Academic Research & Internships)

Mr. A Gopi
Assistant Dean Academics
(Projects, Academic Research & Internships)

Dr. Fazal Noor Basha
Associate Dean Academics
(Academic Counselling)

Dr. M Latha
Associate Dean Academics
(Academic Counselling)

Dr. A S Chandra Sekhara Sastry
Controller of Examinations

Dr. Ch V Ramana Murthy
Addl. Controller of Examinations

Dr. Chakka Raghava Prasad
Addl. Controller of Examinations

Dr. Chetty Manna Sheela Rani
Addl. Controller of Examinations

Dr. Sreevardhan Cheerla
Addl. Controller of Examinations

Dr. Kallakunta Ravi Kumar
Addl. Controller of Examinations

Dr. M V V K Srinivas Prasad
Asst. Controller of Examinations

Dr. Kallipalli Venkata Raju
Addl. Controller of Examinations

COLLEGE OF ENGINEERING

Dr. T K RAMA KRISHNA RAO
Principal - College of Engineering

Dr. V KRISHNA REDDY
Principal- Freshman Engineering Department

Dr. TADIKONDA VIJAYA KUMAR
Head of the Department
Mechanical Engineering

Dr. V VISWANATH SHENOI
Head of the Department
Integrated Research & Discovery

Dr. K NARASIMHA RAJU
Head of the Department
Multi-disciplinary Innovation & Entrepreneurship

Dr. ASWIN KUMER S V
Head of the Department
Experiential Learning & Global Engagement

Dr. K V DURGA RAJESH
Alternate HoD

Dr. T KANTHIMATHI
Academic Professor Incharge

ABOUT THE DEPARTMENT

Department of Mechanical Engineering

The Department of Mechanical Engineering at K L E F (Deemed to be University), was one of the initial departments established, aiming to provide high-quality education in engineering and technology with a focus on industry-oriented training and skill development since the establishment of Koneru Lakshmaiah College of Engineering in 1980. The department boasts a team of highly distinguished faculty members with expertise across a variety of specialized fields in mechanical engineering, including Thermal fluids, Solar Energy, Alternate fuels, Engineering Design, Condition Monitoring, Finite Element Analysis, Smart manufacturing, Robotics & Mechatronics, Industrial Engineering. The Department of Mechanical Engineering offers a range of undergraduate, postgraduate and Doctoral programs designed to equip students with the skills and knowledge required in today's industry and academics.

- B.Tech in Mechanical Engineering
- M.Tech in Thermal Engineering
- M.Tech in Machine Design
- M.Tech in Mechanical Engineering
- Ph.D program

The department enjoys DST-FIST sponsorships, receiving a grant of Rs. 65 lakhs from the Department of Science and Technology, Govt. of India, New Delhi. Our department is funded by DST with 3.2 Cr for the establishment of CSDCM excellence center. Our prolific research output includes over 1082 publications in prestigious international journals with high impact factors. Scopus H-Index of the department is 36 and WOS H-Index is 22.

Our academic structure is divided into three primary cohorts:

Engineering Design, Energy & CFD and Smart Manufacturing. Students can pursue any specialization across the university by meeting the prerequisite requirements, reflecting our meticulous implementation of the NEP 2020. Our department boasts NBA accreditation for five years. Notably, our faculty is composed with 95% of doctorate holders, including postgraduates, Ph.D.s, and post-doctoral researchers from prestigious institutions such as IISc, IITs, and NITs. This underscores our unwavering commitment to excellence in teaching and research.

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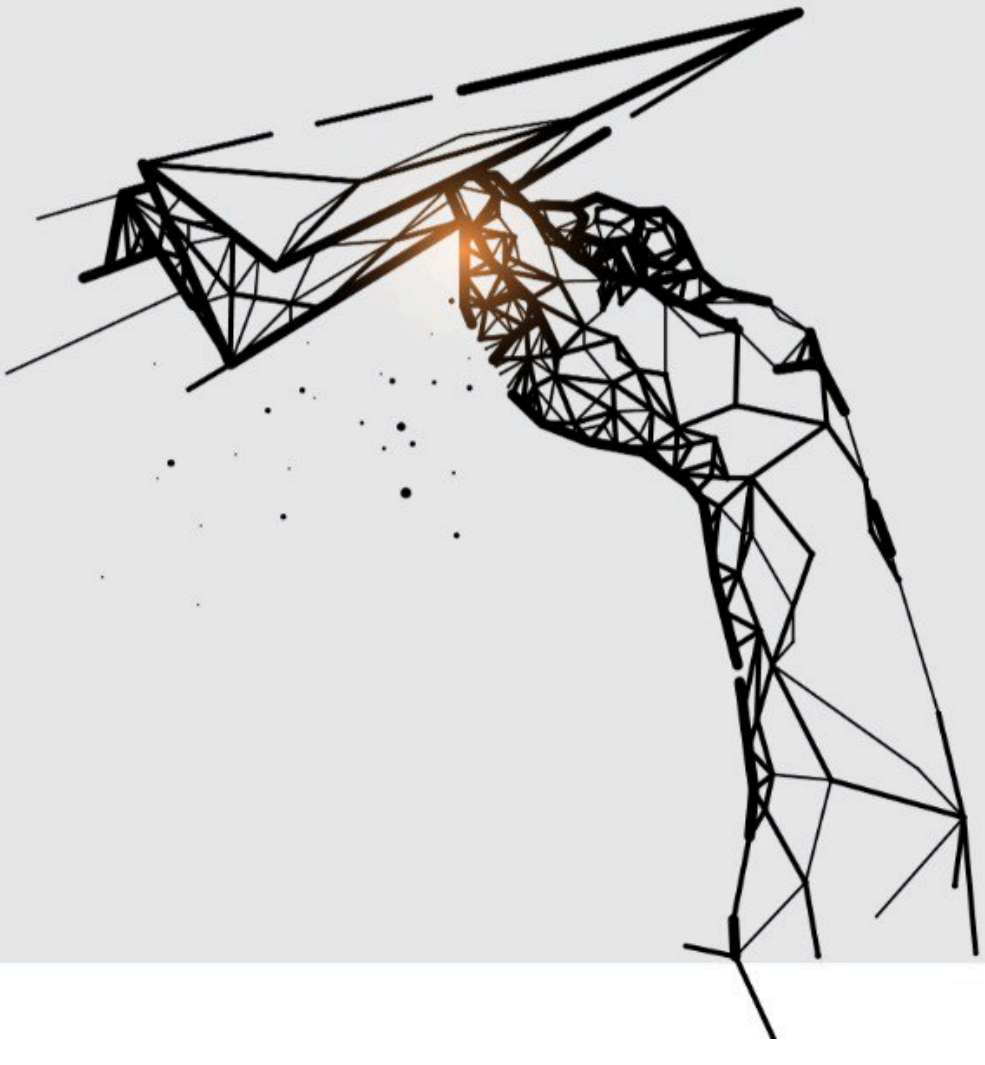
VISION

To be a globally renowned leader in education, research and extension activities in emerging areas of mechanical engineering and allied fields.

MISSION

Training the leaders, innovators and outstanding career professionals of tomorrow and conducting fundamental research to address major technological roadblocks.



Y24: M.Tech. - Thermal Engineering

Program Handbook

Program Educational Objectives (PEOs)

PEOs

PEO	PEO Description
1	To mould the students to become effective global science students in the competitive environment of modern society.
2	To provide students with strong foundation in contemporary practices of science, different functional areas and scientific environment
3	To emphasize on application-oriented learning.
4	To develop communication, analytical, decision-making, motivational, leadership, problem solving and human relations skills of the students.
5	To inculcate professional and ethical attitude in students.
6	To pursue lifelong learning as a means of enhancing knowledge and skills necessary to contribute to the betterment of profession

Program Outcomes & Program Specific Outcomes (PO & PSO)

PO & PSO

PO/PSO	PO/PSO Description
PO1	Advanced knowledge of a broad range of modelling methodologies, and underlying principles of mechanics, commonly used in the development and analysis of mechanical machines and systems.
PO2	Knowledge of fundamental design issues relevant to machine or mechanical component, and an understanding of how to formulate and analyse design solutions in various engineering contexts.
PO3	Working knowledge of a range of modern mathematical methods and tools used in the development and analysis of machines and mechanical systems.
PO4	In-depth knowledge of one or more of the following (depending of selection of option modules and project area): specific engineering systems, design methods, modelling techniques, mathematical and/or numerical techniques.
PO5	Knowledge of basic research and development principles and practices relevant to mainstream engineering industry.
PO6	Knowledge of key professional, safety and ethical issues arising in modern engineering industry.
PO7	Knowledge of time-management and work planning issues related to the organisation, implementation and successful completion, including reporting, of an individual, Masters level, engineering based project.

Program Rules & Regulations

Admission Eligibility Criteria

Bachelor's Degree in the relevant Engineering Program with a minimum of 60% aggregate marks (or) equivalent CGPA.

Program Structure and Curriculum

For each academic program, the curriculum serves as a framework that specifies the credits, course category, codes, titles, and delivery methods (Lectures, Tutorials, Practice, Skills, Projects, Self-Study, Capstone Design, etc.) under the **Choice-Based Credit System (CBCS)**. The curriculum is designed, implemented, and assessed following the **Outcome-Based Education (OBE)** framework.In designing the curriculum, we ensure the integration of key contemporary and traditional values by embedding Indian Knowledge Systems (IKS), Sustainable Development Goals (SDGs), and Design Thinking principles into courses at their inception.

- Each **Academic Year** consists of two regular semesters, each approximately 20 weeks including classwork and exams:
    - **Odd Semester:** July to December
    - **Even Semester:** December to May
- A **Summer Term** may be offered from May to June but is not considered a regular semester for calculating program duration.
- Students have the flexibility to choose courses as prescribed by KLEF.
- Each course has a **Lecture-Tutorial-Practice-Skill (L-T-P-S)**component.

Course Credit Structure:

Credits are allocated to courses based on the **L-T-P-S** structure:

- Every **Lecture** or **Tutorial** hour equals **1 credit**.
- Every **Practical** hour equals **0.5 credits**.
- Every **Skill-based practice** hour equals **0.25 credits**.

Course Precedence:

The following are the guidelines for registering into courses with pre-requisites.

- A course may have one or more of its preceding course(s) as pre- requisite(s).
- To register for a course, the student must successfully be promoted in these course(s) earmarked as pre-requisite(s) for that course.

Registration Process

Key Guidelines:

- **Course Availability:** Students are permitted to register only for courses offered in the specific semester of enrollment.
- **Prerequisites:** Any prerequisite courses must be successfully completed before registering for subsequent courses.
- **Timely Registration:** Students must register on the designated registration day. KLEF reserves the right to deny late registrations.
- **Add/Drop/Change Period:** Students have a one-week window from the start of classes to add a course and two-weeks to drop or change courses.

- **Credit Limits:**
  - The recommended credit load is 22-24.
  - The maximum credit load per semester is 30.
  - If a student finds the standard load overwhelming, they can opt for deceleration, taking fewer courses now and making up the credits in a future summer semester.
  - Students in honors programs or pursuing a minor may be allowed to take on a heavier load through overloading, subject to eligibility criteria.

- **Elective Course Availability:** KLEF may cancel elective courses with low enrollment within the first week. Students will be able to switch to another elective if they meet its prerequisites.

- **Re-registration:** If a student wants to improve their grade in a course, they can re-register for it with approval from the Dean of Academics.

- **Registration Cancellation:** KLEF can cancel a student's registration for disciplinary reasons or plagiarism.

- **Timetable Clashes:** Students are responsible for resolving any timetable conflicts. They should contact their Department Year Coordinator immediately if any clashes arise.

- **Irregularities:** If any irregularities are found in a student's registration later on, KLEF may cancel their registration for a course or even the entire semester.

Registration Flexibilities:

- **Choice of electives:** Students have the flexibility to choose from a diverse set of elective courses that align with their personal interests or career objectives.

- **Choice of faculty:** Students have the flexibility to choose their preferred faculty members for certain courses, depending on departmental policies and course availability.

- **Acceleration & Overloading:** Students can accelerate their progress by taking courses from the next semester in advance, or overload by taking more credits than the standard limit. Prior permission from the Dean of Academics is required for either of these.

- **Deceleration & Underloading:** If students need to lighten their course load, they can decelerate by postponing some courses to the next semester, or underload by taking fewer credits than usual. Students who do not register on time, may also be forced to decelerate to compensate the classwork that they missed due to late registration. In both the cases of deceleration, permission must be sought from Office of Dean Academics through proper channel.

Summer Term Registration:

The Summer Term is designed to help students catch up or get ahead. Here are the guidelines:

- **Eligibility:** Students can register for summer courses if they have backlogs to clear, need to fulfill pre-requisites, or have been approved for acceleration.

- **Credit Limit:** The maximum credit load for the summer term is 12.

- **Timetable Clashes:** Students should ensure there are no conflicts in their summer course schedule.

- **Attendance & Promotion:** The same policies apply as in regular semesters, except that attendance condonation is not available in the summer.

Course Categories

- **Engineering Science Courses (ESC)**: The Engineering Science category comprises foundational engineering courses that introduce students to essential principles and methods used in various engineering fields. These courses provide the necessary technical background and practical knowledge required for more advanced study and specialization in engineering disciplines.

- **Professional Core Courses (PCC):** Professional Core Courses (PCC) are essential courses within each engineering discipline that provide foundational knowledge and skills critical to the field. These courses are integral to the curriculum and ensure that students acquire the core competencies necessary for their professional practice.

- **Professional Elective Courses (PEC)**: Professional Elective Courses (PEC) are required for students who wish to pursue a specific specialization within their field of study. These courses allow students to focus on advanced topics and gain in-depth knowledge in their area of interest, tailoring their education to align with their career goals. By completing the designated PECs, students can achieve a degree of specialization that enhances their expertise and prepares them for specific roles or industries in their professional journey.

- **Project Research and Internship (PRI):** Project Research and Internship courses provide students with real-world experience by engaging them in research projects and internships in industry or academia. These courses are essential for developing practical problem-solving skills, fostering innovation, and giving students the opportunity to apply the theoretical knowledge gained in the classroom to real-life scenarios. Through internships and research projects, students can gain industry exposure, improve their technical skills, and prepare themselves for professional careers or advanced studies.

- **Open Elective Courses (OEC):** Open Elective Courses offer students the flexibility to explore subjects outside their core discipline, fostering interdisciplinary learning and intellectual diversity. Available across all university programs, these courses encourage students to integrate knowledge from various fields, promoting innovation and a holistic understanding of global issues. Open Electives play a key role in broadening student academic perspectives and preparing them for multifaceted professional challenges.

- **Value-Added Courses (VAC):** Value-Added Courses are designed to enhance employability by providing students with training that leads to globally recognized certifications or specialized skills. These courses focus on industry-relevant knowledge and practical applications, ensuring students are well-prepared for current job market demands. By offering advanced skills and certifications, Value-Added Courses give students a competitive edge in their careers.

- **Audit Course (AUC):** Audit courses are courses that students can attend without receiving a formal grade or credit towards their degree. These courses are often chosen by students who want to learn a subject for personal enrichment or to gain knowledge in areas outside of their major.

Requirements for the award of Degree

To be eligible for the award of a M.Tech. degree, a student must successfully fulfill the following criteria:

- **Credit Requirements:** Earn the minimum number of credits specified in the program structure.

- **Focused Training:** Successfully undertake specific training in focused areas that enable students to be successful in their chosen career tracks. The focused areas are: (a) Employment in MNCs, (b) Civil Services (c) Higher Studies (d) Research and (e) Entrepreneurship.

- **Certifications:** Successfully complete at least two global certifications or value-added courses in the chosen discipline.

- **Audit Courses:** Successfully complete all audit courses outlined in the program structure.

- **Minimum CGPA:** Achieve a minimum Cumulative Grade Point Average (CGPA) of 5.5 by the end of the program.

- **Extra Courses:** Students with extra courses having 'DT' or 'F' grades can still graduate if they meet all other requirements. However, these courses will be factored into the CGPA calculation.

- **Time Limit:** Complete all requirements within:
  - A minimum of 4 regular semesters (excluding summer terms)
  - A maximum of 4 years

Academic Bank of Credits

- ABC helps the students to digitally store their academic credits from any higher education institute registered under ABC in order to award Certificate/Diploma/Degree/Honors based on the credits earned by the student.
- All the credits acquired by the students are stored digitally by registering into Academic Bank of Credits (ABC) portal. It also supports retaining the credits for a shelf period and continue their program study with multiple breakovers.
- Students may exit from their current program of study due to any unforeseen reasons or to focus on their chosen career path. In such cases, the student may break for a period of time (preferably not in the middle of an academic year) and may continue with the program of study at a later stage.
- Students must be able to complete their program by not exceeding the maximum duration of the program. If not, they may be issued with a Certificate, diploma, degree or honors based on the credits acquired over the period of time for all the programs approved by UGC.

Award of Class

A student having cleared all the courses and met all the requirements for the award of degree with:

- **Pass class:** CGPA greater than or equal to 5.5 and lesser than 5.75.
- **Second class:** CGPA greater than or equal to 5.75 and lesser than 6.75.
- **First class:** CGPA greater than or equal to 6.75 and lesser than 7.75
- **First class with Distinction:** CGPA greater than or equal to 7.75, provided the student has cleared all the courses in first attempt and must have fulfilled all the program requirements in program specified minimum years duration.

Award of Medals

KLEF awards Gold and Silver medals to the top two candidates in each program after successful completion of their study. The medals are awarded based on their CGPA during the Annual Convocation with the following constraints:

- The grade obtained through betterment/ supplementary will not be considered for this award.
- He/She must have obtained first class with distinction for the award of Gold or Silver-medal.

Course Flexibilities

In line with the institution's commitment to personalized learning, courses are offered in multiple modes, allowing students to tailor their academic journey based on personal preferences, career goals, and learning styles. The available modes include:

- **Regular Mode:** It is the traditional method of learning, involving in-person classroom instruction, a structured curriculum, and traditional assessments. This mode provides students with a structured and predictable learning environment, facilitating direct interaction with professors and classmates. It is suitable for students who prefer a traditional learning approach and value face-to-face interaction.

- **Advanced Mode:** This mode is designed for students seeking a more rigorous academic experience, this mode offers additional credits, in-depth theoretical studies, research projects, and complex problem-solving evaluations. It is particularly suitable for students participating in honors programs.

- **Experiential Mode:** This mode emphasizes practical learning through real-world projects, lab work, or industry interactions. It offers variable credits based on the extent of practical involvement and assessments centered around project outcomes and presentations. Honors students pursuing experiential learning often choose this option.

- **MOOCs Mode:** Massive Open Online Courses (MOOCs) are utilized to support independent learners, such as students engaged in internships or practice school. Students can earn credits by completing accredited online courses at their own pace. Assessments in this mode may include online quizzes, certifications, and institutional evaluations.

- **Work-in-lieu Mode:** It allows students to substitute certain coursework with relevant work experience, internships, or on-the-job training. Credits are awarded based on the work performed, and evaluations are typically centered around performance reports, supervisor evaluations, and reflective essays. This mode is ideal for students who want to gain practical experience while fulfilling academic requirements.

Attendance calculation in a course

- **Attendance calculation for LTPS:** Attendance of a student on a course is calculated based on the credit-weighted average of the student's attendance in each of the LTPS components of the course.

- **Attendance start date:** Attendance is counted from the class commencement date. However, for transferred or newly admitted students, attendance in their admitted semester is counted from the date of admission.

Attendance requirements leading to promotion

- **Minimum Attendance:** 85% attendance is required for course promotion and appearing for the semester-end exam.
- **Condonation:** Up to 10% condonation by Principal, College of Engineering, is possible for medical emergencies with proper documentation submitted within a week. Students will be levied a condonation fee to appear for the semester-end exam.
- **Marginal Cases:** Attendance slightly below 75% due to severe medical or valid reasons may be considered for further relaxation by the condonation board appointed and headed by the Vice-Chancellor.

Attendance-based marks

- **Optional Marks:** Course coordinators can allocate up to 5% of the total marks for attendance, clearly stated in the course handout and approved by the Dean of Academics through proper channel.

- **Mark Distribution:** Marks are awarded based on attendance ranges: 85-88% = 1 mark, 89-91% = 2 marks, and so on. Below 85% results in zero marks, even with condonation.

- **Applicability:** Attendance marks, if given, apply to all L-T-P-S components cumulatively, not just the theory part.

Attendance waiver

- **Eligibility:** Students with a CGPA and SGPA of 9.00 or higher in the previous semester can get an attendance waiver for up to three courses in the next semester, with prior approval from the Dean of Academics through proper channel.

- **Conditions:** Students using the attendance waiver can participate in all assessments and evaluation components without being marked ineligible due to attendance-based regulations.

Compensatory (Extra) attendance policy

- **Eligibility:** Students representing KLEF in events or participating in co-curricular / extracurricular activities can get compensatory attendance with prior written approval.

- **Limit:** Compensation is limited to 10% of total classes per course per semester and doesn't apply to the summer term.

Course-based promotion and detention policy

- **Minimum Attendance:** Students must meet the minimum attendance requirement to be promoted in a course. If a student fails to meet this requirement, their grade in the course will be marked as "DT", indicating that the student is detained in the course.

- **Next Steps after detention:** Student must re-register in a detained course and study it completely by attending the classwork, submitting all assessments, taking all evaluation components

Eligibility for appearing Sem-End Examination

A Student registered for a course and got promoted is eligible to write the Semester End Examination for that course unless found ineligible due to one or more of the following reasons:

- Shortfall of attendance.
- Acts of indiscipline.
- Withdrawal from a course.
- Non-payment of examination fees.
- Without a hall ticket.

Assessment & Evaluation

The assessment in each theory subject consists of Sem In Exams, in class quizzes/tutorials/home-assignments/Active Learning Methods (continuous assessment) and the Semester End Exanimation (SEE). Students are advised to refer to the course handout to get more detailed information on assessment.

- Sem In Examinations and the Semester End Examinations will be conducted as per the Academic Calendar.
- As per the necessity, the Supplementary examinations will be conducted at the discretion of Dean Academics with the approval of the Vice Chancellor.
- Students may have to take more than one examination in a day during Sem In exams, Semester End Examinations /Supplementary examinations.

College / School Name	Semester-In Evaluation (Weightage in percent) (A)	Sem End Examination (Weightage in percent) (B)	Minimum requirement for pass percent	
			(A+B)	B
College of Engineering	60	40	50	50

Semester-In Evaluation

The following guidelines are followed for the Semester In evaluation.

- The process of evaluation is continuous throughout the semester
- The distribution of marks for Semester In evaluation is 60 percent of aggregate marks of the course.
- The distribution of weightage for various evaluation components are decided and notified by the course coordinator through the course handout after approval by the Dean Academics, prior to the beginning of the semester.
- In order to maintain transparency in evaluation, answer scripts are shown to the students for verification, within one week of conduct of exam. If there is any discrepancy in evaluation, the student can request the course coordinator to re-evaluate.
- The solution key and scheme of evaluation for all examinations are displayed by the Course Coordinator in the appropriate web portal of the course, on the day of the conduct of examination.
- In case the student is unable to appear for any evaluation component owing to hospitalization, participation in extra/ co-curricular activities representing KLEF/ state/ country; the Dean Academics can permit to conduct of re-examination for such students.
- In case a student has missed any of the two in semester evaluations, S/he is eligible for and will be provided with an opportunity of appearing for re-examination.
- The pattern and duration of such examination are decided and notified by the Course Coordinator through the Course handout, after approval from the Dean Academic.
- To maintain transparency in evaluation, answer scripts are shown to the students for verification. If there is any discrepancy in evaluation, the student can request the Controller of Examinations to re-evaluate.
- If a student earns F grade in any of the courses of a semester, an instant supplementary exam (for only Semester End Exam component) will be provided within a fortnight of the declaration of the results.

Semester-End Evaluation

The following guidelines are followed for the End Semester evaluation.

- The end-semester evaluation typically includes a variety of components such as Sem End Exams, projects, presentations, or practical assessments, skill assessments as detailed in the course handout.
- Each component is evaluated based on the criteria outlined in the course handout.
- The distribution of weightage for various evaluation components are decided and notified by the course coordinator through the course handout after approval by the Dean Academics, prior to the beginning of the semester.
- To pass in a course, student must meet or exceed the minimum passing marks specified for each end semester summative assessment component mentioned in the course handout.
- The key and scheme of evaluation for all examinations are displayed by the Course Coordinator in the appropriate web portal of the course, on the day of the conduct of examination.
- In case the student is unable to appear for any Sem end summative evaluation component owing to hospitalization, participation in extra/ co-curricular activities representing KLEF/ state/ country; student can request for re-examination by taking prior permission from Dean Academics.
- If a student earns F grade in any of the courses of a semester, an instant supplementary exam (for only Semester End Exam component) will be provided within a fortnight of the declaration of the results.

Absence in Assessment and Examination

If a student misses a formative assessment component (quizzes, assignments, etc.) due to illness or other valid reasons, no retakes will be permitted, and a score of zero will be recorded. However, in cases of an excused absence, the instructor may allow the student to retake the assessment, subject to written approval from both the Principal and the relevant Head of Department.

Make-up Exams:

A student's absence from Semester In or Semester End Exams will only be considered for a make-up exam under the following circumstances.

- Pre-approved participation in university/state/national/international co-curricular or extracurricular activities.
- Illness or medical emergencies resulting in hospitalization, with a doctor's certification explicitly stating the student's inability to attend the exam within the designated period.
- Death of an immediate family member.

Remedial Exams:

- Remedial exams are conducted for students who score less than 60% on Semester In Exam I and have attended at least 85% of the remedial classes.
- For courses without remedial classes, no remedial exam will be scheduled.
- If a student does not take or scores less than 60% on Semester In Exam I, they must attend remedial classes and maintain a minimum 85% attendance to be eligible for the remedial exam. The remedial exam score will then be considered.
- The number of remedial classes will be 33% of the regular classes held prior to Semester In Exam I. However, there are no remedial exams for Semester In Exam II or laboratory exams.

Remedial Classes Policy

The following categories of students are recommended to attend Remedial classes:

- Students who did not attend or obtain a minimum of 60 percent marks in the Sem In exam1.
- Students for whom CO1/CO2 is (are) not attained in Sem In Exam 1
- Any other student may also be permitted to attend remedial classes as per the discretion of the principal.

The following are the guidelines to conduct remedial classes:

- Remedial classes which are scheduled to be conducted usually one or two weeks post conclusion of Sem In exam1.
- The number of remedial classes to be conducted shall be 33 percent of regular classes held till the Sem In exam I.
- Remedial classes MUST NOT be scheduled during regular class work hours.

Assessment of Project/Research based Courses

- All project or research-based subjects must have a defined time limit for completion.
- The specific time limits for completion and schedule for monitoring and evaluation of performance of students will be announced each term.
- The final project report, after getting the plagiarism certificate, only will be considered and evaluated by the panel of examiners.
- Student project reports must follow the guidelines prescribed by the office of Dean Academics.

Grading Process

At the end of all evaluation components based on the performance of the student, each student is awarded based on absolute/relative grading system. Relative grading is only applicable to a section of a course in which the number of registered students is greater than or equal to 25. Choice of grading system is decided by the Course Coordinator with due approval of Dean Academics and is specified in the course handout.

(i) Absolute Grading:

The list of absolute grades and its connotation are given below:

Performance	Letter Grade	Grade Point	Percentage of marks
Outstanding	O	10	90 - 100
Excellent	A+	9	80 - 89
Very Good	A	8	70 - 79
Good	B+	7	60 - 69
Above Average	B	6	50 - 59
Fail	F	0	0 – 49
Absent	AB	0	Absent

(ii) Relative Grading:

The following table lists the grades and its connotation for relative grading:

Letter Grade	Grade Point	Grade Calculation
O	10	total marks >= 90% and total marks >= mean + 1.50σ
A+	9	μ+0.50σ <= total marks < μ+1.50σ
A	8	μ <= total marks < μ+0.50σ
B+	7	μ-0.50σ <= total marks < μ
B	6	μ-1.00σ <= total marks < μ-0.50σ
F	0	total marks <μ-1.50σ or total marks <=49
AB	0	Absent

μ is the mean mark of the class excluding the marks of those students who scored greater than or equal 90 percent and less than or equal 50 percent after rounding the percentages to the next highest integer. σ is the standard deviation of the marks.

Course handout

A course handout is a document that provides essential information about a specific course. It's like a roadmap that guides you through the course, helping you understand the expectations, assignments, and grading criteria.

Significance of Course Handout:

- **Clarity and Organization:** Course handouts help you stay organized and focused by outlining the course structure, topics, and deadlines.
- **Expectations:** They communicate the instructor's expectations for your participation, assignments, and overall performance.
- **Grading:** Course handouts outline the grading criteria, so you know exactly how your work will be evaluated.
- **Resources:** They often list valuable resources, such as textbooks, articles, or online tools, that can aid your learning.

Expectations from the course handout:

- **Course Description:** A brief overview of the course, its goals, and its relevance to your studies.
- **Learning Outcomes:** Clear goals for what you should be able to do by the end of the course. These outcomes will help you understand the skills and knowledge that are expected to gain.
- **Instructor Information:** Contact details, office hours, and specific communication preferences.
- **Course Schedule:** A tentative timeline of topics, assignments, and exams.
- **Required Materials:** A list of textbooks, articles, or other materials essential for the course.
- **Assessment Methods:** A breakdown of how your final grade will be determined, including the weight of assignments, exams, and participation.
- **Assignment Guidelines:** Detailed instructions for each assignment, including due dates, submission requirements, and expectations.

Effective use of the course handout:

- **Refer to it regularly:** Check back to keep track of important dates and assignments.
- **Highlight key points:** Make notes or highlight sections that are particularly important to you.
- **Ask questions:** If something isn't clear, bring it up in class or during office hours.

Betterment

- A student may reappear for the semester-end examination for betterment, only in the theory part of a course to improve their grade, provided that the student has passed the course, his/her CGPA is less than or equal to 6.75 and the grade in the respective course is equal to or lower than a 'C'. In case of reappearing for a course, the best of the two grades will be considered.

- A student may re-register for any course in any semester during the program to improve their grade if the current grade in the course is lower than 'B+', with the approval of the Dean Academics and in accordance with academic regulations.

- A student cannot reappear for the semester-end examination in courses with an L-T-P-S structure such as 0-0-X-X, 0-0-X-0, 0-0-0-X, Social Internship, Technical Internship, Seminar, Term Paper, Project, Capstone Project, Practice School, Industrial Internship.

- A student is not eligible for the award of a Degree with Honors if they opt for the betterment option.

Supplementary

- A student is eligible for a supplementary exam if they don't meet the minimum passing marks for a course or if they fail any component of the end-of-semester assessments listed in the course handout.

- If a student has failed courses from a previous odd semester that are not offered in the current semester, the supplementary exams for those courses will be scheduled for the summer supply.

- As per the end semester assessment components listed in the course handout (i.e. end semester summative) if student fail any component, they are eligible for a supplementary exam. Only the component(s) student failed will be considered for this supplementary attempt, though in some cases, you might be allowed to retake all components to improve your marks.

- If a student fails any of the end-of-semester examinations in an odd semester, supplementary exams for the current semester's courses will be conducted within one month after the release of the results. These supplementary exams will only cover the courses offered in that specific odd semester.

- In cases where there is a clash between odd semester supplementary exams and other scheduled exams, students may take the supplementary exams during the summer supply.

- If a student fails any of the end-of-semester examinations in an even semester, supplementary exams will be scheduled either within one month after the release of the results (i.e. summer supply) or during the summer term.

- Student must register for supplementary exams within a specified period after the results are declared.

- Student may be required to pay a supplementary exam fee. Details on the fee structure and payment process will be provided along with the supplementary exam notification.

- A student is not eligible for the award of a degree with first class with Distinction, if they opt for the Supplementary option.

Revaluation

Students desirous of seeing their Semester End Examination answer scripts have to apply online to the COE for the same within the timeframe as declared by the COE by paying the prescribed fee through ERP. Student applications must be forwarded by the Head of the Department and the Principal of the School and then re evaluation fees are to be paid. The application along with the attached fee receipt must be submitted to the office of the COE.

- There is no provision for re evaluation in case of Lab/Practical/skilling exams, project, viva voce exam or seminar / design / mini project courses.
- The final grades awarded to each course shall be announced by the COE and the same will be made available to students through the website/notice boards.

Credit Transfer

Credit transfer between KLEF and other Institution:

Credit transfer from KLEF to other institutions: Student studying in KLEF can take transfer to another institution under the following conditions:

- KLEF has signed MOU with the institution

- However, a student, after seeking transfer from KLEF can return to KLEF after a semester or year. Based on courses done in the other institution, equivalent credits shall be awarded to such students.

Credit transfer from another institution to KLEF:

A student studying in another institution can take transfer to KLEF under the following conditions:

- When a student seeks transfer, equivalent credits will be assigned to the student based on the courses studied by the student.

- To determine the equivalent credits for a course from a previous institution on a 10-point scale at KLEF, the number of credits of the course is multiplied by the equivalent grade point of the previous institution and then divided by the number of credits of the corresponding course at KLEF.

- If a course from the previous institution has zero credits and no grade assigned, the student must sit for the final examination for the equivalent course at KLEF.
- A transfer student seeking improvement in any course can take the final examination at KLEF, where the grade received at KLEF becomes the final grade recorded on their grade sheets.
- The student, when transferred from other institutions, must stick to the rules and regulations of KLEF.
- To graduate from KLEF, a student must study at least half of the minimum duration prescribed for a program at KLEF.

Credit Transfer Through MOOCs:

- Undergraduate students can get credits for MOOCs courses recommended by KLEF up to a maximum of 20% of their minimum credits required for graduation. The discretion of allocation of MOOCs courses equivalent to the courses in the curriculum lies with the office of the Dean Academics.
- A student may also be permitted to obtain 20 credits through MOOCs in addition to the minimum credits required for graduation. These 20 credits can also be utilized to acquire a Minor degree or an Honors degree if the courses are pronounced equivalent to those specified for the respective degrees by the office of the Dean Academics. These additional credits through MOOCs if to be considered for CGPA/Minor/Honors degree must be approved by Dean Academics prior to enrollment in the respective MOOCs.
- Students acquiring additional credits for Honors/Minor degree must adhere to the rules governing the award of the respective degree, otherwise, a student applying for registering into additional credits through MOOCs must possess a minimum CGPA of 7.5 till that semester.

Semester Promotion policy

Promotion is only course-based. Semester-based promotion is not applicable for M.Tech. students.

Counselling procedure

KLEF is committed to fostering a supportive and nurturing environment for our students, addressing not only their academic needs but also their psychological well-being. To achieve this, KLEF is implementing a comprehensive Mentor-Mentee Scheme aimed at providing holistic support through academic, career, and psychological counselling. To achieve this, KLEF implement a comprehensive Mentor-Mentee Scheme and establish the Central Academic Counselling Board (CACB) in addressing academic, career and student-psychological issues.

The Mentor-Mentee Scheme aims to provide personalized guidance and support to students throughout their academic journey. Each student shall be assigned a mentor from the faculty, who will act as a guide, counselor, and advocate for the student's academic and personal growth. The mentor-mentee relationship is intended to facilitate communication, goal-setting, and problem-solving.

The primary objectives of the Mentor-Mentee Scheme are:

- To facilitate a strong and positive mentor-mentee relationship that supports students' academic growth, personal development, and psychological well-being.
- To offer career counselling, guiding mentees in exploring career options, developing professional skills, and making informed career-related decisions.
- To provide psychological counselling, offering a safe space for mentees to discuss psychological concerns and providing appropriate support or referrals when needed.
- To provide tailored academic counselling, helping mentees set academic goals, plan their course of study, and navigate academic challenges effectively.

Academic Counselling:
The mentors oversee the following academic counselling activities which are not limited to:

- Providing guidance during academic registration sessions
- Monitoring attendance and addressing attendance-related concerns
- Communicating attendance and marks information to parents/guardians
- Addressing concerns related to backlogs and providing advice
- Advising on domain specializations and academic flexibilities
- Assisting students in exploring study abroad opportunities
- Conducting student and parent meetings to address academic concerns

Career Counselling:
The mentors oversee the following career counselling activities which are not limited to:

- Recommending technical skilling courses and certificate programs
- Facilitating internship opportunities and competitive exam preparations
- Guiding students through term papers, projects, hackathons, and coding challenges
- Providing information on higher education options and entrance exams
- Encouraging entrepreneurship awareness and guiding start-ups initiatives
- Assisting students in preparing for placements and future career goals
- Conducting student and parent meetings to discuss career aspirations

Psychological Counselling:
The Mentors oversee the following psychological counselling activities which are not limited to:

- Providing guidance on time management and classroom activities
- Addressing anti-ragging issues and promoting a positive attitude
- Providing support for managing mental stress and promoting well-being
- Addressing hostel, room, home, and food-related concerns
- Conducting student and parent meetings to address personal well-being

Mentor-Mentee allocation

- The Department Academic Counselling Board (DACB) is responsible for assigning approximately 20 students to each faculty member, who will act as their mentor. The mentors will guide and support their assigned students throughout their academic journey.
- Counsellors/mentors will be appointed from the students' respective parent departments, and these faculty members will continue as mentors until the students complete their course.
- The counselling program aims to help students develop their character, academic abilities, professional skills, and social responsibilities. Mentors play a vital role in this process by:
    - Maintaining detailed records of mentor-mentee interactions in the ERP system. Mentors are required to update the ERP with counselling remarks for both students and their parents every fortnight.
    - Providing regular updates to parents about students' academic progress, career developments, and physiological status through various communication channels, including phone calls, SMS, WhatsApp, and Telegram.
    - Ensuring that counselling remarks are accurately recorded in the ERP system, and reflecting these updates in DACB monthly reports and CACB semester reports.

Academic Counselling Board

- Academic Counselling Board is constituted by the Dean Academics. This board shall comprise of the Chairman, Convener, Principal/Director, HOD and Professor/Associate Professor. A student will be put under Academic Counselling Board in the following circumstances:
    - Has CGPA of less than 6.00.
    - Has F grade or Detained in multiple courses.
- The first level of Counselling such students will be done by the Mentor of the student and the HoD followed by the ACB and the list of students who have to undergo the ACB counselling be forwarded by the HoD to the Office of Dean Academics.
- The students undergoing the Academic Counselling Board process may be allowed to register only for a few courses based on the recommendation of Academic Counselling Board.

Rustication policy

A student may be rusticated from the KLEF on disciplinary grounds, based on the recommendations of any empowered committee, by the Vice Chancellor.

Malpractice penalty policy

The following actions constitute malpractice during examinations and are subject to disciplinary actions as outlined below:

Clause 1: Possession of unauthorized material in the examination hall (e.g., paper, notebooks, programmable calculators, cell phones, or any material related to the exam subject). This includes any marks on the candidate's body that could be used as an aid.

Penalty: Immediate expulsion from the examination hall, without cancelling the paper.

Clause 2: a) Providing or receiving assistance, or communicating with others via oral means, body language, or electronic devices (such as cell phones), either inside or outside the examination hall. b) Smuggling in or out answer sheets, additional sheets, or arranging to send out the question paper or answer sheets during or after the exam. c) Using objectionable or offensive language in the answer paper or in communication with examiners, or attempting to influence examiners to award passing marks. d) Exchanging answer scripts or additional sheets in the examination hall

Penalty: Expulsion from the examination hall and cancellation of the comprehensive examination performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him

Clause 3: Copying from any unauthorized material (e.g., paper, books, programmable calculators, palm computers) during the exam.

Penalty: Expulsion from the examination hall, cancellation of the exam performance in that subject, and a fine of Rs. 1000.

Clause 4: a) Taking the answer script outside the exam hall, tearing the script or any part of it inside or outside the hall. b) Appearing for the exam in a drunken condition.

Penalty: Expulsion from the examination hall and cancellation of comprehensive examination performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining comprehensive examinations of the subjects of that semester/year.

Clause 5: a) Disobeying examination authorities, creating disturbances, organizing or instigating a walk-out, threatening or assaulting officials, or damaging property inside or outside the exam hall. b) Possession of any lethal weapon or firearm in the examination hall.

Penalty: Expulsion from the exam hall and cancellation of exam performance in all subjects. The student will be debarred from future exams and may forfeit their seat. Outsiders will be handed over to the police.

Clause 6: Impersonation during the examination.

Penalty: Both the impersonator and the original candidate will be expelled from the exam hall. The original candidate's performance will be cancelled in all subjects, including practical and project work, and they will be barred from exams for two consecutive semesters. Continuation in the course is subject to academic regulations. The impersonator (if an outsider) will be handed over to the police.

Clause 7: Repeated offenses.

Penalty: For a second offense, the candidate will face expulsion from the exam hall and cancellation of all exam performances for that term, with a fine of Rs. 1000. Repeated academic dishonesty may result in the issuance of a transfer certificate (TC).

Clause 8: Any other form of malpractice not specified.

Penalty: Punishment will be determined by the Examination Malpractice Committee and approved by the Vice-Chancellor.

Plagiarism Penalty Policy

Plagiarism is considered a serious breach of academic integrity, compromising both the ethical standards of the university and the intellectual development of students. The university enforces a strict zero-tolerance policy regarding plagiarism, and all students are expected to uphold the highest standards of academic honesty.

Penalties for plagiarism will be applied as follows:

First Offense:

- Minor Plagiarism (e.g., improper citation, small portions of copied work): The student will receive a warning and be required to resubmit the work with proper citations. Marks may be reduced up to 50%.
- Major Plagiarism (e.g., copying significant portions, submitting another person's work): The assignment will receive a grade of zero. The student may be required to attend a mandatory workshop on academic integrity.

Second Offense:

- Any second offense, regardless of severity, will result in a zero for the assignment and an official letter of reprimand placed in the student's record. The student will be placed on academic probation.

Third Offense:

- The student will face suspension from the university for one academic term. A record of academic misconduct will be permanently placed in the student's academic file.

Repeated Violations:

- Further violations after the third offense may lead to expulsion from the university.

In cases of group work, if plagiarism is identified, all group members will be held equally accountable unless it can be demonstrated that the act of plagiarism was isolated to specific individuals.

Terminology

Absolute Grading: Absolute grading is a method of assigning grades based on predetermined criteria or standards rather than comparing student performance to other students in the class (See: Relative Grading where the performances are compared).

Academic Bank of Credits (ABC): Academic Bank of Credits, an initiative of Government of India, is a digital platform that stores the academic credits earned by a student throughout their educational journey. It's essentially a virtual repository of a student's academic achievements.

Academic Council: The Academic Council is the highest academic body of the University and is responsible for the maintenance of standards of instruction, education and examination within the University. The Academic Council is an authority as per UGC regulations and has the right to decide all academic matters including academic research.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises of two consecutive regular semesters i.e., Odd and Even semesters.

Acceleration: Acceleration of courses refers to a student's ability to progress through their academic program at a faster pace than traditional timelines.

Attendance: Attendance refers to the record of a student's presence or absence in educational institutions. It is a critical factor influencing academic performance, overall development, and future success.

Audited Course: It is a course of study which has zero credits and has a "Satisfactory" or an "Unsatisfactory" grade.

Backlog Course: A course is considered to be a backlog if the student has obtained 'F' grade or detained in the course.

Basic Sciences: The courses of foundational nature in the areas of Mathematics, Physics, Chemistry, Biology etc., are offered in this category.

Betterment: Betterment is a way that contributes towards improving the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Board of Studies: Board of Studies (BOS) is an authority as defined in UGC regulations, constituted by Vice Chancellor for each of the department separately. They are responsible for curriculum design and update in respect of all the programs offered by a department.

Branch of Study: It is a branch of knowledge, an area of study or a specific program (like Civil Engineering, Mechanical Engineering, Electrical and Electronics Engineering etc.)

Bridge Courses: Courses which are required to bridge the continuity among the Basic sciences/Engineering Sciences/professional courses (both core and electives) and are identified through gap analysis carried out using feedback obtained from various academic stakeholders are termed as Bridge Courses. These courses also do not yield any credits but require a "Satisfactory" result to register into the attached professional courses.

Capstone Project: A capstone project is the culminating academic experience for many students, typically undertaken in the final year of a degree program. It's designed to integrate and apply the knowledge and skills acquired throughout the course of study.

Certificate course: It is a course that makes a student gain hands-on expertise and skills required for holistic development. It is a mandatory, non-credited course for the award of degree.

Change of Branch: Change of branch means transfer from one's branch of study to another.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Course: A course is a subject offered by the University for learning in a particular semester.

Course Handout: Course Handout is a document which gives a complete plan of the course. It contains the details of the course viz. Course title, Course code, Pre-requisite, Credit structure, team of instructors, Course objectives, Course rationale, Course Outcomes and the relevant syllabus, textbook(s) and reference books, Course delivery plan and session plan, evaluation method, chamber consultation hour, course notices and other course related aspects. In essence, course handout is an agreement between students (learners) and the instructor.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Course Withdrawal: Withdrawing from a Course means that a student can drop from a course within the first two weeks of the odd or even Semester (deadlines are different for summer sessions). However, s/he can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture hour per week or two hours per week of tutorials/ self-learning/ practical/ field work during a semester.

Credit point: It is the product of grade point and number of credits for a course.

Credit Transfer: The procedure of granting credit (s) to a student for course(s) undertaken at another institution.

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

Curriculum: Curriculum is a standards-based sequence of planned experiences where students practice and achieve proficiency in content and applied learning skills. Curriculum is the central guide for all educators as to what is essential for teaching and learning, so that every student has access to rigorous academic experiences.

Deceleration: Deceleration of courses typically refers to a student's decision to reduce their course load or extend the time taken to complete a degree program.

Degree: A student who fulfils all the Program requirements is eligible to receive a degree.

Degree Requirements: Degree requirements are the specific courses, credits, and academic standards that a student must fulfill to earn a particular degree.

Degree with Specialization: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of Professional elective courses in a specialized area is eligible to receive a degree with specialization.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff and other resources.

Designing Your Own Degree: Designing your own degree is a revolutionary concept that empowers students to create a customized educational path aligned with their passions, career goals, and unique learning styles.

Dissertation: Dissertation is a substantial piece of original research written and defended by a candidate for a degree.

Detention in a course: Student who does not obtain minimum prescribed marks in continuous in-semester evaluation and /or minimum prescribed attendance in a course shall be detained in that course.

Double Major Degree: A double major degree allows students to specialize in two academic fields while earning a single bachelor's degree.

Dropping from the Semester: A student who doesn't want to register for the semester should do so in writing in a prescribed format before commencement of the semester.

End-semester Evaluation: End-semester evaluation is a summative assessment conducted at the conclusion of an academic term to measure students' overall performance.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective, Open Elective, Management Elective and Humanities Elective.

Engineering Sciences: The courses belonging to basic evolutionary aspects of engineering from Mechanical Sciences, Electrical Sciences and Computing like Engineering Mechanics, Data structures, Network Theory, Signal Analysis.

EPICS: EPICS stands for Engineering Projects in Community Service. It's a unique program that combines engineering education with community service.

Evaluation: Evaluation is the process of judging the academic work done by the student in her/his courses. It is done through a combination of continuous in-semester assessment and semester end examinations.

Experiential Learning: Experiential learning is a process through which students develop knowledge, skills, and values from direct experiences outside a traditional academic setting. It involves learning by doing, where students engage in hands-on activities, real-world problem-solving, and reflective practices to gain deeper understanding and practical application of the concepts they are studying.

Flexi-Core course: A Flexi-Core course typically refers to an elective or optional course within a degree program that offers students flexibility in choosing subjects based on their interests and career goals.

Formative Assessment: Formative assessment is ongoing evaluation of student understanding to inform instruction and facilitate learning.

Flipped Learning: Flipped learning is an instructional strategy that reverses the traditional teaching model. In flipped learning, students are introduced to new content outside of class, usually through video lectures, readings, or other materials. The in-class time is then used for more interactive activities, such as discussions, problem-solving, group work, and applying the concepts learned at home.

Grade: It is an index of the performance of the students in a said course. Grades are denoted by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 - point scale.

Grade Point Average (GPA): Grade Point Average is a numerical representation of a student's academic performance. It is calculated by averaging the numerical equivalents of letter grades earned in courses, considering the number of credit hours for each course.

Honors Degree: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of additional courses within the same program is eligible to receive an Honors degree.

Humanities, Arts and Social Sciences (HAS): It is a broad term that groups together the academic disciplines of humanities, arts and social sciences.

Industrial Training: Training program undergone by the student as per the academic requirement in any company/firm.

Industrial Visit: Visit to a company/firm as per the academic requirement.

Internship: Internship is a temporary work experience offered by an organization for a limited period. It provides students, graduates, or career changers with an opportunity to gain practical skills and experience in a specific field.

In-Semester Evaluation: Summative assessments used to evaluate student learning, acquired skills, and academic attainment during a course.

Induction Courses: Student who gets admitted into B.Tech. program must complete a set of Induction courses for a minimum period of 3 weeks and obtain a "Satisfactory" result prior to registering into 1st Semester of the Program.

Innovation Semester: An Innovation Semester is a dedicated academic term focused on cultivating a culture of creativity, problem-solving, and entrepreneurial thinking.

Lecture: A lecture is a formal instructional session where an instructor presents information to a large group of students.

Make-up Test: An additional test scheduled on a date other than the originally scheduled date.

Malpractice: Malpractice typically refers to academic dishonesty or misconduct during examinations or coursework. This can include a wide range of behaviors that compromise the integrity of the evaluation process.

Management elective: A course that develops managerial skills and inculcates entrepreneurial skills.

Minor Degree: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of courses from another discipline is eligible to receive a minor degree in that discipline.

Multiple Entry and Multiple Exit (MEME): It is an educational framework designed to provide flexibility in learning pathways, allowing students to enter and exit educational programs at various stages based on their individual needs, prior knowledge, and career goals.

National Education Policy (NEP): NEP 2020 is a comprehensive framework for transforming India's Education System. It aims to create an equitable and vibrant knowledge society by providing high-quality education to all.

NHEQF: NHEQF stands for National Higher Education Qualifications Framework. It's a comprehensive framework designed to standardize and classify higher education qualifications in India. The primary goal of NHEQF is to ensure that qualifications from different institutions are comparable and recognized nationally and internationally.

Open Elective: This is a course of interdisciplinary nature. It is offered across the University for all Programs.

Overloading: Registering for more number of credits than normally prescribed by the Program in a semester.

Peer Learning: Peer learning is a collaborative learning process where students learn from each other. It involves sharing knowledge, skills, and experiences among peers.

Practical: A practical is a hands-on session where students apply theoretical knowledge in a real-world or laboratory setting. Practical sessions are designed to develop students' technical skills, problem-solving abilities, and understanding of experimental procedures.

Practice School: It is a part of the total program and takes one full semester in a professional location, where the students and the faculty get involved in finding solutions to real-world problems. A student can choose Project/Practice School during his/her final year to meet the final requirements for the award of degree.

Pre-requisite: A course, the knowledge required for registration into higher level course.

Product Development Semester: A Product Development Semester is an academic term dedicated to the process of creating new products or improving existing ones.

Professional Core: The courses that are essential constituents of each engineering discipline are categorized as Professional Core courses for that discipline.

Professional Elective: A course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: A set of courses offered by the Department. A student can opt and complete the stipulated minimum credits to qualify for the award of a degree in that Program.

Program Educational Objectives: The broad career, professional, personal goals that every student will achieve through a strategic and sequential action plan.

Program Outcome (PO): Program outcomes are statements that describe what students are expected to know, understand, and be able to do upon completing a specific academic program.

Project: Course that a student must undergo during his/her final year which involves the student to undertake a research or design, which is carefully planned to achieve a particular aim. It is a credit-based course.

Project-Based Learning (PBL): Project-Based Learning is an instructional approach where students actively engage in real-world and personally meaningful projects.

Rapid Prototyping Semester: A Rapid Prototyping Semester is an academic term dedicated to the practical application of rapid prototyping techniques to create physical models or prototypes of products or designs.

Registration: Process of enrolling into a set of courses in a semester/ term of the Program.

Re-Registration: Student who are detained in courses due to attendance or marks criteria as per their regulation are given a chance to re-register for the same and complete it during the summer term.

Relative Grading: Relative grading is a method of assigning grades based on a student's performance compared to the rest of the class.

Remedial Exam: A remedial Exam is an assessment designed to identify specific areas of weakness or gaps in a student's knowledge or skills. It is typically administered after a student has performed poorly on a regular assessment.

Research Project: A research project is a systematic investigation undertaken to answer a specific question or address a particular problem.

Research Semester: A research semester is a dedicated period within an academic program focused on independent research or scholarly inquiry.

Research Seminar: A research seminar is a formal academic gathering where researchers present their ongoing work to a group of peers, faculty, and other interested individuals.

Self-learning: Self-learning is the process of acquiring knowledge and skills independently without formal instruction.

Semester: It is a period of study consisting of 15+1 weeks of academic work equivalent to normally 90 working days including examination and preparation holidays. The odd Semester starts normally in July and even semester in December.

Semester End Examinations: It is an examination conducted at the end of a course of study.

Skilling: It is a process of developing and enhancing specific skills that are essential for performing particular tasks or activities effectively. It involves structured training and practice aimed at equipping individuals with the practical abilities, knowledge, and competencies required for professional success and personal development.

Social Immersive Learning (SIL): Social Immersive Learning is a pedagogical approach that combines the power of social interaction with immersive technologies to create engaging and impactful learning experiences.

Social Service: An activity designed to promote social awareness and generate well-being; to improve the life and living conditions of society.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.

Substitution of Elective course: Replacing an elective course with another elective course as opted by the student.

Summative Assessment: Summative Assessment is a type of evaluation that occurs at the end of a learning period.

Summer term: The term during which courses are offered from May to July. Summer term is not a student's right and will be offered at the discretion of the University.

Supplementary: A student can reappear only in the semester end examination for the Theory component of a course, subject to the regulations contained herein.

Term paper: A 'term paper' is a research report written by students that evolves their course-based knowledge, accounting for a grade. Term paper is a written original research work discussing a topic in detail. It is a credit-based course.

Tutorial: A tutorial is a small group session designed to provide personalized guidance and support to students. Tutorials often involve discussions, problem-solving activities, and hands-on practice to reinforce concepts learned in lectures.

Under-loading: Registering for lesser number of credits than normally prescribed for a semester in that Program.

Value-Added Courses: Courses leading to global certification and those which are conducted exclusively for employability are referred to as value added courses.

FAQs

Q:What is the Choice-Based Credit System (CBCS) and how does it work?
A: CBCS allows student to choose courses from various categories based on your interests and career goals. Each course has a credit value assigned to it, and you need to earn a minimum number of credits in each category and in total to complete your program.

Q: Can I choose electives based on my interests?
A: Yes, student has the flexibility to choose electives that align with your personal interests and career objectives.

Q: Can I choose my preferred faculty members for certain courses?
A: During registrations prior to commencement of each semester, if a course is offered for multiple sections and if multiple faculty are teaching the same course, you will then have a choice of selecting the section being taught by that faculty under whom you wish to study.

Q: When and how do I register for courses?
A: Student must register for courses on the designated registration day. There is a one-week window for adding courses and a two-week window for dropping or changing them.

Q: Can I get an attendance waiver?
A: Students with a CGPA and SGPA of 9.00 or higher in the previous semester can get an attendance waiver for up to three courses with prior approval.

Q: What is the minimum attendance requirement for promotion?
A: 85% attendance is required for course promotion and appearing for the semester-end exam.

Q: Can I study some semesters in abroad?

A: KLEF University may have exchange programs or partnerships with foreign universities, allowing you to study abroad for a semester or year.

Q: Are there any extracurricular activities or clubs available?
A: Yes, KLEF offers various extracurricular activities and clubs, such as sports, cultural events, and student organizations.

Q: What happens if I have less than 85% attendance?
A: Upto 75% attendance, student may be eligible for condonation or marginal case consideration, but need to provide proper documentation and may be subject to fees. But falling below 75% will make you detain in the course.

Q: What happens if I detain a course?
A: Student who detained in a course must re-register for the course and study it again in summer term. If the detained course is not offered by the department, then the student can study other equivalent course from the same category upon taking approval from office of Dean Academics.

Q: What is ABC?
A: ABC enables you to digitally store your earned credits and potentially use them towards future studies at other institutions.

Q: Will I get my degree upon acquiring all the required credits?

A: Apart from fulfilling the total credit requirement, it is required to fulfill category and sub-category wise credit requirements and outcome requirements (which are clearly mentioned in the degree-wise credit requirements section) to be eligible for award of specific degree.

Q: Can I accelerate or decelerate my studies?

A: Students are generally recommended to register for 20 to 24 credits in each semester. Students who cannot cope up with such load, may consult their counsellor and Head of the Department to register in lower number of credits. This process is called "Deceleration". Students who do not register on time, may also be forced to decelerate to compensate the classwork that they missed due to late registration. In both the cases of deceleration, permission must be sought from Office of Dean Academics through proper channel. On the contrary, Students who wish to accelerate can register for upto 30 credits by selecting courses that are usually offered in later semesters and complete them in advance. Students may also use the optional Summer Term for accelerating courses upto 12 credits. In Similarly, a student may also register for credits lower than. However, you'll need approval from the Dean of Academics.

Q: Can I register for a course without promoting in its pre-requisite course?

A: No, student must promote in the pre-requisite course in order to register for a course having pre-requisite.

Program - Degrees(Design your own Degree)

S#	Major Flexibility	Program Addon
1	No Flexibility	No Add-on

Degree-wise Credit Requirements

1. No Flexibility with No Add-on

a) Credit Requirement **Total Credit Required: 80**

S#	Category	Sub-Category	Min-Credit	Max-Credit	Min-Courses	Max-Courses	Grouping
1	ESC	ESC-CORE	4	4	1	1	
2	PCC	PCC-CORE	19	19	5	5	
3	PEC	PE-1	3	3	1	1	
4	PEC	PE-2	3	3	1	1	
5	PEC	PE-3	4	4	1	1	
6	PEC	PE-4	3	3	1	1	
7	PEC	PE-5	3	3	1	1	
8	PRI	PRI-CORE	38	38	4	4	
9	OEC	OE-1	3	3	1	1	
10	VAC	VAC-CERT	0	0	2	2	
11	AUC	AUC-CORE	0	0	2	2	
12	AUC	AUC-CAREER	0	0	1	1	

b) Outcome Requirement

- Must have successfully obtain a minimum CGPA of 5.5 at the end of the program.
- Must complete 1 SCOPUS / WEB OF SCIENCE publication.
- Must have finished all the above-mentioned requirements in less than twice the period of the program, which includes deceleration period chosen by the student, deceleration imposed by KLEF or debarred from the KLEF.

Program Structure

S#	Cat	Sub-Cat	CourseCode	Course Title	Mode	Acrym	L	T	P	S	CR	CH	Pre-req
1	ESC	ESC-CORE	23MT5102	COMPUTATIONAL TECHNIQUES IN ENGINEERING OPTIMIZATION	R	CTEO	2	2	0	0	4	4	
2	PCC	PCC-CORE	23TE5102	DESIGN OF THERMAL SYSTEMS	R	DTS	2	0	2	4	4	8	
3	PCC	PCC-CORE	23TE5103	ADVANCED THERMODYNAMICS	R	ATD	3	0	2	0	4	5	
4	PCC	PCC-CORE	23TE5104	COMPUTATIONAL FLUID DYNAMICS	R	CFD	3	0	2	0	4	5	
5	PCC	PCC-CORE	23TE5205	ADVANCED HEAT AND MASS TRANSFER	R	AHMT	3	0	2	0	4	5	
6	PCC	PCC-CORE	23TE5206	MEASUREMENTS IN THERMAL ENGINEERING	R	MTE	2	0	2	0	3	4	
7	PEC	PE-1	23TE51A1	GAS TURBINE ENGINEERING	R	GTE	2	0	2	0	3	4	
8	PEC	PE-1	23TE51A2	ELECTRIC VEHICLE ENGINEERING	R	EVE	2	0	2	0	3	4	
9	PEC	PE-1	23TE51A3	ENERGY CONSERVATION & AUDIT	R	ECA	2	0	2	0	3	4	
10	PEC	PE-2	23TE52B1	ADVANCED ENERGY STORAGE TECHNOLOGIES	R	AEST	2	0	2	0	3	4	
11	PEC	PE-2	23TE52B2	FOOD PROCESSING, PRESERVATION AND TRANSPORT	R	FPPT	2	0	2	0	3	4	
12	PEC	PE-2	23TE52B3	CONVECTION AND TWO-PHASE FLOW	R	CTPF	2	0	2	0	3	4	
13	PEC	PE-3	23TE52C1	RENEWABLE ENERGY SOURCES & TECHNOLOGY	R	REST	3	0	2	0	4	5	
14	PEC	PE-3	23TE52C2	PRINCIPLES OF TURBO MACHINERY	R	PTM	3	0	2	0	4	5	
15	PEC	PE-3	23TE52C3	HEAT EXCHANGER DESIGN	R	HED	3	0	2	0	4	5	
16	PEC	PE-4	23TE52D1	REFRIGERATION AND CRYOGENICS	R	RAC	3	0	0	0	3	3	
17	PEC	PE-4	23TE52D2	AIR CONDITIONING SYSTEMS	R	ACS	3	0	0	0	3	3	
18	PEC	PE-4	23TE52D3	SOLAR ENERGY & SYSTEMS	R	SES	3	0	0	0	3	3	
19	PEC	PE-5	23TE53E1	HYDROGEN AND FUEL CELLS	R	HFC	3	0	0	0	3	3	
20	PEC	PE-5	23TE53E2	AIRCRAFT AND JET PROPULSION SYSTEMS	R	AJPS	3	0	0	0	3	3	
21	PEC	PE-5	23TE53E3	BATTERY AND THERMAL MANAGEMENT SYSTEMS	R	BTMS	3	0	0	0	3	3	
22	PRI	PRI-CORE	23IE6150	DISSERTATION (PART-1)	R	DIS	0	0	32	0	16	32	
23	PRI	PRI-CORE	23IE6250	DISSERTATION (PART-2)	R	DIS	0	0	32	0	16	32	
24	PRI	PRI-CORE	23IE5201	ESSENTIALS OF RESEARCH DESIGN	R	ERD	1	1	0	0	2	2	
25	PRI	PRI-CORE	23IE5149	TERM PAPER	R	TP	0	0	8	0	4	8	
26	OEC	OE-1	23OEBT01	IPR AND PATENT LAWS	R	IPR	4	0	0	0	4	4	

S#	Cat	Sub-Cat	CourseCode	Course Title	Mode	Acrym	L	T	P	S	CR	CH	Pre-req
27	OEC	OE-1	23OEIN01	FUNDAMENTALS OF IOT	R	FIOT	4	0	0	0	4	4	
28	VAC	VAC-CERT	23CC3071	PROGRAMMING USING PYTHON	R	PUP	0	0	0	8	0	8	
29	VAC	VAC-CERT	23CC3114	FLOW ANALYSIS USING ANSYS CFD	R	FAACFD	0	0	0	8	0	8	
30	AUC	AUC-CORE	23TE5101	SIMULATION OF ENERGY MANAGEMENT SYSTEMS	R	SEMS	0	0	4	0	0	4	
31	AUC	AUC-CORE	23UC5201	PROFESSIONAL COMMUNICATION SKILLS	R	PCS	0	0	4	0	0	4	
32	AUC	AUC-CAREER	CRTVQRL1V1	CAMPUS RECRUITMENT: VERBAL APTITUDE TRAINING	R	CRT: VAT	0	0	0	8	0	8	
33	AUC	AUC-CAREER	CRTVQRL2V2	CAMPUS RECRUITMENT: QUANTITATIVE APTITUDE TRAINING	R	CRT: QAT	0	0	0	8	0	8	
34	AUC	AUC-CAREER	CRTVQRL3V3	CAMPUS RECRUITMENT: REASONING APTITUDE TRAINING	R	CRT: RAT	0	0	0	8	0	8	
35	AUC	AUC-CAREER	CRTCSSL1V1	CAMPUS RECRUITMENT: COMMUNICATION SKILLS TRAINING	R	CRT: CST	0	0	0	8	0	8	
36	AUC	AUC-CAREER	CRTCSSL2V2	CAMPUS RECRUITMENT: SOFT SKILLS TRAINING	R	CRT: SST	0	0	0	8	0	8	
37	AUC	AUC-CAREER	CADCORL1V1	CAREER ADVANCEMENT: TRAINING IN CORE DOMAIN	R	CAD: TICD	0	0	0	8	0	8	
38	AUC	AUC-CAREER	CADUPSL1V1	CAREER ADVANCEMENT: UPSC-CIVIL SERVICES EXAM TRAINING	R	CAD: UPSC	0	0	0	8	0	8	
39	AUC	AUC-CAREER	CADENTL1V1	CAREER ADVANCEMENT:ENTREPRENEURIAL CAREER PATHWAY TRAINING	R	CAD: ECPT	0	0	0	8	0	8	
40	AUC	AUC-CAREER	CRTCODL1V1	CAMPUS RECRUITMENT: LOGIC BUILDING SKILLS TRAINING	R	CRT: LBST	0	0	0	8	0	8	
41	AUC	AUC-CAREER	CADCOML1V1	CAREER ADVANCEMENT:COMPETITIVE EXAM TRAINING	R	CAD: COM	0	0	0	8	0	8	

Program Articulation Matrix

S#	Cat	Course	CO	CO Description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
1	ESC	23MT5102 - CTEO	CO1	Understand the fundamental concepts of optimization, including types of problems, mathematical formulation, and programming implementation.	3	3					
2	ESC	23MT5102 - CTEO	CO2	Apply mathematical optimization techniques, both unconstrained and constrained, to solve engineering problems using programming languages like Matlab/Python/R.	3				3		
3	ESC	23MT5102 - CTEO	CO3	Analyze and solve multi-objective optimization problems, considering trade-offs and conflicting objectives, using appropriate algorithms and methodologies.	3				3		
4	ESC	23MT5102 - CTEO	CO4	Apply optimization techniques to solve application-specific problems in Machine Design and Thermal Engineering domains, demonstrating domain-specific knowledge and skills.	3				3		
5	PCC	23TE5102 - DTS	CO1	Apply the modelling concepts to the design of thermal systems		2					
6	PCC	23TE5102 - DTS	CO2	Analyze the design of thermal systems by considering its economic viability.			3	3			
7	PCC	23TE5102 - DTS	CO3	Analyze the problem formulation for optimization and its search methods and understanding Lagrange multiplier			3		3		
8	PCC	23TE5102 - DTS	CO4	Analyze the Geometric, linear and dynamic Programming and modelling of thermal equipment.					3		
9	PCC	23TE5102 - DTS	CO5	Analyze the design and Modeling of thermal systems.					3		

S#	Cat	Course	CO	CO Description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
10	PCC	23TE5102 - DTS	CO6	Analyze the models of thermal systems using tools.				3			
11	PCC	23TE5103 - ATD	CO1	Apply a review of the Joule-Thompson experiment, the Maxwell equations, the first and second laws of thermodynamics, irreversibility and availability, and energy analysis.	3				3		
12	PCC	23TE5103 - ATD	CO2	Apply thermodynamics entails grasping phase transitions, equilibrium types, multi-component and multi-phase systems, equations of state, chemical thermodynamics, combustion, and the Third Law.	3				3		
13	PCC	23TE5103 - ATD	CO3	Apply the knowledge of the kinetic theory of gases involves understanding molecular flux, the equation of state for an ideal gas, collisions with a moving wall, the principle of equipartition of energy, the classical theory of specific heat capacity, and transport phenomena related to intermolecular forces.	3				3		
14	PCC	23TE5103 - ATD	CO4	Applying fundamental knowledge of statistical thermodynamics involves understanding energy states and levels on macro and micro scales.	3				3		
15	PCC	23TE5103 - ATD	CO5	Analyze advanced thermodynamics and statistical mechanics involves a deep dive into the First and Second Laws.					3		
16	PCC	23TE5104 - CFD	CO1	Derive Governing equations of fluid flow and heat transfer and apply finite difference formulation to discretize the governing equations	3		3	3			

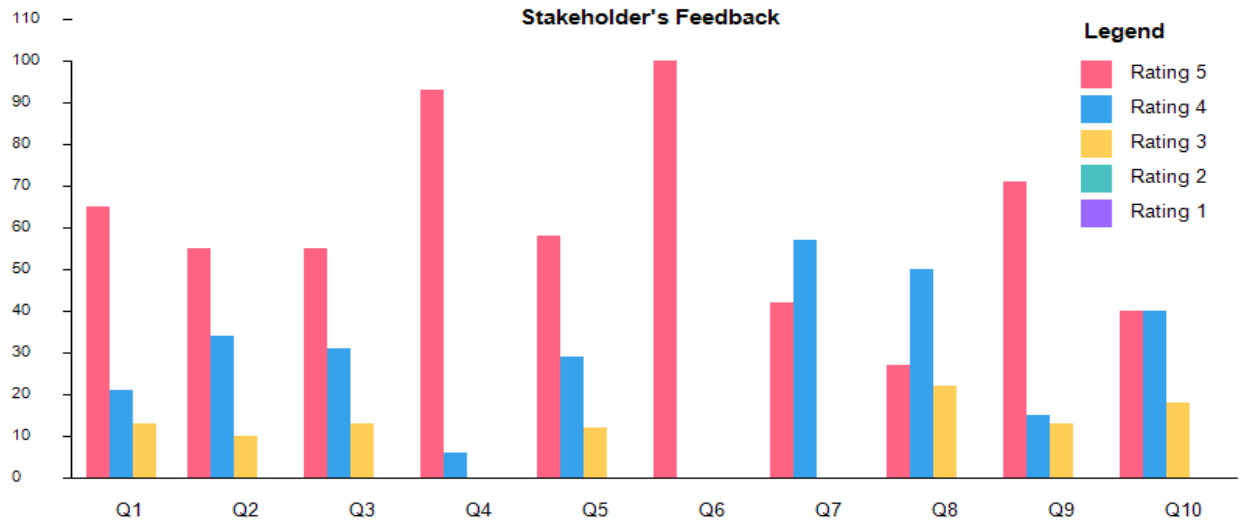
S#	Cat	Course	CO	CO Description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
17	PCC	23TE5104 - CFD	CO2	Analyze heat transfer characteristics in case of steady diffusion problems using finite volume discretization technique	3		3	3			
18	PCC	23TE5104 - CFD	CO3	Analyze fluid flow and heat transfer characteristics in case of steady advection diffusion	3		3	3			
19	PCC	23TE5104 - CFD	CO4	Formulate explicit and implicit algorithms to solve N-S Equations and to understand the turbulence modelling	3		3	3			
20	PCC	23TE5104 - CFD	CO5	Analyze various fluid flow and heat transfer characteristics using a simulation software (Ansys-Fluent)	3		3	3			2
21	PCC	23TE5205 - AHMT	CO1	Analyze 1D steady and unsteady state state heat conduction in various heat transfer applications	2	2					
22	PCC	23TE5205 - AHMT	CO2	Analyze Multidimensional and transient heat conduction and heat transfer characteristics in various various heat transfer applications	2	2					
23	PCC	23TE5205 - AHMT	CO3	Design heat exchangers by applying the basic heat transfer principles and analyze the radiation heat transfer characteristics	2	3					
24	PCC	23TE5205 - AHMT	CO4	Analyze the Diffusion and convective mass transfer in plate and pipes	2	2					
25	PCC	23TE5205 - AHMT	CO5	Analyze various the heat transfer characteristics in fins and heat exchangers using Ansys software		2	2	3			
26	PCC	23TE5206 - MTE	CO1	Apply scientific and engineering methods for the measurement of field and derived quantities	1						

S#	Cat	Course	CO	CO Description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
27	PCC	23TE5206 - MTE	CO2	Analyze principles of presentation, estimation and data analysis		2					
28	PCC	23TE5206 - MTE	CO3	Apply various experimental measurement techniques for the measurement of field quantities with probe and non-instructive techniques			1				
29	PCC	23TE5206 - MTE	CO4	Evaluate the measurement of derived quantities and analytical methods and design and conduct the experiments, as well as to organize, analyze and interpret data to produce meaningful conclusions and recommendations				3			
30	PCC	23TE5206 - MTE	CO5	Analyze the various measurement of the thermal engineering components					3		
31	PRI	23IE5149 - TP	CO1	Understand Literature Review and Problem Identification	1	2		2			
32	PRI	23IE5149 - TP	CO2	Understand Methodology and Implementation	1	2		2			
33	PRI	23IE5201 - ERD	CO1	Analyze existing research to identify a focused and answerable research question or develop a well-defined hypothesis	2	3					
34	PRI	23IE5201 - ERD	CO2	Evaluate different research designs based on their strengths and weaknesses in relation to the chosen research question and data needs.		3				2	3
35	PRI	23IE5201 - ERD	CO3	Apply appropriate data collection methods considering the chosen research design and data characteristics.	2					3	
36	PRI	23IE5201 - ERD	CO4	Analyze and interpret data using relevant data analysis methods to address the research question							3

S#	Cat	Course	CO	CO Description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
37	PRI	23IE6150 - DIS	CO1	Identify and articulate research problems within their field of study, demonstrating an understanding of current research gaps.	2				2		
38	PRI	23IE6150 - DIS	CO2	Design and execute research methodologies, employing relevant techniques for data collection, analysis, and interpretation.		2				2	
39	PRI	23IE6150 - DIS	CO3	Demonstrate advanced critical thinking skills, analyzing research findings within the context of existing literature to draw meaningful conclusions.		2			2		
40	PRI	23IE6250 - DIS	CO1	Demonstrate a comprehensive understanding of a chosen research topic and its significance in the broader field.	2					2	
41	PRI	23IE6250 - DIS	CO2	Apply appropriate research methodologies to address research questions		2			2		
42	PRI	23IE6250 - DIS	CO3	Analyze and interpret data effectively, drawing meaningful conclusions	2					2	
					2.4	2.3	2.7	2.8	2.8	2.2	2.7

Stakeholder's Feedback

Q#	Question	No. of Stakeholder's						Rating (%)				
		STU	ALU	IE	AP	FAC	TOT	[5]	[4]	[3]	[2]	[1]
Q1	How would you rate the relevance of the current syllabus content in addressing industry needs and trends?	15	1	0	7	15	38	65.8	21.1	13.2	0	0
Q2	How well do the course outcomes align with the skills required in the industry?	15	1	0	7	15	38	55.3	34.2	10.5	0	0
Q3	How would you rate the inclusion of emerging technologies or methodologies in the syllabus?	15	1	0	7	15	38	55.3	31.6	13.2	0	0
Q4	How effectively are the latest tools integrated into the curriculum?	15	1	0	0	0	16	93.8	6.3	0	0	0
Q5	How beneficial are the global certifications included in the curriculum for industry readiness?	15	1	0	0	15	31	58.1	29	12.9	0	0
Q6	How effectively does the curriculum incorporate practical lab experiments relevant to industry practices?	0	1	0	0	0	1	100	0	0	0	0
Q7	How does this curriculum compare with similar curricula at other institutions in terms of content and quality?	0	0	0	7	0	7	42.9	57.1	0	0	0
Q8	How effective is the integration of research opportunities into the curriculum?	0	0	0	7	15	22	27.3	50	22.7	0	0
Q9	How beneficial were the MOOCs recommended as part of the curriculum?	15	1	0	7	15	38	71.1	15.8	13.2	0	0
Q10	How well does the course content map to skill council recommendations?	0	0	0	7	15	22	40.9	40.9	18.2	0	0



Y24: M.Tech. - Thermal Engineering

Category: Engineering Science Courses (ESC)

23MT5102 - COMPUTATIONAL TECHNIQUES IN ENGINEERING OPTIMIZATION (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23MT5102	COMPUTATIONAL TECHNIQUES IN ENGINEERING OPTIMIZATION	CTEO	R	2	2	0	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand the fundamental concepts of optimization, including types of problems, mathematical formulation, and programming implementation.	2	PO1, PO2
CO2	Apply mathematical optimization techniques, both unconstrained and constrained, to solve engineering problems using programming languages like Matlab/Python/R.	3	PO1, PO5
CO3	Analyze and solve multi-objective optimization problems, considering trade-offs and conflicting objectives, using appropriate algorithms and methodologies.	4	PO1, PO5
CO4	Apply optimization techniques to solve application-specific problems in Machine Design and Thermal Engineering domains, demonstrating domain-specific knowledge and skills.	3	PO1, PO5

Syllabus

Introduction to Engineering Optimization: Basics of optimization, mathematical formulations, and algorithms. Applications in mechanical and machine design.

Unconstrained Optimization Techniques: Newton\'s method, gradient descent, conjugate gradient. Implementation in MATLAB/Python.

Constrained Optimization Techniques: Linear and nonlinear constraints, Lagrange multipliers, penalty and barrier methods. Application in mechanical design.

Multi-objective Optimization: Pareto optimality, weighted sum, epsilon-constraint methods. Implementing multi-objective optimization using Python.

Reference Books

1. "Engineering Optimization: Methods and Applications", Ravindran, R., Ragsdell, K. M., & Reklaitis, G. V., 2006, Wiley.
2. "Introduction to Optimization", Chong, E. K. P., & Zak, S. H., 2013, Wiley.
3. "Optimization Concepts and Applications in Engineering", Belegundu, A. D., & Chandrupatla, T. R., 2011, Pearson.
4. "Optimization in Practice with MATLAB?: For Engineering Students and Professionals", Achanta, S., & Darby-Dowman, K., 2015, Cambridge University Press.
5. "Applied Optimization: Formulation and Algorithms for Engineering Systems", Ross, I. J., 1999, Cambridge University Press.

Y24: M.Tech. - Thermal Engineering

Category: Professional Core Courses (PCC)

23TE5102 - DESIGN OF THERMAL SYSTEMS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE5102	DESIGN OF THERMAL SYSTEMS	DTS	R	2	0	2	4	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply the modelling concepts to the design of thermal systems	3	PO2
CO2	Analyze the design of thermal systems by considering its economic viability.	4	PO3, PO4
CO3	Analyze the problem formulation for optimization and its search methods and understanding Lagrange multiplier	4	PO3, PO5
CO4	Analyze the Geometric, linear and dynamic Programming and modelling of thermal equipment.	4	PO5
CO5	Analyze the design and Modeling of thermal systems.	4	PO5
CO6	Analyze the models of thermal systems using tools.	4	PO4

Syllabus

Modeling of Thermal Systems: types of models, mathematical modelling, curve fitting, linear algebraic systems, numerical model for a system, system simulation, methods for numerical simulation; Acceptable Design of thermal System: initial design, design strategies, design of systems from different application areas, additional considerations for large practical system.

Economic Considerations: calculation of interest, worth of money as a function of time, series of payments, raising capital, taxes, economic factor in design, application to thermal systems;

Problem Formulation for Optimization: optimization methods, optimization of thermal systems, practical aspects in optimal design, Lagrange multipliers, optimization of constrained and unconstrained problems, applicability to thermal systems; search methods: single-variable problem, multivariable constrained optimization, examples of thermal systems; geometric, linear, and dynami cprogramming and other methods for optimization, knowledge-baseddesign and additional considerations, professional ethics

Optimization, Objective function formulation, Constraint equations, Mathematical formulation, Calculus method, Dynamic programming, Geometric programming, linear programming methods, solution procedures. Equation fitting, Empirical equation, best fit method, method of least squares. Modeling of thermal equipments such as turbines, compressors, pumps, heat exchangers, evaporators and condensers

Reference Books

1 Thermal Design and Optimization, Bejan,G.Tsatsaronis, M.J.Moran, 1th edition, 1995, Wiley.

2 Design&SimulationofThermalSystem s, N.V.Suryanarayan a, 2th edition, 2002, MGH.

3 Design of Thermal Systems, W.F. Stoecker,, 2th edition, 1996, McGraw-Hill.

4 Design and Optimization of Thermal Systems, Y. Jaluria, 1th edition, 2004, CRC Press.

23TE5103 - ADVANCED THERMODYNAMICS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE5103	ADVANCED THERMODYNAMICS	ATD	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply a review of the Joule-Thompson experiment, the Maxwell equations, the first and second laws of thermodynamics, irreversibility and availability, and energy analysis.	3	PO1, PO5
CO2	Apply thermodynamics entails grasping phase transitions, equilibrium types, multi-component and multi-phase systems, equations of state, chemical thermodynamics, combustion, and the Third Law.	3	PO1, PO5
CO3	Apply the knowledge of the kinetic theory of gases involves understanding molecular flux, the equation of state for an ideal gas, collisions with a moving wall, the principle of equipartition of energy, the classical theory of specific heat capacity, and transport phenomena related to intermolecular forces.	3	PO1, PO5
CO4	Applying fundamental knowledge of statistical thermodynamics involves understanding energy states and levels on macro and micro scales.	3	PO1, PO5
CO5	Analyze advanced thermodynamics and statistical mechanics involves a deep dive into the First and Second Laws.	4	PO5

Syllabus

Review of first and second law of thermodynamics, Maxwell equations, Joule-Thompson experiment, irreversibility and availability, exergy analysis

phase transition, types of equilibrium and stability, multi-component and multi-phase systems, equations of state, chemical thermodynamics, combustion. Third law of thermodynamics,

Kinetic theory of gases introduction, basic assumption, molecular flux, equationof state for an ideal gas, collisions with a moving wall, principle of equi-partition of energy, classical theory of specific heat capacity. Transport phenomena-inter molecular forces, The Vander Waals equation of state, collision cross section, mean free path,

Statistical thermodynamics-introduction, energy states and energy levels, macro and micro-scales, thermodynamic probability, Bose-Einstein, Fermi-Dirac, Maxwell-Boltzmann statistics, distribution function, partition energy, statistical interpretation of entropy, application of statistics to gases-mono-atomic ideal gas.

Advanced thermodynamics and statistical mechanics, First and Second Laws, entropy in phase transitions, Maxwell\'s equations, multi-component phase diagrams, chemical equilibrium, kinetic theory of gases, and transport phenomena for aprofound understanding of physical systems

Reference Books

1 Advanced Thermodynamics for Engineers, Kenneth Wark, 1, McGraw-Hil (1995).

2 Thermodynamics, Kinetic theory, and Statistical thermodynamics, F. W. Sears, and G. L. Salinger, 3, Narosa Publishing House (1975).

3 Fundamentals of Engineering thermodynamics, M. J. Moron, and H. N. Shapiro, 5, John Wiley& Sons (2006).

4 Heat and thermodynamics, M. W. Zemansky, and R. H. Dittman, 8, McGraw Hill International (2017).

23TE5104 - COMPUTATIONAL FLUID DYNAMICS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE5104	COMPUTATIONAL FLUID DYNAMICS	CFD	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Derive Governing equations of fluid flow and heat transfer and apply finite difference formulation to discretize the governing equations	3	PO1, PO3, PO4
CO2	Analyze heat transfer characteristics in case of steady diffusion problems using finite volume discretization technique	4	PO1, PO3, PO4
CO3	Analyze fluid flow and heat transfer characteristics in case of steady advection diffusion	4	PO1, PO3, PO4
CO4	Formulate explicit and implicit algorithms to solve N-S Equations and to understand the turbulence modelling	4	PO1, PO3, PO4
CO5	Analyze various fluid flow and heat transfer characteristics using a simulation software (Ansys-Fluent)	4	PO1, PO3, PO4, PO7

Syllabus

ntroduction: Conservation equation; mass; momentum and energy equations; convective forms of the equations and general description, Classification and Overview of Numerical Methods: Classification into various types of equation; parabolic elliptic and hyperbolic; boundary and initial conditions; overview of numerical methods, Finite Difference Technique: Finite difference methods; different means for formulating finite difference equation; Taylor series expansion

Finite Volume Technique: Finite volume methods; different types of finite volume grids; approximation of surface and volume integrals; interpolation methods Finite Element Methods :Finite element methods; Rayleigh-Ritz, Galerkin and Least square methods; interpolation functions; one and two dimensional elements; applications, Methods of Solution:; iterative methods; matrix inversion methods;

ADI method; operators plitting; fast Fourier transform, Time integration Methods: Single and multi level methods; predictor-corrector methods; stability analysis; Applications to transient conduction and advection-diffusion problems, Numerical Grid Generation: Numerical grid generation; basic ideas; transformation and mapping,

Navier-Stokes Equations: Explicit and implicit methods; SIMPLE type methods; fractional step methods, Turbulence modeling: Reynolds averaged Navier-Stokes equations, RANS modeling, DNS and LES.

Analyse theoretical concepts of CFD to formulate and conduct numerical experiments using commercial software and coding

Reference Books

1 Essential Computational Fluid Dynamics, Zikanov.O, 2000, Wiley.

2 Fundamentals of CFD, T. K. Sengupta, 2004, University Press.

3 Computational Fluid Mechanics and Heat Transfer, J. C. Anderson, D. A. Tannehil and R. H. Pletcher, 2010, Taylor&Francis.

4 Computational Techniques for Fluid Dynamics, C. A. J. Fletcher,, 2010, Springer.

5 Computational Methods for Fluid Dynamics, J. H. Ferziger and M. Peric, 2006, Springer.

23TE5205 - ADVANCED HEAT AND MASS TRANSFER (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE5205	ADVANCED HEAT AND MASS TRANSFER	AHMT	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Analyze 1D steady and unsteady state state heat conduction in various heat transfer applications	4	PO1, PO2
CO2	Analyze Multidimensional and transient heat conduction and heat transfer characteristics in various various heat transfer applications	4	PO1, PO2
CO3	Design heat exchangers by applying the basic heat transfer principles and analyze the radiation heat transfer characteristics	4	PO1, PO2
CO4	Analyze the Diffusion and convective mass transfer in plate and pipes	4	PO1, PO2
CO5	Analyze various the heat transfer characteristics in fins and heat exchangers using Ansys software	4	PO2, PO3, PO4

Syllabus

Introduction - review of heat transfer Fundamentals - transient conduction and extended surface Heat Transfer, Unsteady heat conduction. Lumped capacity model, awareness of one-dimensional unsteady results (charts; Biot and Fourier numbers)

Brief review of Steady Laminar and Turbulent Heat Transfer in External and Internal Flows - Heat Transfer at High Speeds - Unsteady Laminar and Turbulent Forced Convection in Ducts and on Plates - Convection with body forces, Boundary layers and internal flows. Awareness of these configurations, some knowledge of internal flow energy balances, Convection correlations. Finding heat transfer coefficients from Reynolds numbers and Rayleigh numbers

Heat Exchangers. Typical configurations and epsilon-NTU analysis, phase-change heat transfer. General awareness of processes of condensation and boiling in a pure substance, some use of correlations, Quenching of metals, Leidenfrost problem, heat transfer of sprays, jets and films, Radiation basics -Radiation in Enclosures - Gas Radiation

Diffusion and Convective Mass Transfer - Combined Heat andMass Transfer from Plates and in Pipes.

Reference Books

1 Heat Transfer, A. Bejan, 5th edition: 1993, John Wiley & Sons.

2 Advanced Heat and Mass Transfer, A.Faghri, Y. Zhang, J. Howell, 3rd edition: 2010, Global Digital Press.

3 Heat Transfer, P.S.Ghoshdatidar, 3rd Edition: 2004, Oxford University Press.

4 Heat and Mass Transfer: Fundamentals and Applications, Yunus A. ?engel, Afshin J. Ghajar, 5th Edition:2015, McGraw-Hill Education.

23TE5206 - MEASUREMENTS IN THERMAL ENGINEERING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE5206	MEASUREMENTS IN THERMAL ENGINEERING	MTE	R	2	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply scientific and engineering methods for the measurement of field and derived quantities	3	PO1
CO2	Analyze principles of presentation, estimation and data analysis	4	PO2
CO3	Apply various experimental measurement techniques for the measurement of field quantities with probe and non-instructive techniques	3	PO3
CO4	Evaluate the measurement of derived quantities and analytical methods and design and conduct the experiments, as well as to organize, analyze and interpret data to produce meaningful conclusions and recommendations	4	PO4
CO5	Analyze the various measurement of the thermal engineering components	4	PO5

Syllabus

Introduction to measurements for scientific and engineering applications- need and goal - broad category of methods for measuring field and derived quantities

Principlesofmeasurement-parameterestimation-regressionanalysis-correlationserrorestimation and data presentation - analysis of data;

Measurement of field quantities -thermometry-heat flux measurement-measurement of force, pressure, flowrate, velocity, humidity, noise, vibration- measurement of the above by probe and nonintrusive techniques

Measurement of derived quantities-torque,power,thermo-physical properties - radiation and surface properties; Analytical methods and pollutionmonitoringmassspectrometry-chromatography-spectrosc

Reference Books

1 Fluid mechanics and measurements, ,R.J.Goldstein , 1th edition, 2005, Taylor Francis.

2 Hand book of experimental fluid mechanics, C.Tropea,Y.Alexander,J.F.Foss , 2th edition, 1994, Springer.

3 Experiments and Uncertainty Analysis for Engineers, H.W. Coleman and W.G. Steele Jr, 1th edition, 1997, Wiley & Sons, .

4 Fundamentals of temperature, pressure and flow measurement, R. P. Benedict, 2th edition, 2008, John Wiley and Sons.

Y24: M.Tech. - Thermal Engineering

Category: Professional Elective Courses (PEC)

23TE51A1 - GAS TURBINE ENGINEERING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE51A1	GAS TURBINE ENGINEERING	GTE	R	2	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply the concepts of air standard cycle to analyse the performance of ideal and actual gas turbine cycles	3	PO1
CO2	Apply gas turbine theory to jet propulsion and understand fabrication techniques of components	3	PO1
CO3	Analyze the performance of compressors and combustion chambers.	4	PO2
CO4	Analyze the performance of gas turbine and cogeneration systems.	4	PO2
CO5	Analyze troubleshooting of gas turbine systems in various mechanical and aerospace applications.	4	PO2

Syllabus

Thermodynamics of gas turbines: Cycle analysis; Gas Turbine Components: compressor, combustor, heat exchangers, turbine - description: analytical considerations, performance.

Matching of compressor and turbine: cooling of turbine blades. Compressor and turbine impeller construction, blade fixing details, sealing; Material selection for components

Protective coating for hot turbine parts, Components fabrication techniques, Gas turbine turbocharger, gas turbine power generation, turbo expander, gas turbine application, Closed cycle gas turbines

Co-generation-Introduction, Thermodynamics of co-generation, Criteria for component performance, Some practical schemes

Reference Books

1 Aircraft Propulsion and Gas Turbine Engines, AhmedF.El-Sayed , 1, CRCpress,2008.

2 Turbine, Compressors and Fans , S.M. Yahya, 1, MC Grahill.

3 Gas Turbine Theory, H.I.H. Saravanamuttoo, G.F.C. Rogers, and H. Cohen, 7, Pearson.

4 Gas Turbine Performance, Philip P. Walsh and Paul Fletcher, 1, Wiley.

23TE51A2 - ELECTRIC VEHICLE ENGINEERING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE51A2	ELECTRIC VEHICLE ENGINEERING	EVE	R	2	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand Hybrid /EV Vehicles and study of vehicle dynamics	3	PO1, PO2
CO2	Apply Architecture of Hybrid/EV Vehicles, components and Battery EV	3	PO1, PO2, PO3
CO3	Apply and analyse Fuel Cell, DC/AC Drives and SRM	3	PO1, PO3, PO4
CO4	Apply EV Controls, Controller, and control strategies	4	PO1, PO2, PO4
CO5	Analyze and apply theoretical concepts to develop mathematical models and simulate the Combustion and EV Vehicles	5	PO2, PO3, PO5

Syllabus

:Introduction: Electric Vehicle History, Components of Electric Vehicle, Comparison with Internal combustion, Engine: Technology, Comparison with Internal combustion Engine: Benefits and Challenges, EV classification and their electrification levels, EV Terminology Motor Torque Calculations for Electric Vehicle:

Calculating the Rolling Resistance, calculating the grade resistance, Calculating the Acceleration Force, Finding the Total Tractive Effort, Torque Required On The Drive Wheel. Electric Vehicle Architecture Design:

Types of Electric Vehicle and components, Electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV), Plug-in hybrid vehicle(PHEV), Fuel cell electric vehicle (FCEV), Electrification Level of EV, Comparison of fuel vs Electric and solar power, Solar Power operated Electric vehicles. Electric Drive and controller:

Types of Motors, Selection and sizing of Motor, RPM and Torque calculation of motor, Motor Controllers, Component sizing, Physical locations, Mechanical connection of motor, Electrical connection of motor.

Reference Books

1 Vehicular Electric Power Systems, Ali Emadi, Mehrdad Ehsani, John M. Miller, 1, Marcel Dekker Publications.

2 Vehicle Dynamics- Theory & Practice, Reza N. Jazar, 1, Springer Publications..

3 Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, 5, CRC Press.

23TE51A3 - ENERGY CONSERVATION & AUDIT (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE51A3	ENERGY CONSERVATION & AUDIT	ECA	R	2	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand the energy auditing methods to meet the energy conservation and various tariffs	2	PO2
CO2	Apply the energy conservation techniques to power system elements	3	PO5
CO3	Understand the energy conservation opportunities in industrial motors and lighting systems	2	PO3
CO4	Understand the energy conservation opportunities incooling systems and cogeneration	2	PO2
CO5	Apply energy conservation techniques in electrical installations	3	PO5

Syllabus

Role of energy in economic development and social transformation, Energy Sources and Overall Energy demand and availability, Energy Conservation Act-2001 & 2003. Electricity Tariff. Energy Audit, Need, Types, Methodology and Approach.

Energy Management Approach, Understanding Energy Costs, Bench marking, Energy performance, matching energy usage to requirements, maximizing system efficiency. Instruments Used in Energy Auditing, Energy Conservation opportunities in Transformers and cables. Energy Conservation opportunities in Transmission lines, P.F. improvements, Demand Side management (DSM), Variable speed drivers.

Electric Motors Types, Losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, Energy efficient motors and Soft starters.

Energy conservation opportunities. Illumination / Lighting Systems: Light source, choice of lighting, luminance requirements, electronic ballast, occupancy sensors, energy efficient lighting control. LED Ligh ting, Trends and Approaches.

Energy conservation opportunities in HVAC, Refrigeration and Air Conditioning systems, Energy Saving in Pumps & Pumping Systems. Energy Conservation Opportunities in Public and Private Buildings, Concepts of Cogeneration. Peak Demand controls- Methodologies

Reference Books

1 Energy-Efficient Electric Motors and their applications , Howard E.Jordan, 2, Plenum pub corp.

2 Energy Management Hand book , Turner, Wayne C, 2, The Fairmont press.

23TE52B1 - ADVANCED ENERGY STORAGE TECHNOLOGIES (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE52B1	ADVANCED ENERGY STORAGE TECHNOLOGIES	AEST	R	2	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand various thermal storage systems and storage materials	2	PO1
CO2	Analyze the sensible and latent heat concepts and develop a heat storage units	4	PO2
CO3	Apply the basics of storage systems to understand the various thermal storage systems	3	PO1
CO4	Apply the principles of heat storage systems on regenerators and its applications	3	PO1
CO5	Analyze various energy storage Systems using using a commercial software Ansys-Fluent	4	PO1

Syllabus

Necessity of thermal storage, types, energy storage devices , comparison of energy storage technologies, seasonal thermal energy storage

Basic concepts and modelling of heat storage units , modelling of simple water and rock bed storage system , use of TRNSYS ,pressurized water storage system for power plant applications

Modelling of phase change problems , temperature based model , enthalpy model , porous medium approach ,conduction dominated phase change, convection dominated phase change

Specific areas of application of energy storage , food preservation, waste heat recovery ,solar energy storage , green house heating , power plant applications, drying and heating for process industries

Reference Books

1 Energy Production and Storage , Crabtree R.H, 1, Wiley.

2 Energy Storage Fundamentals, Materials and Applications, Huggins & Robert, 1, Springer .

3 Thermal Energy Storage Systems and Applications, Ibrahim Dincer and Mark A. Rosen, 1, Wiley & Sons.

4 Advanced Energy Storage Technologies and Their Applications, Junsheng Zhang and Shaohua Jia, 2, MDPI.

23TE52B2 - FOOD PROCESSING, PRESERVATION AND TRANSPORT (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE52B2	FOOD PROCESSING, PRESERVATION AND TRANSPORT	FPPT	R	2	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply food preservation methods and understand the factors effecting food deterioration	3	PO1
CO2	Analyse the different types of drying and food concentration methods	4	PO1
CO3	Analyse the role of natural, chemical preservatives and recent preservation techniques	4	PO2
CO4	Analyse the effect of molecules in transport mechanisms	4	PO2
CO5	Analyse the transport of goods under varying conditions	4	PO2

Syllabus

Food and its preservation Food preservation - Need, importance, principals and methods. Perishable and non perishable foods, concept of shelf life- definition and factors affecting water activity in food and its significance in food preservation, factors affecting food deterioration

Drying- Theory and Mechansim, drying characteristics of materials, preliminary processing, Sun drying vs dehydration, Driers - Air convection driers and types, Drum /Roller Drier, Vacuum drier, Belt drier, tunnel drier, spray drier, rotary drier, fluidized bed drier, Freeze drying and microwave drying

Use of high temperature- principle and equipments: Methods - pasteurization, blanching, sterilization , canning-procedure, canning of acid foods and nonacid foods, aseptic canning nutritive value of canned foods, types of spoilage in canned foods, storage of canned foods, influence of canning on the quality of food

Introduction to transport phenomena. Molecular transport mechanism, transport properties and their proportionality constants in momentum, energy and mass transfer. Mass transfer

Reference Books

1 Food Microbiology, William C Frazier & Dennis C Westhoff, 2013, Tata McGraw Hill Publications.

2 Food Science, Norman N Potter Joseph H Hotchkiss, 2005, CBS Publishers.

3 The Technology of Food Preservation, Norman W Desrosier James N Desrosier, 2006, CBS Publishers.

4 Food Processing and Preservation, B. Sivasankar P, 2002, PHI Learning Pvt Ltd.

5 Introduction to Food Science and Technology, Stewart GP and Amerine MA, 2012, Elsevier.

23TE52B3 - CONVECTION AND TWO-PHASE FLOW (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE52B3	CONVECTION AND TWO-PHASE FLOW	CTPF	R	2	0	2	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply the knowledge of fluid mechanics and heat transfer to understand the two-phase flow phenomena	3	PO1, PO3
CO2	Analyze various boiling mechanisms	4	PO1, PO3, PO5
CO3	Analyze various condensation mechanisms	4	PO1, PO3, PO5
CO4	Analyze the performance of various devices based on two-phase flow and heat transfer	4	PO3
CO5	Simulate and analyse two phase flows with and without phase change	4	PO3, PO7

Syllabus

Introduction to two-phase flow and heat transfer technology, Liquid-vapor phase change phenomena, Interfacial tension, Wetting phenomenon, Contact angles, Transport effects, Dynamic behavior of interfaces, Phase stability and nucleation, Two-phase flow fundamentals, Flow patterns and map representation

Development of homogeneous, separated flow and drift flux models, Flooding mechanisms, Boiling Fundamentals, Homogeneous and heterogeneous nucleation, Pool boiling and convective flow boiling, Heat transfer and CFH mechanisms, Enhancement techniques

Condensation fundamentals, External and internal condensation, Film condensation theory, Drop-wise condensation theory, Enhancement techniques micro-scale boiling and condensation, atomistic nucleation models.

Application of two-phase flow and heat transfer, Electronics thermal management, Latent heat storage devices, Gravity assisted thermo-siphons/Vapor chambers, Theory and operation of Conventional heatpipes, Micro heatpipes, Pulsating heat pipes, Capillary pumped oops/Loop heatpipes, Micro two-phase heat exchangers, Static and dynamic instabilities,

Simulate and analyse two phase flows with and without phase change. Film condensation theory, Drop-wise condensation theory, Enhancement techniques micro-scale boiling and condensation, atomistic nucleation models.

Reference Books

1 Heat Transfer Characteristics in Boiling and Condensation, KarlStephan, 1976, Springer.

2 Liquid Vapor Phase Change Phenomena, Van P. Carey, 2020, Taylor & Francis.

3 Two-phase Flow and Heat Transfer, P. B. Whalley, 2005, Oxford Engineering Science.

4 One Dimensional Two-Phase Flow, , G. B. Wallis, 2020, TMH.

23TE52C1 - RENEWABLE ENERGY SOURCES & TECHNOLOGY (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE52C1	RENEWABLE ENERGY SOURCES & TECHNOLOGY	REST	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand concept of various forms of Non-renewable and renewable energy	2	PO3
CO2	Outline division aspects and utilization of renewable energy sources for both domestics and industrial applications	2	PO3
CO3	Study the environmental and cost economics of using renewable energy sources compared to fossil fuels	2	PO3
CO4	Understand the commercial energy and renewable energy sources. Know the working principle of various energy systems	2	PO3
CO5	Apply RET Screen software in feasibility analysis for the installation of Solar PV and water heater	4	PO3

Syllabus

Renewable Energy Sources in India - Potential sites, availability. Solar Energy: Measurement and collection, flat plate collectors, concentrating collectors, solar ponds

photovoltaic conversion, Thermal energy storage. Ocean Energy: Principles of OTEC; wave energy, tidal energy, energy conversion systems. Wind Energy: Principle, potential and status; Wind Characteristics; National Wind Atlas; Theory of wind turbine blades; Types of wind turbines and their characteristics.

Biofuels: Sources and potential, properties and characterization; Biogas generation through aerobic and anaerobic digestion; Thermochemical methods of biofuel utilization: Combustion and gasification; Status of biofuel technology

Geothermal Energy-Nature, types and utilization. Applications: Applications of renewable energy sources-Typical examples.

Reference Books

1 Renewable Energy Resources, Twidell, 4, 2021, CRC Press.

2 Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, 3, 2012, Oxford University Press.

3 Wind Energy Conversion systems, L. L. Freris, 1, 1990, Prentice Hall.

4 Renewable Energy Resources: Basic Principles and Applications, Tiwari and Ghosal, 1, 2005, Alpha Science International.

23TE52C2 - PRINCIPLES OF TURBO MACHINERY (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE52C2	PRINCIPLES OF TURBO MACHINERY	PTM	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Analyse the design principles of turbomachinery to improve and optimize its performance	4	PO2
CO2	Design the performance of Turbo machines for engineering applications	5	PO3
CO3	Analyse the energy transfer process in Turbomachines and governing equations of various forms.	4	PO2
CO4	Design various Turbomachines for power plant and aircraft applications	5	PO3
CO5	Design and Maintain Turbomachinery Using Ansys Simulation Solutions	5	PO3

Syllabus

Classification - Specific work - Representation of specific work in T-s and h-s diagrams -Internal and external losses

Euler\'s equation of turbo-machinery - Ideal and actual velocity triangles-Slip and its estimation-Impulse and reaction type machines

Degree of reaction - Effect of outlet blade angle on blade shape - Model laws, specific speed and shape number-Special features of hydro, steam and gas turbines

Performance characteristics of turbo-machines-Cavitation, Surge and Stall-Thin aerofoil theory - Cascade mechanics.

Use of CFD for Turbo-machinery analysis and design.

Reference Books

1 Fundamentals of Turbomachinery, WilliamW.Peng, 4, 2020, JohnWiley&Sons.

2 Principles of turbomachinery, D.G.Shepherd, 3, 2011, Macmilan.

3 Aircraft Propulsion and Gas Turbine Engines, AhmedF.El-Sayed, 3, 2009, CRCpress.

4 Hydraulic and Compressible Flow Turbo machines, A.T.Sayers, 2, 2008, Mc-GrawHill.

23TE52C3 - HEAT EXCHANGER DESIGN (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE52C3	HEAT EXCHANGER DESIGN	HED	R	3	0	2	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Classify heat exchangers and understand thermo-hydraulicfundamentals of the exchangers	2	PO1
CO2	Apply LMTD and effectiveness NTU methods for the design of different typesof shell and tube heat exchangers	3	PO3
CO3	Apply different methods in the design of shell and tube heat exchangers	3	PO3
CO4	Design of Compact heat exchangers and study of fouling control techniques	3	PO3
CO5	Analyze the performance of various heat exchangers and optimize the design parameters using ANSYS software	4	PO3

Syllabus

Heat Exchangers: Introduction, Classification, and Selection. Heat Exchanger: Thermo Hydraulic Fundamentals

Heat Exchanger Design. Compact Heat Exchangers. Shell and Tube Heat Exchanger Design.Regenerators. Plate Heat Exchangers and Spiral Plate Heat Exchangers

Heat-Transfer Augmentation. Fouling;Flow-Induced Vibration of Shell and Tube Heat Exchangers. Mechanical Design of Shell and Tube HeatExchangers.

Corrosion; Material Selection and Fabrication. Quality Control and Quality Assurance andNondestructive Testing. Heat Exchanger Fabrication

Reference Books

1 Heat Exchangers: Selection, Design and Construction, E. A. Saunders, Longman, 1988, Scientific and Technical.

2 Fundamentals of Heat Exchanger Design, Ramesh K. Shah, Dusan P. Sekulic, , 2002, Wiley.

3 Heat Exchanger Design, Arthur P. Fraas, 2nd Edition: 1989, Wiley.

4 Heat Exchangers: Selection, Rating, and Thermal Design, Sadik Kaka?, Hongtan Liu, 3rd Edition :2002, CRC Press.

23TE52D1 - REFRIGERATION AND CRYOGENICS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE52D1	REFRIGERATION AND CRYOGENICS	RAC	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply basic thermodynamic principles to produce low temperatures and to the liquefaction systems.	3	PO2
CO2	Analyse different types of cryogenic refrigerators and insulation and their applications.	4	PO2
CO3	Describe the properties of matter at low temperatures and the techniques used to measure them.	2	PO3
CO4	Understand the principle of superconductivity, adiabatic demagnetization, and dilution refrigeration etc. to produce low temperatures	2	PO2

Syllabus

Review of Basic Thermodynamics, Properties of Cryogenic fluids, First and Second Law approaches to the study of thermodynamic cycles, Isothermal, Adiabatic, and Isenthal pic processes. Production of Low Temperatures: Liquefaction systems, ideal, Cascade, LindeHampson, and Claude cycles and their derivatives; Refrigerators: Stirling, Gifford-McMahoncycles and their derivatives.

Cryogenic Insulations: Foam, Fibre, powder, and Multi-layer.Applications of Cryogenics in Industry, Space Technology, Nuclear Technology, Biology, and Medicine. The matter at low temperatures: specific heat, thermal conductivity, electrical conductivity, magnetic and mechanical properties.

Properties of liquid 4He and 3He; and their measurements. Review of a free electron and band theory of solids: Basic properties of Superconductors; outlines of Ginzbarg Landau and Bardeen-Cooper-Schrieffer theories of superconductivity.

superconducting tunnelling phenomena; Introduction to type IIsuperconductivity including flux flow and critical current density: High-temperature superconductivity. Production of very low temperatures by adiabatic demagnetization, dilution refrigeration, and nuclear demagnetization.

Reference Books

1 A Textbook of Cryogenics, V V Kostionk, 1, Discovery Publishing house (2015).

2 Cryogenic Fundamentals, Haselden.G.G, 1, Academic Press-Newyork (1971).

3 Principles of Refrigeration, Dossat Thomas, 4, J.Horan Books (2002).

4 Refrigeration and Air conditioning, Stoecker and Jones, 2, McGraw Hill (1983).

5 Cryogenic Systems, RFBarron, 2, Oxford University press (1985).

6 Cryogenics-Theory, Process, and applications, Allyson E Hayes, 2, Nova science Incorporated (2011).

23TE52D2 - AIR CONDITIONING SYSTEMS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE52D2	AIR CONDITIONING SYSTEMS	ACS	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply Psychrometric process in air conditioning equipment	3	PO1
CO2	Analyse the effect of cooling and dehumidification	4	PO1
CO3	Analyse air conditioning processes in various seasons.	4	PO2
CO4	Analyse the factors governing optimum effective temperature, Design consideration in comfort air conditioning systems.	4	PO2

Syllabus

PSYCHROMETRY: Properties of moist air. Important Psychrometry properties, Dry bulb temperature, Humidity ratio, degree of saturation, Dew point temperature and Enthalpy, Psychometric chart and ASHRAE chart. Psychrometric process in air conditioning equipment, Bypass factor and sensible heat factor

APPLIED PSYCHROMETRY: Use of Effective and grand sensible heat factor, Selection of air conditioning equipment for cooling and dehumidification. High latent cooling load applications, All outdoor air applications.

AIR CONDITIONING PROCESSES: Mixing process- Summer, winter and year round air Conditioning system, Hot and dry outdoor conditions. Hot and humid outdoor conditions. Winter air conditioning system. Year round air conditioning system.

COMFORT AIR CONDITIONING: Thermodynamics of human body. Body regulation process against heat and cold. Comfort & Comfort chart, Effective temperature, Factors governing optimum effective temperature, Design consideration. Selection of outside and inside design conditions, Air conditioning control systems, basic elements of the control system, Temperature, Humidity & Pressure controls, Refrigeration, Room thermostat.

Reference Books

1 Refrigeration & Air Conditioning, CP Arora, 2013, Tata McGraw Hill Publications.

2 Refrigeration & Air Conditioning, Arora and Domkundwar, 2005, Dhanpat Rai &Co.

3 Refrigeration & Air Conditioning, RC Arora, 2012, PHI Learning Pvt Ltd.

4 Refrigeration & Air Conditioning, SC Jain, 2002, Chand & Co.

5 Hand Book of Air Conditioning System Design, Carrier, 2012, Carrier.

23TE52D3 - SOLAR ENERGY & SYSTEMS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE52D3	SOLAR ENERGY & SYSTEMS	SES	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Expose to Solar energy and its applications	3	PO1
CO2	Demonstrate the importance of renewable energy source and various applications of solar energy systems	3	PO1
CO3	Do the preliminary analysis related to solar energy systems and design of solar PV and solar thermal systems	3	PO1
CO4	Identify the power electronic converters for solar PV energy systems	4	PO1

Syllabus

Availability, Measurement and Estimation, Isotropic and an Isotropic Models, Introduction to Solar Collectors ,Liquid Flat, Plate Collector, Air Heater and Concentrating Collector and Thermal Storage, Steady State Transient Analysis, Solar Pond, Solar Refrigeration

Modeling of Solar Thermal Systems and Simulations in Process Design: Design of Active Systems by f-chart and Utilizability Methods, Water Heating Systems, Active and Passive, Passive Heating and Cooling of Buildings, Solar Distillation, Solar Drying

Photovoltaic Solar Cell P-N Junction Metal Schottky Junction, Electrolyte Semiconductor Junction, Types of Solar Cells their Applications

Experimental Techniques to determine the Characteristics of Solar Cells, Photovoltaic Hybrid Systems Photovoltaic Thermal Systems, Storage Battery, Solar Array and their Characteristics Evaluation, Solar Chargeable Battery

Reference Books

1 Solar Energy: Principles of Thermal Collection and Storage, S.P. Sukhatme, J K Nayak, 3, 2008, McGraw-Hill Education.

2 Solar Energy Handbook, J.F. Kreider and F. Kreith, 2, 2022, McGraw-Hill .

3 Solar Energy : Fundamentals and Applications, J Prakash, 1, 2000, McGraw-Hill Education.

4 Solar Photovoltaic Power Systems : Principles Design And Applications, Dr. Sundaravadivelu S, 1, 2017, Notion Press.

23TE53E1 - HYDROGEN AND FUEL CELLS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE53E1	HYDROGEN AND FUEL CELLS	HFC	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand various properties of hydrogen and variousproduction methods	2	PO1, PO2
CO2	Understand hydrogen storage methods and employing hydrogenas fuel for IC engine	2	PO1, PO2
CO3	Apply fuel cell basics and Fuel cell thermodynamics	3	PO1, PO2
CO4	Apply fuel cell reaction kinetics	3	PO1, PO2

Syllabus

Hydrogen basics and Production methods: Hydrogen physical and chemical properties

Hydrogen storage methods: Hydrogen storage options, compressed gas, liquidhydrogen

Overview of Fuel Cells, low and high temperature fuel cells. Fuel Cell performance, Polymer electrolytefuel cells, Alkaline fuel cells, Phosphoric fuel cells,

Fuel cell reaction kinetics - electrode kinetics, over voltages, Tafelequation, charge transfer reaction, exchange currents, electrocatalyses - design, activation kinetics, Fuel cellcharge and mass transport - flow field, transport in electrode and electrolyte

Reference Books

1 Hydrogen and Fuel Cells: A Comprehensive Guide, Rebecca L. and Busby, 2005, Penn WellCorporation, Oklahoma.

2 Fuel Cell Handbook, Mark C. Williams and H. Quedenfeld, 2004, EG&GTechnical Services, Inc.

3 Fuel Cells Principles and Applications, Viswanathan, B and M Aulice Scibioh, 2006, Universities Press.

4 Non Conventional Energy Sources, G.D Rai, 2017, Khanna Publishers.

23TE53E2 - AIRCRAFT AND JET PROPULSION SYSTEMS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE53E2	AIRCRAFT AND JET PROPULSION SYSTEMS	AJPS	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Analyze the Air craft and jet propulsion systems and its applications,	4	PO1, PO2, PO4
CO2	Applying the One Dimensional Flows and shock waves	3	PO1, PO2, PO4
CO3	Applying the Propulsive Engines For Aircraft	3	PO1, PO2, PO4
CO4	Analyze the Shaft Power and Gas Turbine Cycles	4	PO1, PO2, PO4

Syllabus

Basic Principles of Propulsion, Historical background, how the jet engines make thrust: conceptual basis; Jet engine: Turbo-jet, Turbo-fans, Turbo prop, Turbo-shaft, Ramjet. Scramjets. Combustion and Fuel Systems in Jet Engines: Principles of combustion processes in jet engines, Design and operation of fuel systems for efficient and reliable engine performance.

Compressible flow; Quasi One dimensional flow, Normal shock, Oblique shock, , Air intake, Nozzle flow, Boundary layer flow, Rayleigh flow, Fanno flow, Effect of frictional duct length in subsonic flow and supersonic flow, numerical problems in 1D flow

The Otto cycles; IC engines for aircraft application Reciprocating engine performance; Supercharging and Performance enhancement Propeller fundamentals & Theories. Engine Cooling and Lubrication Systems: Importance and methods of cooling in aircraft engines, Lubrication system design and its role in engine reliability and performance.

Reheat cycle, cycle with heat and heat exchange, Methods of accounting for components losses, stagnation properties, compressor and turbine efficiencies, isentropic and polytropic, pressure losses, heat exchanger effectiveness, Mechanical losses, bleed flows, design point calculations, comparative performance of practical cycles.

Reference Books

1 Elements of Gas Turbine Propulsion, Mattingly J.D, 2015, McGraw hill.

2 Aerothermodynamics of Aircraft Engine Components, G C Oates, 1997, AIAA.

3 Aircraft Propulsion and Gas Turbine Engines, Ahmed F. El-Sayed, 2017, CRC Press Taylor & Francis group.

4 Jet Propulsion: A Simple Guide to the Aerodynamic and Thermodynamic Design and Performance of Jet Engines, N. A. Cumpsty, 2003, Cambridge University Press.

23TE53E3 - BATTERY AND THERMAL MANAGEMENT SYSTEMS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE53E3	BATTERY AND THERMAL MANAGEMENT SYSTEMS	BTMS	R	3	0	0	0	3

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Select suitable battery for EV application	3	PO1
CO2	Compare the materials used for the components of the battery	4	PO2
CO3	Conduct tests on battery cells to determine various performance and operating parameters	4	PO3
CO4	Estimate heat generation inside battery and propose cooling strategy for the battery pack.	4	PO4

Syllabus

History of Battery cells, Primary Battery, Secondary Battery, Performance parameters and operating variables of Battery, Electric vehicle (EV) requirements, Battery Technologies for EV applications, Lead Acid battery, Nickel Cadmium, Nickel Metal Hydrite, Lithium-Ion Batteries: Working, chemical reactions, comparison, future battery trends and challenges, Metal-Air Batteries, fuel cells, ultra-capacitors

Introduction, Components, Functions, Cathode Materials, Anode Materials, Electrolytes: salts and solvents, separators, advantages and drawbacks, Battey cell Manufacturing: Cylindrical, prismatic and Pouch cells, recycling/disposal of batteries

Battery operating and performance parameters, Charge-discharge characteristics of batteries, Measurement of current, voltage, temperature, Estimation of SOC: Coulomb Counting method, OCV method, Estimation of SoH, Capacity, efficiency

Heat Generation inside battery, Thermal issues of Lithium-Ion Battery, impact of temperature on capacity, cycle life, Thermal Runaway, Cooling strategies: Direct/indirect cooling, Air cooling, liquid cooling, PCM based cooling, advanced colling methods

Reference Books

1 Battery Management Systems, Gregory L. Plett,, 1th edition, 2006, Artech House, London.

2 Li-I Batteries Basics and Applications, Reiner_Korthauer, 2th edition, 1990, Springer International Publication.

3 Fundamentals and Application of Lithium-ion Batteries in Electric Drive Vehicles, Jiuchun Jiang, Caiping Zhang -, 2th edition, 1996, Wiley.

4 Thermal Energy Storage Systems and Applications,, Ibrahim Dincer and Mark A. Rosen, 2th edition, 2009, Wiley & Sons.

Y24: M.Tech. - Thermal Engineering

Category: Project Research And Internship (PRI)

23IE5149 - TERM PAPER (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23IE5149	TERM PAPER	TP	R	0	0	8	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand Literature Review and Problem Identification	2	PO1, PO2, PO4
CO2	Understand Methodology and Implementation	2	PO1, PO2, PO4

Syllabus

Literature Review and Problem Identification

Methodology and Implementation

Reference Books

1 Research methodology, C R Kothari, Ist Edition, New Age International Publishers.

2 Research Methodology, Panneerselvam R, Ist Edition, PHI.

3 Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, Ist Edition, SAGE Publications Ltd.

4 Researching Lived Experience Human Science for an Action Sensitive Pedagogy, Max Van Manen, Ist Edition, State Univ of New York Pr.

23IE5201 - ESSENTIALS OF RESEARCH DESIGN (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23IE5201	ESSENTIALS OF RESEARCH DESIGN	ERD	R	1	1	0	0	2

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Analyze existing research to identify a focused and answerable research question or develop a well-defined hypothesis	4	PO1, PO2
CO2	Evaluate different research designs based on their strengths and weaknesses in relation to the chosen research question and data needs.	4	PO2, PO6, PO7
CO3	Apply appropriate data collection methods considering the chosen research design and data characteristics.	3	PO1, PO6
CO4	Analyze and interpret data using relevant data analysis methods to address the research question	4	PO7

Syllabus

Definition and objectives of Research Types of research, Various Steps in Research process, Applied Mathematical tools for analysis, developing a research question- Choice of a problem, Literature review, Surveying, Synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research APA Ethics code.

Literature Review (LR) Meaning and its Types-Narrative and Systematic, LR using Web of Science, Google and Google Scholar, Citations-Types, referencing in academic writing, Citation vs Referencing Vs Bibliography, Citation tools Zotero, Qualitative Research and its methods, Quantitative Research, and its Methods. Data Collection-Primary data collection using Questionnaire, Google forms, survey monkey, Testing the validity and Reliability of Questionnaire using Factor Analysis and Cronbach\'s Alpha

Diagrammatic and graphical presentation of data: Diagrams and Graphs of frequency data of one variable- histogram, bar charts simple, sub divided and multiple; line charts, Diagrams and Graphs of frequency data of two variables scatter plot, preparing data for analysis. Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Error Analysis. Analysing data using one dimensional statistics, two-dimensional statistics and multidimensional statistics.

Technical Writing and Publishing, Conference presentations, Poster Presentations, Plagiarism check and tools, Self Plagiarism. Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, Design Thinking for Contextualized Problem Solving and Empathetic Research.

Reference Books

1 Business Research Methods , Donald R.Cooper, Pamela S. Schhindler, 12th , McGraw-Hill.

2 Research Methods, Nicholas Walliman,Routledge, 3rd, The Taylor & Francis Group.

3 Essentials of Research Design and Methodology, David DeMatteo,Geoffrey R. Marczyk, 4th, wiley .

4 Research Design: Qualitative, Quantitative, and Mixed Methods Approaches , J. David Creswell, 6th, wiley.

23IE6150 - DISSERTATION (PART-1) (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23IE6150	DISSERTATION (PART-1)	DIS	R	0	0	32	0	16

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Identify and articulate research problems within their field of study, demonstrating an understanding of current research gaps.	4	PO1, PO5
CO2	Design and execute research methodologies, employing relevant techniques for data collection, analysis, and interpretation.	5	PO2, PO6
CO3	Demonstrate advanced critical thinking skills, analyzing research findings within the context of existing literature to draw meaningful conclusions.	5	PO2, PO5

Syllabus

Identify and articulate research problems within their field of study, demonstrating an understanding of current research gaps.

Design and execute research methodologies, employing relevant techniques for data collection, analysis, and interpretation.

Demonstrate advanced critical thinking skills, analyzing research findings within the context of existing literature to draw meaningful conclusions.

Reference Books

1 Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, John W. Creswell and J. David Creswell, 2018, SAGE Publications.

2 Engineering Research Methodology: A Practical Insight for Researchers, Dipankar Deb, Brojo Kishore Mishra, and Jayanta Bhattacharya, 2019, Springer.

3 Essentials of Research Methodology for Engineers, Pradip Kumar Sahu, 2020, Springer.

4 Advanced Research Methods for Engineers, Ali Salehnia and Ebrahim Pouresmaeil, 2018, Elsevier.

23IE6250 - DISSERTATION (PART-2) (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23IE6250	DISSERTATION (PART-2)	DIS	R	0	0	32	0	16

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Demonstrate a comprehensive understanding of a chosen research topic and its significance in the broader field.	4	PO1, PO6
CO2	Apply appropriate research methodologies to address research questions	3	PO2, PO5
CO3	Analyze and interpret data effectively, drawing meaningful conclusions	4	PO1, PO6

Syllabus

Demonstrate a comprehensive understanding of a chosen research topic and its significance in the broader field.

Apply appropriate research methodologies to address research questions

Analyze and interpret data effectively, drawing meaningful conclusions

Reference Books

1 Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, John W. Creswell and J. David Creswell, 2018, SAGE Publications.

2 Engineering Research Methodology: A Practical Insight for Researchers, Dipankar Deb, Brojo Kishore Mishra, and Jayanta Bhattacharya, 2019, Springer.

3 Essentials of Research Methodology for Engineers, Pradip Kumar Sahu, 2020, Springer.

4 Advanced Research Methods for Engineers, Ali Salehnia and Ebrahim Pouresmaeil, 2018, Elsevier.

Y24: M.Tech. - Thermal Engineering

Category: Open Elective Courses (OEC)

23OEBT01 - IPR AND PATENT LAWS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23OEBT01	IPR AND PATENT LAWS	IPR	R	4	0	0	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand the the principles of copy rights in applying patents, trademarks, copyrights, and trade secrets	2	PO6
CO2	Apply the guidelines framed by GATT & WTO in patenting	3	PO6
CO3	Apply the regulatory affairs in maintaining patenting rights	3	PO6
CO4	Apply the concepts of copy rights in drafting patents of various types.	3	PO6

Syllabus

Intellectual Property Rights; Patents and intellectual property rights (IPR): Definition,History of intellectual property; Types of intellectual property rights, copy rights, trade marks, geographical indication, Industrial design rights, patents. Sources of patent information, patent application procedures

Principles, Scope and Functions of GATT&WTO; GATT- Historical perspective, objectives and fundamental principles, impact on developing countries. WTO-Objectives, scope, functions, structure, status, membership and withdrawal, dispute settlement, impact on globalization, India tasks and challenges

Regulatory Affairs; Indian contest-requirements and guidelines of GMP, understanding of Drugs and cosmetic act 1940 and rules 1945 with reference schedule M,U & Y. Related quality systems-objectives and guidelines of USFDA,WHO & ICH; Introduction to ISO series

Documentation and Protocols; Documentation: Types related to pharmaceuticals industry, protocols, harmonizing formulation development for global fillings, NDA, ANDA, CTD, Dealing with post approval changes-SUPAC, handling and maintenance including electronic documentation. self study topic: Case Studies on Patents and Case Studies on - Patents (Basmati rice, turmeric, Neem, and related medicinal plants and byproducts)

Reference Books

1 Patent Law and Policy: Cases and Materials, Robert Patrick Merges, John Fitzgerald Duffy, and Mark D. Lemley, 2021, Carolina Academic Press.

2 Intellectual Property Rights: Legal and Economic Challenges for Development, Carlos M. Correa, 2020, Oxford University Press .

3 Principles of Intellectual Property Law, Thomas G. Field Jr., 2021, New Hampshire.

4 Good manufacturing practices for Pharmaceuticals, Informa Healthcare, S.H. Willig, 2010, Academic Press.

5 IPR,Biosafety and Bioethics, Deepa Goel, Shomini Parashar, 2021, Pearson .

23OEIN01 - FUNDAMENTALS OF IOT (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23OEIN01	FUNDAMENTALS OF IOT	FIOT	R	4	0	0	0	4

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply the basic concepts of IoT and its implementation using the Development Hardware.	3	PO1
CO2	Apply the different sensors interfacing with Development Hardware.	3	PO1
CO3	Apply the different actuators interfacing with Development Hardware.	3	PO1
CO4	Analyze the IoT concepts to solve real time insights using Arduino / ESP32.	4	PO1

Syllabus

This module covers digital components (multiplexer, de-multiplexer, encoder, decoder), the ATMEGA328P microcontroller, and Arduino (types, features, pin descriptions, IDE, applications, GPIO programming).

It covers sensor basics, types, and classifications, focusing on temperature sensors (thermistors, LM35), LDR, IR, PIR, ultrasonic, and gas sensors, along with their interfacing and application implementations.

This module introduces actuators and their interfacing, covering types of DC motors, servo motors, and stepper motors along with their applications. It also includes motor driver circuits, relays, and optocouplers.

It covers IoT case studies on home automation, smart irrigation, and healthcare, with self-learning topics like smart lighting, intrusion detection, and air pollution monitoring.

Reference Books

1 Internet of Things (A-Hand-on-Approach), Arshdeep Bahga and Vijay Madisetti, 1st edition, 2015, Universities Press.

2 Internet of Things, Rajkamal, 2012, Tata McGraw Hill.

3 Internet of Things Architectures, Protocols and Standards, Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, 1st edition, 2019, Wiley.

4 The Internet of Things: Key applications and Protocols , Olivier Hersent, David Boswarthick, Omar Elloumi , 2012, Wiley.

5 The Internet of Things: Connecting Objects, Hakima Chaouchi, 2013, Wiley.

Y24: M.Tech. - Thermal Engineering

Category: Value Added Courses (VAC)

23CC3071 - PROGRAMMING USING PYTHON (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23CC3071	PROGRAMMING USING PYTHON	PUP	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understand Python Modules and Packages	2	PO3
CO2	Apply Exception handling and string methods in Python	3	PO3
CO3	Apply object-oriented programming in python	3	PO3
CO4	Apply functions and Input/Output operations in python	3	PO3

Syllabus

Modules and Packages: Import and use modules and packages, Perform evaluations using the math module, Generate random values using the random module, Discover host platform properties using the platform module, Create and use user-defined modules and packages.

Exceptions: Handle errors using Python-defined exceptions, Extend the Python exceptions hierarchy with self-defined exceptions. Strings: Understand machine representation of characters, Operate on strings, Employ built-in string methods.

Object-Oriented Programming: Understand the Object-Oriented approach, Employ class and object properties, Equip a class with methods, Discover the class structure, Build a class hierarchy using inheritance, Construct and initialize objects.

Miscellaneous: Build complex lists using list comprehension, Embed lambda functions into the code, Define and use closures, Understand basic Input/Output terminology, Perform Input/Output operations.

Reference Books

1 Programming Python, Mark Lutz, 2001, O'Reilly Media.

2 Learning Python: Powerful Object-Oriented Programming, Mark Lutz, 2013, O'Reilly Media.

3 Python for Everyone, Cay Horstmann and Rance Necaise, 2016, John Wiley & Sons, Inc..

4 Programming and Problem Solving with Python , Ashok Namdev Kamthane and Amit Ashok Kamthane, 2018, McGraw Hill Education (India) Private Limited.

5 Starting Out with Python , Tony Gaddis, 2019, Pearson Education Limited.

23CC3114 - FLOW ANALYSIS USING ANSYS CFD (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23CC3114	FLOW ANALYSIS USING ANSYS CFD	FAACFD	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply governing equations to create geometry / model for the flow field	3	PO1, PO3, PO4
CO2	Perform fluid flow and heat transfer analysis for external and internal flow fields	4	PO1, PO3, PO4

Syllabus

Introduction to CFD, Conservation of mass, momemtum and energy equations, Navier Stokes equation of motion. Introduction to Ansys Fluent Workbench-Creation or Importing of geometry using Ansys Design Modeler and Space Claim

Analysis of fluid flow through pipe, T-Junction, Duct flows, enclosures, Double pipe heat exchanger, Shell and Tube heat exchanger, and spiral heat exchanger. Heat transfer analysis in various heat exchangers and enclosures

Reference Books

1 Essential Computational Fluid Dynamics, Zikanov.O, 2000, Wiley.

2 Fundamentals of CFD, T. K. Sengupta, 2004, University Press.

3 An Introduction to ANSYS Fluent 2022, John.E, Mattson, 2022, SDC Publications.

4 Computational Fluid Mechanics and Heat Transfer, J. C. Anderson, D. A. Tannehil and R. H. Pletcher, 2010, Taylor&Francis.

Y24: M.Tech. - Thermal Engineering

Category: Audit Courses (AUC)

23TE5101 - SIMULATION OF ENERGY MANAGEMENT SYSTEMS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23TE5101	SIMULATION OF ENERGY MANAGEMENT SYSTEMS	SEMS	R	0	0	4	0	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Design of renewable energy power plants by optimum sizing ofcomponents	4	PO1, PO5
CO2	Perform financial analysis of different RE technologies	3	PO1, PO5

Syllabus

Introduction to RETScreen software-Clean Energy Management-Virtual Energy Analyser- Designand sizing RET Projects-Greenhouse Gas (GHG) Emission Reduction Analysis Financial Analysis forvarious case studies listed below a. Photovoltaic Project Model for on-grid (central-grid and micro- grid PVsystems); off-grid (stand-alone (PV-battery) and hybrid (PV-battery-genset) systems; and water pumpingapplications b. Solar Water Heating Project Model for domestic hot water, industrial process heat andswimming pools, ranging in size from small residential systems to large scale commercial, institutional andindustrial systems.

Facility worksheet-Energy Audit or Feasibilty-Emission Savings-Sensitivity Analysis-Project Life-Cycle Analysis-Benchmark Analysis- Feasibility Analysis- Performance Analysis- PortfolioAnalysis- Integrated Databases-Product data- Cost data-Climate data- Hydrology data- Energy resourcemaps

Reference Books

1. Clean Energy Project Analysis: RETScreen Engineering & Cases Textbook-Photovoltaic Project Analysis, Leng, G., Meloche, N., Monarque, A., Painchaud, G., Thevenard, D., Ross, M., & Hosette, P., 8, 2004, CANMET Energy Technology Center.
2. PVSYST user's manual, Mermoud, A., & Wittmer, B., 9, 2014, Switzerland..
3. U.S. Department of Energy, EnergyPlus Documentation https://energyplus.net/documentation, 5, 2017, U.S. Department of Energy.
4. Simulation and Modeling of Systems of Energy Systems, Ashu Gupta, Rajeev Kumar, 6, 2019, Springer.

23UC5201 - PROFESSIONAL COMMUNICATION SKILLS (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
23UC5201	PROFESSIONAL COMMUNICATION SKILLS	PCS	R	0	0	4	0	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Develop the skill of contextual Vocabulary and Critical Reading	3	PO7
CO2	Demonstrate different types of personal and professional skills and apply them for growth in professional zone.	3	PO7
CO3	Apply the concepts of Mathematical Principles to solve problems on Arithmetic , Algebra & Geometry to improve problem solving ability.	3	PO3
CO4	Apply the concepts and using Logical thinking to solve problems on verbal & Non-Verbal Reasoning to develop Logical thinking skills.	3	PO3

Syllabus

Vocabulary: Synonyms, Antonyms and One-word substitutes, (B)Reading comprehension, Critical reading, (C) Writing skills: Email writing, report writing and paragraph writing (D) Listening/Speaking Skills: listen & speak, Functional grammar

- A)Personal Skills: Intra & Interpersonal skills (B) Assertiveness (C) Group Discussion (D) Resume writing (E) Video resumes (F) Interview skills

Simple Equations, Ratio & Partnership, Averages, Percentages, Profit & Loss, Simple & Compound Interest, Numbers, Quadratic Equations & Inequalities, Time & Work, Time, Speed & Distance, Permutations & Combinations, Probability, Mensuration, Data Interpretation.

Syllogism, Logical Venn Diagrams, Cubes & Dice, Number& letter series, Number, letter & word Analogy, Odd Man Out, Coding & Decoding, Blood Relations, Directions, clocks, calendars, Number, ranking & Time sequence test, Seating Arrangements, Data Sufficiency.

Reference Books

1 OBJECTIVE ENGLISH FOR COMPETITIVE EXAMINATION, HARI MOHAN PRASAD AND UMA SINHA, 2017, MC GRAW HILL.

2 55 ESSENTIAL TOOL FOR EVERY WRITER, ROY PETER CLARK, 2006, LITTLE BROWN AND COMPANY.

3 QUANTTAITIVE APTITUDE, ABHJITH GUPTA, 2017, MC GRAW HILL.

4 LOGICAL REASONING , ARUN SHARMA, 2006, MC GRAW HILL.

5 LOGICAL REASONING, PIYUSH BAHRADWAJ, 2006, ARIHANT PUBLICATIONS.

CADCOML1V1 - CAREER ADVANCEMENT:COMPETITIVE EXAM TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CADCOML1V1	CAREER ADVANCEMENT:COMPETITIVE EXAM TRAINING	CAD: COM	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Enhance critical thinking and problem-solving skills to analyze and solve complex problems effectively.	3	PO7
CO2	Apply strategic test-taking techniques to improve performance and manage exam-related stress.	3	PO7

Syllabus

Introduction to Critical Thinking: covering the definition, importance, and key components; Logical Reasoning: focusing on types of reasoning (deductive and inductive) and common logical fallacies; Data Interpretation: analyzing graphs, charts, and statistical information; and Problem-Solving Techniques: emphasizing creative problem-solving methods and structured frameworks.

Practice Sessions through case studies and group discussions. It also explores Understanding Exam Formats, providing an overview of common competitive exams such as GRE, GMAT, and UPSC, along with types of questions encountered. Students will learn Time Management Techniques for prioritizing questions and allocating time efficiently, alongside Effective Study Habits to create study schedules and utilize resources. The syllabus includes Stress Management Strategies, focusing on mindfulness and relaxation techniques, and concludes with Mock Exams and Feedback to assess performance and identify areas for improvement.

Reference Books

1 Critical Thinking: A Beginner's Guide, Gail McDonald, Springer, 2018.

2 The 7 Habits of Highly Effective People, Stephen R. Covey, Free Press, 2020.

CADCORL1V1 - CAREER ADVANCEMENT: TRAINING IN CORE DOMAIN (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CADCORL1V1	CAREER ADVANCEMENT: TRAINING IN CORE DOMAIN	CAD: TICD	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply advanced domain-specific concepts and emerging trends to address industry challenges and innovations.	3	PO1, PO2
CO2	Apply advanced problem-solving and strategic decision-making techniques to manage complex projects within the core domain.	3	PO1, PO2

Syllabus

Core Concepts, theories, and frameworks of the specific domain (e.g., finance, IT, healthcare, engineering), Advanced Domain-Specific Tools, innovations and their impact on the core domain, Real-world examples of how new trends are being applied within the domain

Domain specific challenges, Practical exercises to resolve complex issues in the domain, best practices for managing projects within the domain, Case Studies and Simulations.

CADENTL1V1 - CAREER ADVANCEMENT:ENTREPRENEURIAL CAREER PATHWAY TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CADENTL1V1	CAREER ADVANCEMENT:ENTREPRENEURIAL CAREER PATHWAY TRAINING	CAD: ECPT	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	apply essential entrepreneurial qualities such as resilience, innovation, and risk-taking, enabling them to pursue entrepreneurial career paths in various contexts, including startups, corporate roles, and freelancing.	3	PO6, PO7
CO2	Develop the skills to recognize potential business opportunities, conduct thorough market research, and validate ideas by addressing customer needs and evaluating feasibility, preparing them to create sustainable business solutions.	3	PO6, PO7

Syllabus

Defining entrepreneurship: What it means to be an entrepreneur; The distinction between entrepreneurial and traditional career paths; The entrepreneurial mindset: resilience, risk-taking, innovation, and adaptability; Exploring entrepreneurial career pathways in startups, corporate environments, freelancing, and social ventures.

Spotting opportunities: How to find unmet needs and gaps in the market; Market research: Tools and techniques for understanding trends and customer needs; Idea validation: Testing the feasibility of your business idea; Problem-solving for innovation: Leveraging customer pain points and inefficiencies.

Reference Books

1 The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries, 1st (2011), Crown Business.

2 The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company, Steve Blank, Bob Dorf, 2nd (2020), K&S Ranch Press.

3 Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, Alexander Osterwalder, Yves Pigneur, 1st (2010), Wiley.

4 The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail, Clayton M. Christensen, 1st (1997), Harvard Business Review.

CADUPSL1V1 - CAREER ADVANCEMENT: UPSC-CIVIL SERVICES EXAM TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CADUPSL1V1	CAREER ADVANCEMENT: UPSC-CIVIL SERVICES EXAM TRAINING	CAD: UPSC	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Understanding the basics of Indian History and it\'s evolution	2	PO7
CO2	Understanding the basics of Indian Geography	2	PO7
CO3	Understanding the Evolution of Indian Constitution.	2	PO7
CO4	Understanding the evolution of Indian Economy	2	PO7

Syllabus

Ancient Indian History- IVC,Rig Vedic, Later Vedic, Buddhism, Jainism, Mahajanapadas, Mouryan Empire, Guptan Empire, Harshavardhana empire, Sangam Age.

Exploring The Physical and Social Geography of India: The Universe, Big Bang Theory, Solar system, Geological Time Scale, Earth\'s Interior, Earth\'s Magnetic Feild.

Indian Polity and Constitution: Sailent featuresof Indian constitution, Preamble, Fundamental RIghts, Directrive Principles of State Policy, Fundamental Duties , Indian Parliament.

Understanding India\'s Economy - Indian Economic Development, National Income, Public Finance, Indian Budget.

Reference Books

1 Indian Polity, M. Laxmikanth, 7, Tata Mc Graw Hill.

2 Indian Economy, Nitin Singhania, 5, Mc Graw Hill.

3 Ancient and Medieval India, Poonam Dalal Dahiya, 3, Mc Graw Hill.

4 Fundamentals of Physical Geography, Husain Majid, 5, Mc Graw Hill.

CRTCODL1V1 - CAMPUS RECRUITMENT: LOGIC BUILDING SKILLS TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTCODL1V1	CAMPUS RECRUITMENT: LOGIC BUILDING SKILLS TRAINING	CRT: LBST	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply logical principles and critical thinking skills to analyze and evaluate arguments, solve problems, and make informed decisions.	3	PO1
CO2	Identify various logical reasoning techniques to solve complex problems, identify patterns, and draw valid conclusions	3	PO1

Syllabus

Introduction to Logic and Critical Thinking: fundamentals of logic, including the concepts of statements, propositions, truth values, logical connectives (AND, OR, NOT, IF-THEN, IF-AND-ONLY-IF), truth tables, and logical equivalence. Students will learn to identify and analyze different types of arguments, including deductive and inductive reasoning. They will also develop critical thinking skills, such as evaluating evidence, identifying assumptions, and recognizing fallacies

Logical Reasoning and Problem-Solving: applying logical reasoning techniques to solve various types of problems. Students will learn about different problem-solving strategies, including problem decomposition, pattern recognition, working backward, and using analogies. They will practice solving logic puzzles, brain teasers, and real-world problems that require logical thinking. Additionally, students will explore the concepts of syllogisms, Venn diagrams, and conditional reasoning to enhance their problem-solving abilities

Reference Books

1 Introduction to Logic, Irving M. Copi, Carl Cohen, Victor Rodych, 2014, Routledge.

2 Critical Thinking, Richard Paul, Linda Elder, 2019, Pearson.

3 The Art of Logical Thinking; Or, The Laws of Reasoning, William Walker Atkinson, 2013, Public domain in the

4 Symbolic logic and The game of logic, Carroll, Lewis, 1958, Dover Publications.

CRTCSSL1V1 - CAMPUS RECRUITMENT: COMMUNICATION SKILLS TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTCSSL1V1	CAMPUS RECRUITMENT: COMMUNICATION SKILLS TRAINING	CRT: CST	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	apply knowledge of communication of different types and techniques while analyzing body language and tone to enhance overall communication effectiveness.	3	PO7
CO2	apply active listening and feedback techniques, and analyzing effective participation in group discussions, while exploring roles in teamwork and strategies for managing conflicts, alongside professional communication practices such as writing emails and conducting meetings.	3	PO7

Syllabus

Communication: Basics, significance, types, verbal & non-verbal communication techniques, effective speaking and presentation skills tone and pacing in verbal interactions

Interpersonal skills, listening skills, feedback techniques, group communication and dynamics, group discussion, conflict management in professional communication, E-mail writing, report writing, presentations, interview skills.

Reference Books

1 Business Communication: A Problem-Solving Approach, Louis E. Boone & David L. Kurtz, 3rd Edition, McGraw Hill Education.

2 The Complete Guide to Business School Presentations", Jennifer D. D. McDonald, 2nd Edition, Pearson.

3 Listening: The Forgotten Skill", Geoffrey M. Cohen, 1st Edition, University Press of America.

4 Business Communication: Process and Product", Mary Ellen Guffey & Dana Loewy, 8th Edition, Cengage Learning.

5 Effective Communication Skills" Author, John Adair, 2nd Edition, Pan Macmillan.

CRTCSSL2V2 - CAMPUS RECRUITMENT: SOFT SKILLS TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTCSSL2V2	CAMPUS RECRUITMENT: SOFT SKILLS TRAINING	CRT: SST	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	applyi and practice empathy, critical thinking, problem-solving, decision-making, effective communication, and interpersonal skills through real-life scenarios and interactive activities.	3	PO7
CO2	apply group discussion techniques, interview skills, and mock interviews through practical exercises, encouraging learners to practice and refine these skills in realistic settings.	3	PO7

Syllabus

Critical thinking, problem soving, decision making, communication skills, interpersonal skills

Grooming, group discussions, story narrations, interview skills, mock interviews

Reference Books

1 Personality Development and Soft Skills", Barun K. Mitra, 2nd Edition, Oxford University Press.

2 Communication Skills for Engineers", C. Muralikrishna & Sunita Mishra, 1st Edition, Pearson Education.

3 Developing Soft Skills", Robert L. Katz, 1st Edition, McGraw Hill Education.

CRTVQRL1V1 - CAMPUS RECRUITMENT: VERBAL APTITUDE TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTVQRL1V1	CAMPUS RECRUITMENT: VERBAL APTITUDE TRAINING	CRT: VAT	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	apply and practice grammatical concepts like sentence formation, identifying odd words, using one-word substitutions, while enhancing understanding of idioms, phrases, spellings, and structures.	3	PO7
CO2	apply concepts like paragraph formation, sentence completion, reading comprehension, sentence correction, and correcting jumbled sentences, while enhancing word selection and sentence structure accuracy.	3	PO7

Syllabus

Synonyms, Antonyms, odd words, parts of speech, idioms and phrases, one word substitutions, odd words, formation of sentences

sentence completion, sentence correction, jumbled sentences, paragraph formation, reading comprehension, and sentence selection

Reference Books

1 The Pearson Guide to Verbal Ability and Logical Reasoning for the CAT", Nishit K. Sinha, 2nd Edition, Pearson.

2 Objective General English", S.P. Bakshi, 3rd Edition, Arihant Publications.

3 English Grammar in Use", Raymond Murphy, 5th Edition, Cambridge University Press.

CRTVQRL2V2 - CAMPUS RECRUITMENT: QUANTITATIVE APTITUDE TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTVQRL2V2	CAMPUS RECRUITMENT: QUANTITATIVE APTITUDE TRAINING	CRT: QAT	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply principles of quantitative techniques to solve problems on Simple Equations, Simple & Compound Interest etc	3	PO7
CO2	Apply principles of quantitative techniques to solve problems on Divisibility, Functions, Surds & Indices etc	3	PO7

Syllabus

Simple Equations, Problem on Ages, Ratio & Proportion, Variation& Partnership, Percentages, Profit, Loss& Discounts, Simple & Compound Interest, Averages & Allegations or Mixtures

Numbers, Divisibility, Decimal Fractions, LCM & HCF, Simplification, Sequence, Series & Progressions, Linear Algebra, Quadratic Equations & Inequalities, Theory of Equations. Sets, Relations & Functions, Surds & Indices, Logarithms

Reference Books

1 Quantitative Aptitude by R.S. Agarwal, SCHAND Publications, R.S. Agarwal, 2021, SCHAND Publications.

2 A Modern Approach to Verbal Reasoning by R.S. Agarwal, SCHAND Publications, R.S. Agarwal, 2021, SCHAND Publications.

CRTVQRL3V3 - CAMPUS RECRUITMENT: REASONING APTITUDE TRAINING (R)

CourseCode	Course Title	Acronym	Mode	L	T	P	S	CR
CRTVQRL3V3	CAMPUS RECRUITMENT: REASONING APTITUDE TRAINING	CRT: RAT	R	0	0	0	8	0

Course Outcomes

CO#	CO Description	BTL	PO/PSO
CO1	Apply principles of deductive logic to solve problems on syllogisms, Venn diagrams, etc	3	PO7
CO2	Apply principles of inductive logic to solve problems on assumptions and conclusions	3	PO7

Syllabus

Syllogism, Number& letter series, Number, letter & word Analogy, Odd man out, coding & decoding, Cubes & Dice, Logical Venn Diagrams

Statements & conclusions, statements & Arguments (Critical Reasoning), statements & Assumptions, logical connectives, Binary logic

Reference Books

1 A Modern Approach to Verbal Reasoning, R.S. Agarwal, 2022, SCHAND Publications.

2 Logical Reasoning for CAT, Arun Sharma, 2021, McGraw Hills.

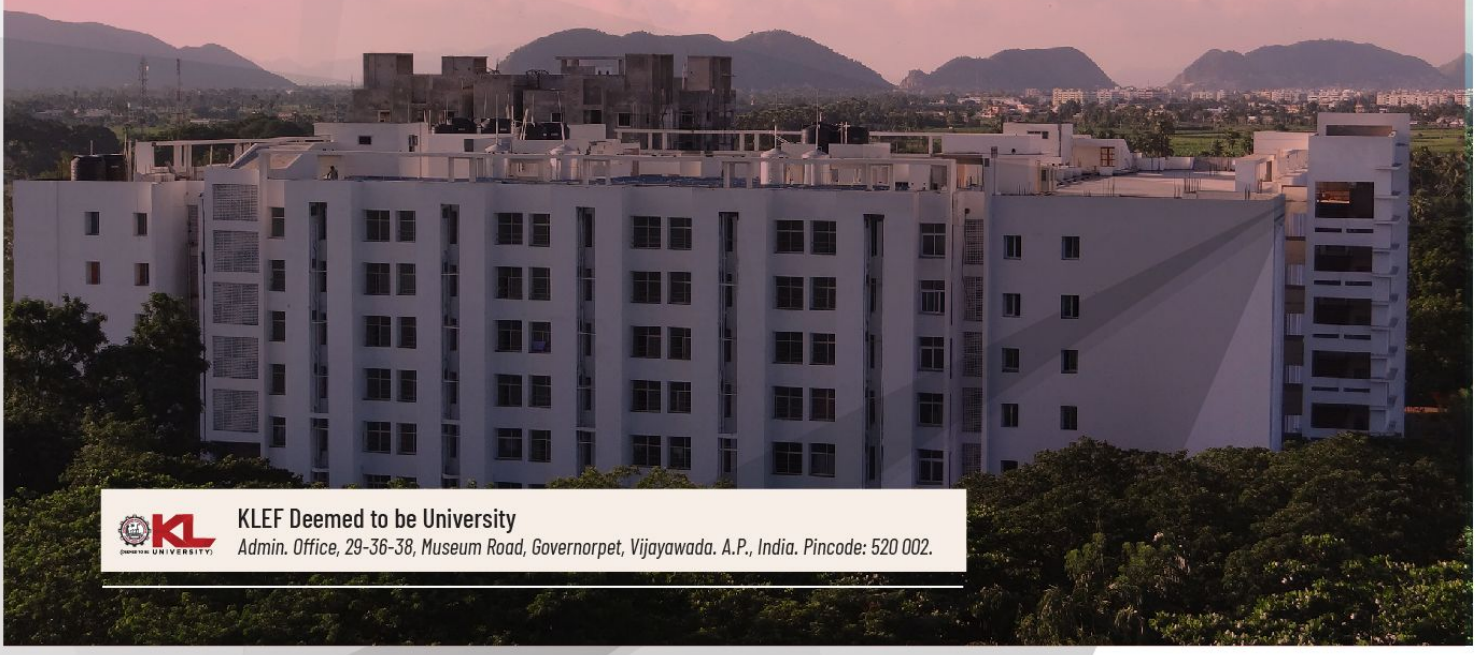
Our Campuses

KL UNIVERSITY
Green Fields, Vaddeswaram.
Guntur District, A.P., India, Pincode : 522 302.

KLH UNIVERSITY
Aziznagar, Moinabad Road,
Near TS Police Academy, Hyderabad, Telangana,
India, Pincode : 500 075

KLH UNIVERSITY
Bowrampet, ALEAP Industrial Area,
Gajularamaram, Hyderabad, Telangana,
India, Pincode : 500 043

KLH UNIVERSITY | GBS GLOBAL BUSINESS SCHOOL
Plot No: 52 & 53, Jubilee Gardens Road No. 2,
Kothaguda, Kondapur, Hyderabad Telangana,
India, Pincode : 500 084



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