



Royal School of Engineering and Technology (RSET)

Department of Mechanical Engineering (ME)

Course Structure & Syllabus

(Based on National Education Policy 2020)

For

Bachelor of Technology

In

Mechanical Engineering

W.E.F

AY: 2024-2025

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Preamble

The National Education Policy (NEP) 2020 conceives a new vision for India's higher education system. It recognizes that higher education plays an extremely important role in promoting equity, human as well as societal well-being and in developing India as envisioned in its Constitution. It is desired that higher education will significantly contribute towards sustainable livelihoods and economic development of the nation as India moves towards becoming a knowledge economy and society.

If we focus on the 21st century requirements, the higher education framework of the nation must aim to develop good, thoughtful, well-rounded, and creative individuals and must enable an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and twenty-first-century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects. A quality higher education should be capable enough to enable personal accomplishment and enlightenment, constructive public engagement, and productive contribution to the society. Overall, it should focus on preparing students for more meaningful and satisfying lives and work roles and enable economic independence.

Towards the attainment of holistic and multidisciplinary education, the flexible curricula of the University will include credit-based courses, projects in the areas of community engagement and service, environmental education, and value-based education. As part of holistic education, students will also be provided with opportunities for internships with local industries, businesses, artists, crafts persons, and so on, as well as research internships with faculty and researchers at the University, so that students may actively engage with the practical aspects of their learning and thereby improve their employability.

The undergraduate curriculums are diverse and have varied subjects to be covered to meet the needs of the programs. As per the recommendations from the UGC,

introduction of courses related to Indian Knowledge System (IKS) is being incorporated in the curriculum structure which encompasses all of the systematized disciplines of Knowledge which were developed to a high degree of sophistication in India from ancient times and all of the traditions and practices that the various communities of India—including the tribal communities—have evolved, refined and preserved over generations, like for example Vedic Mathematics, Vedangas, Indian Astronomy, Fine Arts, Metallurgy, etc.

At RGU, we are committed that at the societal level, higher education will enable each student to develop themselves to be an enlightened, socially conscious, knowledgeable, and skilled citizen who can find and implement robust solutions to its own problems. For the students at the University, Higher education is expected to form the basis for knowledge creation and innovation thereby contributing to a more vibrant, socially engaged, cooperative community leading towards a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation.”

The curriculum of the B.Tech. program in Mechanical Engineering, offered by the Department of Mechanical Engineering at the Royal School of Engineering and Technology, RGU, is designed in accordance with the model curriculum framework of AICTE (2023) and aligns with the basic guidelines of the National Education Policy (NEP) 2020. The curriculum follows a Learning Outcome-Centric Framework (LOCF) with a Choice-Based Credit and Semester System (CBCSS), allowing learners to acquire professional competency through a multidisciplinary approach. It caters to the minimum requirements specified by professional bodies such as the ACM and other relevant organizations, as outlined by the Engineering Accreditation Commission (EAC) of ABET and NBA. Additionally, the curriculum and syllabi are meticulously structured, incorporating feedback from various stakeholders, including industry experts, potential employers, alumni, academia, professional bodies, research organizations, and parents. The three fundamental pillars of the academic system—curriculum design, delivery, and assessment—are fully aligned with Outcome-Based Education (OBE) principles. This alignment ensures that learning outcomes are assessed and evaluated, ultimately facilitating learners in achieving their professional and career goals.

Abbreviations

1. Cr. - Credit
2. Major - Core Courses of a Discipline
3. Minor - May/may not be related to Major.
4. SEC - Skill Enhancement Course
5. VAC - Value Addition Course
6. AECC - Ability Enhancement Compulsory Course
7. GEC - Generic Elective Course
8. IKS - Indian Knowledge System
9. AICTE - All India Institute of Technical Education
10. CBCS - Choice Based Credit System
11. HEIs - Higher Education Institutes
12. MSDE - Ministry of Skill Development and Entrepreneurship
13. NAC - National Apprenticeship Certificate
14. NCrF - National Credit Framework
15. NCVET - National Council for Vocational Education and Training
16. NEP - National Education Policy
17. NHEQF - National Higher Education Qualification Framework
18. NSQF - National Skill Qualifications Framework
19. NTA - National Testing Agency
20. SDG - Sustainable Development Goals
21. UGC - University Grants Commission
22. VET - Vocational Education and Training
23. ME-ME - Multiple Entry Multiple Exit
24. OJT - On Job Training
25. NCH - Notional Credit Hours

1. 1. Introduction:

1.1.1 About NEP 2020

The National Education Policy (NEP) 2020 clearly indicates that higher education plays an extremely important role in promoting human as well as societal well-being in India. As envisioned in the 21st-century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals. According to the new education policy, assessments of educational approaches in undergraduate education will integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) that will lead to positive learning outcomes. This will lead to develop creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning, and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning. and more in-depth learning.

The NEP highlights that the following fundamental principles that have a direct bearing on the curricula would guide the education system at large, viz.

- i. Recognizing, identifying, and fostering the unique capabilities of each student to promote her/his holistic development.
- ii. Flexibility, so that learners can select their learning trajectories and programmes, and thereby choose their own paths in life according to their talents and interests.
- iii. Emphasis on conceptual understanding rather than rote learning, critical thinking to encourage logical decision-making and innovation; ethics and human & constitutional values, and life skills such as communication, teamwork, leadership, and resilience.
- iv. Extensive use of technology in teaching and learning, removing language barriers, increasing access for Divyang students, and educational planning and management.
- v. Respect for diversity and respect for the local context in all curricula, pedagogy, and policy.

- vi. Equity and inclusion as the cornerstone of all educational decisions to ensure that all students can thrive in the education system and the institutional environment are responsive to differences to ensure that high-quality education is available for all.

1.1.2 About the B. Tech (ME) Course:

The Bachelor of Technology (B. Tech.) in Mechanical Engineering is meticulously designed in accordance with the AICTE 2023 policy and the National Education Policy (NEP) 2020. The program aims to develop highly skilled and adaptable engineers who are well-prepared for the ever-evolving landscape of mechanical technology. The curriculum emphasizes core technical competencies in mechanical engineering, covering topics such as thermodynamics, fluid mechanics, machine design, and materials science. Additionally, students benefit from interdisciplinary learning, including exposure to areas like robotics, mechatronics, and renewable energy systems.

Practical experience is a key focus, achieved through hands-on labs, project-based learning, and industry internships. Aligned with NEP 2020, the B. Tech. in Mechanical Engineering offers a flexible academic structure. Students have choices in elective courses and projects, allowing them to tailor their education based on their interests and career aspirations. The program also includes essential courses in ethics, communication, and management, ensuring that graduates are not only technically proficient but also socially responsible and effective in diverse workplace environments. Lifelong learning is encouraged, and provisions for credit-based recognition of MOOCs, online courses, and practical workshops foster an environment where students can continuously adapt and thrive in a dynamic and competitive world."

1.1.3 Vision

To be a world leader in mechanical engineering education and research, fostering innovation, interdisciplinary collaboration, and sustainable technologies. We aim to nurture students who become successful entrepreneurs and responsible citizens, contributing to solving societal challenges through academia and industry partnerships.

1.1.3 Mission

- Educate and Empower: Equip students with comprehensive knowledge, critical thinking skills, and ethical values. Our graduates will excel in their chosen careers, contributing to technological advancements.

- **Research and Innovation:** Foster a research ecosystem that encourages collaboration with industry and academia. We strive to develop cutting-edge solutions and contribute to global progress.
- **State-of-the-Art Facilities:** Establish and maintain state-of-the-art laboratories, providing technical expertise and support to propel the nation to the forefront of global engineering.

1.2. Credits in Indian Context:

1.2.1. Choice Based Credit System (CBCS) By UGC

Under the CBCS system, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be earned by the students. This framework is being implemented in several universities across States in India. The main highlights of CBCS are as below:

- The CBCS provides flexibility in designing curriculum and assigning credits based on the course content and learning hours.
- The CBCS provides for a system wherein students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.
- CBCS also provides opportunity for vertical mobility to students from a bachelor's degree programme to masters and research degree programmes.

The detailed Guidelines for Choice Based Credit System is available at https://ugc.ac.in/pdfnews/8023719_Guidelines-for-CBCS.pdf

1.3. Definitions

1.3.1. Academic Credit:

An academic credit is a unit by which a course is weighted. It is fixed by the number of hours of instructions offered per week. As per the National Credit Framework [2];

1 Credit = 30 NOTIONAL CREDIT HOURS (NCH)

Yearly Learning Hours = 1200 Notional Hours (@40 Credits x 30 NCH)

30 Notional Credit Hours		
Lecture/Tutorial	Practicum	Experiential Learning
1 Credit = 15 -22 Lecture Hours	10-15 Practicum Hours	0-8 Experiential Learning Hours

Note: The Department may consider any such combination by due approval from the Dean of Academics and The Vice -Chancellor before placing to the Board of Studies (BoS) & Academic Council.

Some Theory based papers should have 22/23 physical classes to adhere to 30 NCH.

The division of credits should depend upon the Course of Study, level of the students admitted (slow/fast learners).

1.3.2. Course of Study:

Course of study indicate pursuance of study in a particular discipline/programme. Discipline/Programmes shall offer Professional Core Courses, Basic Science Courses, Engineering Courses including workshop, drawing, basics of electrical/mechanical/computer etc., Professional Elective Courses Relevant to chosen specialization, Humanities and Social Sciences including Management Courses, Indian Knowledge System, Multidisciplinary Open Elective Courses, Project Work, Seminar and Internship in Industry, Mandatory Audit Courses.

1.3.3. Disciplinary Major/ Professional Core Courses:

Professional core courses in B.Tech. programs are those that directly relate to the specific field of engineering in which a student is majoring. These courses are typically taken in the latter years of the program and delve deep into the foundational principles, theories, and practical applications of the chosen engineering discipline. Here's a breakdown of what professional core courses might entail:

- i. Core Engineering Concepts:** These courses lay the groundwork for understanding the fundamental principles of the chosen engineering discipline. They may cover topics such as mechanics, dynamics, thermodynamics, fluid mechanics, and electromagnetism. These courses provide students with a solid foundation in the basic principles that underpin all branches of engineering.
- ii. Specialized Technical Courses:** These courses focus on the specific areas of specialization within the chosen engineering discipline. For example, civil engineering students may take courses in structural analysis and design, transportation engineering, geotechnical engineering, or environmental engineering. Similarly, electrical engineering students may study courses in power systems, electronics, control systems, or telecommunications.
- iii. Laboratory Work and Design Projects:** Many professional core courses include laboratory work and design projects to provide students with hands-on experience and practical skills. In laboratory sessions, students may conduct experiments to reinforce theoretical concepts and develop their technical skills. Design projects challenge students to apply their knowledge to solve real-world engineering problems and to work collaboratively in teams.
- iv. Professional Practice and Ethics:** Courses in professional practice and ethics prepare students for the realities of working as professional engineers. Topics may include engineering ethics, codes of

conduct, professional responsibility, safety standards, and legal issues in engineering practice. These courses emphasize the importance of ethical behavior, effective communication, and lifelong learning in the engineering profession.

1.3.4. Multidisciplinary Open Electives:

Students will have the option to choose courses from disciplinary/interdisciplinary skill-based elective courses

1.3.5. Basic Science Courses

These include a range of basic science courses that provide students with a strong foundation in fundamental scientific principles. These courses are designed to equip students with essential knowledge and skills that are necessary for understanding advanced engineering concepts and for solving real-world problems. Here are some common basic science courses offered in B.Tech. programs:

- i. Physics:** Physics courses cover topics such as classical mechanics, electromagnetism, thermodynamics, and quantum mechanics. These courses help students understand the fundamental principles governing the behavior of matter and energy.
- ii. Chemistry:** Chemistry courses introduce students to the structure, properties, and reactions of various chemical substances. Topics covered may include organic chemistry, inorganic chemistry, physical chemistry, and analytical chemistry.
- iii. Mathematics:** Mathematics courses form the backbone of engineering education. Topics typically covered include calculus, differential equations, linear algebra, probability theory, and numerical methods. These mathematical tools are essential for analyzing and solving engineering problems.
- iv. Biology:** Some B.Tech. programs may include basic biology courses to provide students with an understanding of living organisms and their biological processes. Topics covered may include cell biology, genetics, evolution, and ecology.

These basic science courses are typically spread across the first two years of the B.Tech program, after which students delve into more specialized courses related to their chosen engineering discipline. The knowledge gained from these basic science courses forms the basis for advanced engineering coursework and prepares students for careers in various technical field.

1.3.6. Engineering Science Course:

The Engineering Science course within the B.Tech. program is designed to provide a broad-based foundation in the fundamental principles that underpin engineering. This interdisciplinary course integrates key concepts from multiple engineering disciplines, including mechanical, electrical, civil, and computer engineering, offering students a holistic view of how these fields converge and interact. It will equip students with

foundational knowledge across various engineering disciplines to promote versatility in problem-solving.

Some of the Courses are:

- i. **Basic Electronics:** Basic electronics courses cover topics such as circuit theory, semiconductor devices, digital electronics, and electronic circuits. These courses provide students with a foundation in electronics principles, which are essential for many engineering disciplines.
- ii. **Engineering Mechanics:** Engineering mechanics courses bridge the gap between physics and engineering, applying principles of mechanics to solve engineering problems. Topics may include statics, dynamics, solid mechanics, and fluid mechanics.
- iii. **Computational Science:** Programming is essential in engineering education across all disciplines because it enhances problem-solving skills, which are central to engineering tasks. Learning to program equips engineers with the ability to think logically and analytically, breaking down complex problems into simpler, manageable components that can be tackled systematically. In essence, integrating programming into engineering curricula prepares students to tackle real-world engineering challenges with creativity and precision, making it an indispensable skill in their professional toolkit.
- iv. **Engineering Graphics and Design:** Engineering graphics is applicable across various engineering disciplines, including mechanical, civil, electrical, and aerospace engineering. Regardless of their specialization, all engineers need to understand basic drawing principles and graphical representation techniques. Engineering graphics provides a common foundation that prepares students for interdisciplinary collaboration and communication in multidisciplinary engineering projects.

1.3.7. Humanities and Social Sciences:

Humanities courses offered in B.Tech. programs serve a crucial role in providing students with a well-rounded education that goes beyond technical skills. These courses are designed to develop students' critical thinking, communication, and problem-solving abilities, as well as to foster an understanding of social, cultural, and ethical issues. Here are some common humanities courses offered in B.Tech. programs:

- i. **Communication Skills:** Communication skills courses focus on improving students' written and oral communication abilities. They cover topics such as technical writing, presentation skills, and effective communication in professional settings. These courses are essential for engineers who need to convey complex technical information to diverse audiences.
- ii. **Ethics and Professional Responsibility:** Ethics courses explore ethical issues related to engineering practice, such as professional responsibility, safety, sustainability, and social justice. Students learn about ethical frameworks and develop the skills to identify and address ethical dilemmas that may arise in their careers.

1.3.8. Professional Elective Courses

These subjects are offered to offer students the opportunity to tailor their education to align with their interests, career goals, and emerging industry trends within their chosen engineering discipline. These courses allow students to delve deeper into specific areas of specialization or to explore interdisciplinary topics that complement their core engineering curriculum. Here's an overview of professional elective courses:

- i. **Specialized Technical Electives:** These courses focus on advanced topics within a specific area of specialization within the chosen engineering discipline. For example, mechanical engineering students might choose electives in textile engineering, marine engineering, or advanced materials.
- ii. **Professional Development Electives:** These courses focus on developing students' professional skills and preparing them for success in their engineering careers. Topics may include project management, leadership, entrepreneurship, communication skills, technical writing, and professional networking. Professional development electives help students cultivate essential skills that are highly valued by employers and contribute to their overall career readiness.

By offering a range of professional elective courses, students are empowered to customize their education according to their individual interests and career aspirations. These elective courses complement the core engineering curriculum and enable students to develop specialized expertise, practical skills, and professional competencies that enhance their competitiveness in the job market and prepare them for future leadership roles in their field.

1.3.9. Mandatory Audit Courses/Skill Enhancement Courses:

These courses are aimed at imparting practical skills, hands-on training, soft skills, etc., to enhance the employability of students and should be related to Major Discipline. They will aim at providing hands-on training, competencies, proficiency, and skill to students. These courses will be a basket course to provide skill-based instruction.

1.3.10. Summer Internship

Students need to undergo six months of mandatory internship during their course of study which is a total of 10 credits and will be evaluated towards the end of 7th semester. The students can undergo 1 month internship during their semester breaks starting from 2nd semester onwards. The intention is induction into actual work situations. All students must undergo internships / Apprenticeships in a firm, industry, or organization or Training in labs with faculty and researchers in their own or other HEIs/research institutions during the summer/winter term. Students should take up opportunities for internships with local industry, business organizations, health and allied areas, local governments (such as panchayats, municipalities), Parliament or elected representatives, media organizations, artists, crafts persons, and a wide variety of

organizations so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability. Students who wish to exit after the first two semesters will undergo a 4-credit work-based learning/internship during the summer term to get a UG Certificate.

- *Community engagement and service*: The curricular component of ‘community engagement and service’ seeks to expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems. This can be part of summer term activity or part of a major or minor course depending upon the major discipline.
- *Field-based learning/minor project*: The field-based learning/minor project will attempt to provide opportunities for students to understand the different socio-economic contexts. It will aim at giving students exposure to development-related issues in rural and urban settings. It will provide opportunities for students to observe situations in rural and urban contexts, and to observe and study actual field situations regarding issues related to socioeconomic development. Students will be given opportunities to gain a first-hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process. They would have the opportunity to gain an understanding of the complex socio-economic problems in the community, and innovative practices required to generate solutions to the identified problems. This may be a summer term project or part of a major or minor course depending on the subject of study.

1.3.11. Indian Knowledge System:

In view of the importance accorded in the NEP 2020 to rooting our curricula and pedagogy in the Indian context all the students who are enrolled in the four-year UG programmes should be encouraged to take two courses in IKS in 3rd and 4th semester. The students are mandated to take these courses, preferably *during the first two semesters of the UG programme*.

1.3.12. Experiential Learning:

One of the most unique, practical & beneficial features of the National Credit Framework is assignment of credits/credit points/ weightage to the experiential learning including relevant experience and professional levels acquired/ proficiency/ professional levels of a learner/student. Experiential learning is of two types:

a. Experiential learning as part of the curricular structure of academic or vocational program. E.g., projects/OJT/internship/industrial attachments etc. This could be either within the Program-internship/ summer project undertaken relevant to the program being studied or as a part time employment (not relevant to the program being studied- up to certain NSQF level only). In case where

experiential learning is a part of the curricular structure the credits would be calculated and assigned as per basic principles of NCrF i.e., 40 credits for 1200 hours of notional learning.

b. Experiential learning as active employment (both wage and self) post completion of an academic or vocational program. This means that the experience attained by a person after undergoing a particular educational program shall be considered for assignment of credits. This could be either Full or Part time employment after undertaking an academic/ Vocation program.

In case where experiential learning is as a part of employment the learner would earn credits as weightage. The maximum credit points earned in this case shall be double of the credit points earned with respect to the qualification/ course completed. The credit earned and assigned by virtue of relevant experience would enable learners to progress in their career through the work hours put in during a job/employment.

1.3.13. Minor/Honors (Optional)

A total of 18-20 credits has to be earned/ acquired by the students through MOOCS from 3rd semester onwards as a part of their Honors or Minor Track. The track has to be of a specific domain of the interest of the students. A student can acquire even more than 20 credits. However, a minimum of 3 credit must be acquired per semester. For successfully completing a 12 week course, a student will earn 3 credits and for a 16 week course, he/she will earn 4 credits.

Section 2

Award of Degree

The structure and duration of undergraduate programmes of study offered by the University as per NEP 2020 include:

2.1. Undergraduate programmes of either 3 or 4-year duration with Single Major, with multiple entry and exit options, with appropriate certifications:

2.1.1. UG Certificate: Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

2.1.2. UG Diploma: Students who opt to exit after completion of the second year and have secured 80 credits will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

2.1.3. 3-year UG Degree: Students who undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 125 credits and satisfying the minimum credit requirement.

2.1.4. 4-year UG Degree (Honours): A four-year UG Honours degree in the major discipline will be awarded to those who complete a four-year degree programme with 168 credits.

2.1.5. 4-year UG Degree (Honours with Research): Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a Faculty Member of the University. The research project/dissertation will be in the major discipline. The students who secure 168 credits, including 8 credits from a research project/dissertation, will be awarded UG Degree (Honours with Research).

Table: 1: Award of Degree and Credit Structure with ME-ME

Level	Semester	Exit Option	Credits	Additional Credits for exit students	List of exit courses
4.5	I & II	U.G. Certificate	40	6-8	<ol style="list-style-type: none"> 1. Internship (0-0-4=2) 2. Welding Technology (3-0-0 = 3 Credits) 3. Material Testing Lab (0 -0 -4 = 2 Credits) 4. Basic Engineering Sciences (3-0-0= 3 Credits) 5. Engineering Mechanics (3-1-0 = 4 Credits) 6. Thermodynamics (3 -1- 0= 4 Credits) 7. Fluid Mechanics Lab (0-0-4 = 2 Credits) 8. Basics of 3D Printing (0- 0 -4 = 2 Credits) 9. Computer Aided Geometric Modeling (0-0-4=2)
5.0	III & IV	U.G. Diploma	40	6-8	<ol style="list-style-type: none"> 1. Mini Project (0-0-8= 4) 2. Internship (0-0-4=2) 3. CNC Programming (0-0-4=2) 4. Reverse Engineering (2-0-0=2)
5.5	V & VI	B.E. Vocational	45	6-8	<ol style="list-style-type: none"> 1. Mini Project (0-0-8=4) 2. Internship (0-0-4=2) 3. AI for Manufacturing (2-0-0=2) 4. Biomechanics (2-0-0=2)
6.0	VII & VIII	B.Tech.	43		
	VII & VIII	B.Tech. (Honour)	43	18	MOOCs

Section 3

Credit, Credit Points & Credit hours for different types of courses

3.1. Introduction:

'**Credit**' is recognition that a learner has completed a prior course of learning, corresponding to a qualification at a given level. For each such prior qualification, the student would have put in a certain volume of institutional or workplace learning, and the more complex a qualification, the greater the volume of learning that would have gone into it. Credits quantify learning outcomes that are subject achieving the prescribed learning outcomes to valid, reliable methods of assessment.

The **credit points** will give the learners, employers, and institutions a mechanism for describing and comparing the learning outcomes achieved. The credit points can be calculated as credits attained multiplied with the credit level.

The workload relating to a course is measured in terms of credit hours. A credit is a unit by which the coursework is measured. It determines the number of hours of instruction required per week over the duration of a semester (minimum 15 weeks).

Each course may have only a lecture component or a lecture and tutorial component or a lecture and practicum component or a lecture, tutorial, and practicum component, or only practicum component. Refer to the Section 1.3.1

A course can have a combination of **lecture credits, tutorial credits, practicum credits and experiential learning credits**. The following types of courses/activities constitute the programmes of study. Each of them will require a specific number of hours of teaching/guidance and laboratory/studio/workshop activities, field-based learning/projects, internships, and community engagement and service.

- **Lecture courses:** Courses involving lectures relating to a field or discipline by an expert or qualified personnel in a field of learning, work/vocation, or professional practice.
- **Tutorial courses:** Courses involving problem-solving and discussions relating to a field or discipline under the guidance of qualified personnel in a field of learning, work/vocation, or professional practice. Should also refer to the Remedial Classes, flip classrooms and focus on both Slow and Fast Learners of the class according to their merit.

- **Practicum or Laboratory work:** A course requiring students to participate in a project or practical or lab activity that applies previously learned/studied principles/theory related to the chosen field of learning, work/vocation, or professional practice under the supervision of an expert or qualified individual in the field of learning, work/vocation or professional practice.
- **Seminar:** A course requiring students to participate in structured discussion/conversation or debate focused on assigned tasks/readings, current or historical events, or shared experiences guided or led by an expert or qualified personnel in a field of learning, work/vocation, or professional practice.
- **Internship:** A course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations. Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.
- **Field practice/projects:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity.

Table:2: Course wise Distribution of Credits

Sl. No	Category	Abbreviation	Credit Breakup
1	Humanities and Social Sciences including Management courses (HSMC)	HSMC	06
2	Basic Science courses (BSC)	BSC	23
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc (ESC)	ESC	27
4	Professional core courses (PCC)	PCC	61
5	Professional Elective courses relevant to chosen specialization/branch (PEC)	PEC	15
6	Indian Knowledge System (IKS)	IKS	04
7	Open subjects – Electives from other technical and /or emerging subjects (OEC)	OEC	12
8	Project work, seminar and internship in industry or elsewhere (PROJ)	PROJ	18
9	Mandatory Audit/ Skill Enhancement Courses (MC)	MC	02
	Total		168

Section 4

Level of Courses

4.1 NHEQF levels:

The NHEQF levels represent a series of sequential stages expressed in terms of a range of learning outcomes against which typical qualifications are positioned/located. NHEQF level 4.5 represents learning outcomes appropriate to the first year (first two semesters) of the undergraduate programme of study, while Level 8 represents learning outcomes appropriate to the doctoral-level programme of study.

Table: 3: NHEQF Levels

NHEQF level	Examples of higher education qualifications located within each level	Credit Requirements
Level 4.5	Undergraduate Certificate. Programme duration: First year (first two semesters) of the undergraduate programme, followed by an exit 4-credit skills-enhancement course(s).	40
Level 5	Undergraduate Diploma. Programme duration: First two years (first four semesters) of the undergraduate programme, followed by an exit 4-credit skills-enhancement course(s) lasting two months.	80
Level 5.5	Bachelor's Degree. Programme duration: First three years (Six semesters) of the four-year undergraduate programme.	120
Level 6	Bachelor's Degree (Honours/ Honours with Research). Programme duration: Four years (eight semesters).	160
Level 6	Post-Graduate Diploma. Programme duration: One year (two semesters) for those who exit after successful completion of the first year (two semesters) of the 2-year master's programme	160
Level 6.5	Master's degree. Programme duration: Two years (four semesters) after obtaining a 3- year Bachelor's degree (e.g. B.A., B.Sc., B.Com. etc.).	80
Level 6.5	Master's degree. Programme duration: One year (two semesters) after obtaining a 4 -year Bachelor's degree (Honours/ Honours with Research) (e.g. B.A., B.Sc., B.Com. etc.).	40
Level 7	Master's degree. (e.g., M.E./M.Tech. etc.) Programme duration: Two years (four semesters) after obtaining a 4-year Bachelor's degree. (e.g., B.E./B.Tech. etc.)	80
Level 8	Doctoral Degree	Credits for course work, Thesis, and published work

Section 5

Graduate Attributes & Learning Outcomes

5.1 Introduction

As per the NHEQF, each student on completion of a programme of study must possess and demonstrate the expected **Graduate Attributes** acquired through one or more modes of learning, including direct in-person or face-to-face instruction, online learning, and hybrid/blended modes. The graduate attributes indicate the quality and features or characteristics of the graduate of a programme of study, including learning outcomes relating to the disciplinary area(s) relating to the chosen field(s) of learning and generic learning outcomes that are expected to be acquired by a graduate on completion of the programme(s) of study.

The graduate profile/attributes must include,

- capabilities that help widen the current knowledge base and skills,
- gain and apply new knowledge and skills,
- undertake future studies independently, perform well in a chosen career, and
- play a constructive role as a responsible citizen in society.

The graduate profile/attributes are acquired incrementally through development of cognitive levels and describe a set of competencies that are transferable beyond the study of a particular subject/disciplinary area and programme contexts in which they have been developed.

Graduate attributes include,

- **learning outcomes that are specific to disciplinary areas** relating to the chosen field(s) of learning within broad multidisciplinary/interdisciplinary/ transdisciplinary contexts.
- **generic learning outcomes** that graduate of all programmes of study should acquire and demonstrate.

5.2 Graduate Attributes:

Table: 4: The Learning Outcomes Descriptors and Graduate Attributes

Sl.no.	Graduate Attribute	The Learning Outcomes Descriptors (The graduates should be able to demonstrate the capability to:)
GA1	Disciplinary Knowledge	acquire knowledge and coherent understanding of the chosen disciplinary/interdisciplinary areas of study.

Sl.no.	Graduate Attribute	The Learning Outcomes Descriptors (The graduates should be able to demonstrate the capability to:)
GA 2	Complex problem solving	solve different kinds of problems in familiar and non- familiar contexts and apply the learning to real-life situations.
GA 3	Analytical & Critical thinking	apply analytical thought including the analysis and evaluation of policies, and practices. Able to identify relevant assumptions or implications. Identify logical flaws and holes in the arguments of others. Analyse and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples.
GA 4	Creativity	create, perform, or think in different and diverse ways about the same objects or scenarios and deal with problems and situations that do not have simple solutions. Think 'out of the box' and generate solutions to complex problems in unfamiliar contexts by adopting innovative, imaginative, lateral thinking, interpersonal skills, and emotional intelligence.
GA 5	Communication Skills	listen carefully, read texts and research papers analytically, and present complex information in a clear and concise manner to different groups/audiences. Express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media.
GA 6	Research-related skills	develop a keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions. Should acquire the ability to problematize, synthesize and articulate issues and design research proposals, define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships. Should develop the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work.
GA 7	Collaboration	work effectively and respectfully with diverse teams in the interests of a common cause and work efficiently as a member of a team.
GA 8	Leadership readiness/qualities	plan the tasks of a team or an organization and setting direction by formulating an inspiring vision and building a team that can help achieve the vision.
GA 9	Digital and technological skills	use ICT in a variety of learning and work situations. Access, evaluate, and use a variety of relevant information sources and use appropriate software for analysis of data.

Sl.no.	Graduate Attribute	The Learning Outcomes Descriptors (The graduates should be able to demonstrate the capability to:)
GA 10	Autonomy, responsibility, and accountability:	apply knowledge, understanding, and/or skills with an appropriate degree of independence relevant to the level of the qualification,
GA 11	Environmental awareness and action	mitigate the effects of environmental degradation, climate change, and pollution. Should develop the technique of effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living.
GA 12	Community engagement and service	demonstrate the capability to participate in community-engaged services/ activities for promoting the well-being of society

5.3 Programme Learning Outcomes (PLO)

The term ‘programme’ refers to the entire scheme of study followed by learners leading to a qualification. Individual programmes of study will have defined learning outcomes that must be attained for the award of a specific certificate/diploma/degree. Programme Learning Outcomes describe what students are expected to know or be able to do by the time of graduation. PLOs are statements about the knowledge, skills and attitudes (attributes) the graduate of a formal engineering program should have. PLOs deal with the general aspect of graduation for a particular program, and the competencies and expertise a graduate will possess after completion of the program. The identified PLOs are as follows:

- **PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO2: Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO3: Conduct investigations of complex problems:** apply critical thinking skills to identify complex problems in the field of Mechanical engineering, analyze these problems with a systematic and logical approach, evaluate various solutions considering multiple aspects, such as technical feasibility, ethical implications, sustainability, and practicality, and synthesize information to devise effective, efficient, and innovative solutions.

- **PO4: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO5: Communication skills:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO6: Research-related skills:** Conduct original research in mechanical engineering, employing scientific methods to design experiments, analyze data, and interpret results.
- **PO7: Collaboration:** Contribute constructively to collaborative environments, leveraging collective knowledge to achieve common goals, resolve conflicts, and enhance team productivity in both face-to-face and virtual settings.
- **PO7: Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO8: Leadership and readiness/qualities:** Exhibit readiness for professional success in the field of mechanical engineering, with the ability to adapt to emerging technologies, navigate ethical and societal issues, collaborate effectively with diverse teams, and demonstrate integrity and accountability in their work.
- **PO9: Digital and technological skills:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO10: Autonomy, responsibility, and accountability:** Take ownership of their work, setting goals, managing time effectively, and seeking out opportunities for continuous learning and improvement, exhibit accountability for their actions, acknowledging and learning from mistakes, and adhering to ethical and professional standards in all aspects of their work.
- **PO11: Environmental awareness and action:** integrate environmental considerations into their engineering projects, implementing strategies to minimize resource consumption, reduce carbon footprint, and promote environmental sustainability.

- **PO12: Community engagement and service:** Actively collaborate with community stakeholders to identify needs and co-create technology-based solutions that address local, national, or global issues.

5.4 Programme Educational Objectives (PEOs)

The Programme Educational Objectives (PEOs) are defined and developed for each program with the consultation and involvement of various stakeholders such as management, students, industry, regulating authorities, alumni, faculty and parents. Their interests, social relevance and contributions are taken in to account in defining and developing the PEOs. The Program Educational Objectives (PEOs) of the Mechanical Engineering are listed below:

- **PEO1:** To provide students with a strong foundation in the Mathematical, Scientific and Engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for graduate studies, R&D.
- **PEO2:** To provide exposure to emerging cutting-edge technologies, adequate training & opportunities to work as teams on multidisciplinary projects with effective communication skills and leadership qualities.
- **PEO3:** To prepare the students for a successful career for bridging the digital divide and meeting the requirements of Indian and multinational companies.
- **PEO4:** To promote student awareness on life-long learning and to introduce them to professional ethics and codes of professional practice.

5.5 Programme Specific Outcomes (PSOs)

- **PSO1:** Apply mechanical and interdisciplinary knowledge to analyze, design and manufacture products to address the needs of society.
- **PSO2:** Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services.
- **PSO3:** Able to be a technically competent employee, researcher, entrepreneur, excel in competitive exams and zest for higher studies.

5.4 Course Learning Outcomes (CLOs)

The programme learning outcomes are attained by learners through the essential learnings acquired on the completion of selected courses of study within a programme of study. The term ‘course’ is used to mean the individual courses of study that make up the scheme of study for a programme. The Departments and Schools of the University are expected to map the relevant programme learning outcomes when setting the course learning outcomes for the undergraduate certificate/diploma, Bachelor’s degree, Bachelor’s degree with honours/ honours with research or master’s degree programmes.

Course learning outcomes are specific to the learning for a given course of study related to a disciplinary or interdisciplinary/multi-disciplinary area of learning. Some courses of study are highly structured, with a closely laid down progression of compulsory/core courses to be taken at different phases/stages of learning.

5.5 The Qualification Specifications:

Table: 5: NHEQF Qualification specifications

Qualification type	Purpose of the qualification
Undergraduate Certificate	The students will be able to apply technical and theoretical concepts and specialized knowledge and skills in a broad range of contexts to undertake skilled or paraprofessional work and/or to pursue further study/learning at higher levels.
Undergraduate Diploma	The students will be able to apply specialized knowledge in a range of contexts to undertake advanced skilled or paraprofessional work and/or to pursue further learning/study at higher levels.
Bachelor’s degree	The students will be able to apply a broad and coherent body of knowledge and skills in a range of contexts to undertake professional work and/or for further learning.
Bachelor’s degree (Honours/ Honours with Research)	The students will be able to apply the knowledge in a specific context to undertake professional work and for research and further learning.
	The students will be able to apply an advanced body of knowledge in a range of contexts to undertake professional work and apply specialized knowledge and skills for research and scholarship, and/or for further learning relating to the chosen field(s) of learning, work/vocation, or professional practice.

Section 6

Course Structure of the Framework

		SEMESTER I					
Sl.No	Course Title	Course code	L	T	P	Credits	
1.	Physics -I	PHY022C201(BSC)	3	0	2	4	
2	Mathematics-II	MAT022C202(BSC)	3	1	0	4	
3	Basic Electrical Engineering	CSE022C203 (ESC)	3	0	2	4	
4	Engineering Graphics & Design	CEE022C204(ESC)	2	0	4	4	
5	English For Technical Writing	CEN (HSMC)	2	0	0	2	
6	Design Thinking	DES022S206 (ESC)	0	0	2	1	
7	IDEA LAB	MEE022S207 (MC)	0	0	2	1	
Total Credit						20	
		SEMESTER II					
Sl.No	Course Title	Course code	L	T	P	Credits	
1.	Chemistry -I	CHY022C101 (BSC)	3	0	2	4	
2	Mathematics-I	MAT022C102 (BSC)	3	1	0	4	
3	Programming for problem solving	CSE022C103(ESC)	2	0	4	4	
4	Biology For Engineers	MEE022C104(BSC)	3	0	0	3	
5	Manufacturing Practice Workshop	MEE022C105 (ESC)	1	0	4	3	
6	Universal Human Values	BHS (HSMC)	1	0	0	1	
7	Sports and Yoga/NSS/NCC	MEE022C106 (MC)	0	0	2	1	
Total Credit						20	
		SEMESTER III					
Sl.No	Course Title	Course code	L	T	P	Credits	
1.	Engineering Thermodynamics	MEE022C301(ESC)	3	1	0	4	
2	Engineering Mechanics	MEE022C302(ESC)	3	1	0	4	
3	Mechanics of Deformable Solids	MEE022C303(ESC)	3	1	0	4	

FIRST YEAR

SECOND YEAR

4	Mathematics for Mechanical Engineering	MAT022C304(BSC)	3	0	0	3
5	IKS-I	IKS	2	0	0	2
6	Value Added Course /Open Elective -I	XX (OEC)	3	0	0	3
Total Credit						20
7	Honours (Optional) [to be applied through MOOCS]		3	0	0	3
SEMESTER IV						
Sl.No	Course Title	Course code	L	T	P	Credits
1	Fluid Mechanics & Hydraulic Machines	MEE022C401(PCC)	3	1	0	4
2	Applied Thermodynamics	MEE022C402(PCC)	3	1	0	4
3	Theory of Machines	MEE022C403(PCC)	3	1	0	4
4	Engineering Materials & Application	MEE022C404(PCC)	3	1	0	4
5	IKS-II	IKS	2	0	0	2
6	Fluid Mechanics Laboratory	MEE022C411(PCC)	0	1	2	2
Total Credit						20
7	Honours (Optional) [to be applied through MOOCS]		3	0	0	3

SEMESTER V						
Sl.No	Course Title	Course code	L	T	P	Credits
1	Machine element and system design	MEE022C501(PCC)	3	1	0	4
2	Manufacturing Process	MEE022C502(PCC)	3	1	0	4
3	Measurements and metrology	MEE022C503(PCC)	3	0	2	4
4	Heat Transfer and Thermal Machines	MEE022C504(PCC)	3	1	0	4
5	Mechatronics	MEE022C505 (PCC)	3	0	2	4
6	Professional Elective -1	MEE022D70X (PEC)	3	0	0	3
7	Heat Transfer Lab	MEE022C514(PCC)	0	1	2	2
Total Credit						25
8	Honours (Optional) [to be applied through MOOCS]		3	0	0	3
SEMESTER VI						
Sl.No	Course Title	Course code	L	T	P	Credits
1.	CAD/CAM	MEE022C601(PCC)	3	0	2	4
2	Manufacturing Automation	MEE022C602 (PCC)	3	0	2	4
3	IC Engine	MEE022C603 (PCC)	3	1	0	4
4	Dynamics of Machinery	MEE022C604(PCC)	3	1	0	4
5	Dynamics of Machinery Lab	MEE022C614 (PCC)	0	0	2	1
6	Principle of Management/Economics & Accountancy	BSA022A605 (HSMC)	3	0	0	3
Total Credit						20
7	Honours (Optional) [to be applied through MOOCS]		3	0	0	3

THIRD YEAR

SEMESTER VII						
Sl.No	Course Title	Course code	L	T	P	Credits
1.	Product Innovation & Entrepreneurship	MEE022C701 (PCC)	3	1	0	4
2	Professional Elective -2	MEE022D70X (PEC)	3	0	0	3
3	Professional Elective -3	MEE022D70X (PEC)	3	0	0	3
4	Open Elective- 1	XX (OEC)	3	0	0	3
5	Open Elective -2	XX (OEC)	3	0	0	3
6	Internship Evaluation	MEE022C716 (INT)	0	0	20	10
Total Credit						26
7	Honours (Optional) [to be applied through MOOCS]		3	0	0	3
SEMESTER VIII						
Sl.No	Course Title	Course code	L	T	P	Credits
1	Professional Elective -4	MEE022D80X (PEC)	3	0	0	3
2	Professional Elective -5	MEE022D80X (PEC)	3	0	0	3
3	Open Elective- 3	XX (OEC)	3	0	0	3
4	Engineering Project	MEE022C811 (PROJ)	0	0	16	8
Total Credit						17
5	Honours (Optional) [to be applied through MOOCS]		3	0	0	3
TOTAL CREDITS (I, II, III, IV, V, VI, VII, VIII):						168

Note:

- A total of 18-20 credits has to be earned/ acquired by the students through MOOCS from 3rd semester onwards as a part of their Honors or Minor track. The track has to be of a specific domain of interest of the students. A student can acquire even more than 20 credits. However, a minimum of 3 credit must be acquired per semester. For successfully completing a 12-weeks course, a student will earn 3 credits and for a 16-weeks course, he/she will earn 4 credits.

Semester wise component wise distribution of courses

a. Semester-wise Credit Distribution

SEMESTER	CREDITS
I	20
II	20
III	20
IV	20
V	25
VI	20
VII	26
VIII	17
Total	168 credit

Total

168 credits

2. Teaching Learning Process

	Component of Evaluation	Marks	Frequency	Code	Weightage (%)
A	Continuous Evaluation				
I	Analysis/Class test	Combination of any three from (i) to (v) with 5 marks each	1-3	C	25%
II	Home Assignment		1-3	H	
III	Project		1	P	
IV	Seminar		1-2	S	
V	Viva-Voce/Presentation		1-2	V	
VI	MSE	MSE shall be of 10 marks	1-3	Q/CT	
VII	Attendance	Attendance shall be of 5 marks	100%	A	5%
B	Semester End Examination		1	SEE	70%
	Project				100%

Credit Distribution for 4-year Course.

Semester	Course Credits									Total
	HSMC	BSC	ESC	PCC	PEC	IKS	OE	PROJ/ INT	AC	
I	2	9	8	0	0	0	0	0	1	20
II	1	11	7	0	0	0	0	0	1	20
III	0	3	8	4	0	2	3	0	0	20
IV	0	0	4	14	0	2	0	0	0	20
V	0	0	0	22	3	0	0	0	0	25
VI	3	0	0	17	0	0	0	0	0	20
VII	0	0	0	4	6	0	6	10	0	26
VIII	0	0	0	0	6	0	3	8	0	17
	6	23	27	61	12	4	9	18	2	168

List of suggestive Course under Programme Elective Courses:

PROFESSIONAL CORE COURSES

Sl.	Code No.	Subject	Semester	Credits
1	MEE022C401(PCC)	Fluid Mechanics & Hydraulic Machines	4	3:1:0=4
2	MEE022C402(PCC)	Applied Thermodynamics	4	3:1:0=4
3	MEE022C403(PCC)	Theory of Machines	4	3:1:0=4
4	MEE022C404(PCC)	Engineering Materials & Applications	4	3:1:0=4
5	MEE022C411(PCC)	Mechanical Engineering Lab-1 (Fluid Mechanics)	4	0:1:2=2
6	MEE022C501(PCC)	Machine Element & System Design	5	3:1:0=4
7	MEE022C502(PCC)	Manufacturing Processes	5	3:1:0=4
8	MEE022C503(PCC)	Measurements & Metrology	5	3:0:2=4
9	MEE022C504(PCC)	Heat transfer & Thermal Machines	5	3:1:0=4
10	MEE022C514(PCC)	Mechanical Engineering Lab-2 (Heat Transfer Lab)	5	0:1:2=2
11	MEE022C505 (PCC)	Mechatronics	5	3:1:0=4
12	MEE022C601(PCC)	CAD/CAM	6	3:0:2=4
13	MEE022C602 (PCC)	Manufacturing Automation	6	3:0:2=4
14	MEE022C603 (PCC)	IC Engine	6	3:1:0=4
15	MEE022C604(PCC)	Dynamics of Machinery	6	3:1:0=4
16	MEE022C614 (PCC)	Mechanical Engineering Lab-3 (DOM lab)	6	0:0:2=1

17	MEE022C701 (PCC)	Product Innovation & Entrepreneurship	7	3:1:0=4
Total Credits:				61

PROFESSIONAL ELECTIVE

(Total 5 to be taken, at least one from each group)

Sl.	Code No.	Subject	Semester	Credits
<i>TECHNOLOGY GROUP</i>				
1	MEE022D701 (PEC)	Refrigeration & Air Conditioning	7 / 8	3:0:0=3
2	MEE022D702 (PEC)	Power Plant Engineering	7 / 8	3:0:0=3
3	MEE022D703 (PEC)	Renewable Energy Engineering	7 / 8	3:0:0=3
4	MEE022D704 (PEC)	Finite Element Analysis	7 / 8	3:0:0=3
5	MEE022D705 (PEC)	Computational Fluid Dynamics	7 / 8	3:0:0=3
6	MEE022D706 (PEC)	Design for Manufacturing & Assembly	7 / 8	3:0:0=3
7	MEE022D707 (PEC)	Additive Manufacturing	7 / 8	3:0:0=3
8	MEE022D708 (PEC)	Die, Mould and Tool Engineering	7 / 8	3:0:0=3
<i>INDUSTRY SECTOR GROUP</i>				
1	MEE022D709 (PEC)	Automobile Engineering	7 / 8	3:0:0=3
2	MEE022D710 (PEC)	Aerospace Engineering	7 / 8	3:0:0=3
3	MEE022D711 (PEC)	Agricultural Engineering	7 / 8	3:0:0=3
4	MEE022D712 (PEC)	Biomedical Engineering	7 / 8	3:0:0=3
5	MEE022D713 (PEC)	Food Technology	7 / 8	3:0:0=3
6	MEE022D714 (PEC)	Marine Engineering	7 / 8	3:0:0=3
7	MEE022D715 (PEC)	Nuclear Engineering	7 / 8	3:0:0=3
8	MEE022D716 (PEC)	Textile Engineering	7 / 8	3:0:0=3
Total Credits:				9

INTERNSHIP & ENGINEERING PROJECT

Sl.	Code No.	Subject	Semester	Credits
1	MEE022C716 (INT)	Internship Evaluation	7	0:0:20=10
2	MEE022C811 (PROJ)	Engineering Project (Prototype & Testing)	8	0:0:16=08
Total Credits:				18

OPEN ELECTIVE COURSES (3 courses from any department) in 7th / 8th semester

NEW ELECTRONICS/IT-ORIENTED CORE COURSES

Sl.	Code No.	Subject	Semester	Credits
1	DES022S206 (ESC)	Design Thinking (New)	1	0:0:2=1
2	MEE022S207 (MC)	Idea Lab (New)	1	0:0:2=1

3	CSE022C203 (ESC)	Basic Electrical Engineering	1	3:0:2=4
4	CSE022C103(ESC)	Programming for Problem Solving	2	2:0:4=4
5	MEE022C505 (PCC)	Mechatronics (New)	5	3:1:0=4
6	MEE022C601(PCC)	CAD/CAM (New)	6	3:0:2=4
7	MEE022C701 (PCC)	Product Innovation and Entrepreneurship (New)	7	3:1:0=4
			Total Credits:	22

Annexure II

List of Suggestive Courses under SEC

Annexure III

List of Suggestive Courses under VAC

Annexure IV

List of mandatory Courses under AEC

Annexure V

List of interdisciplinary Courses

Annexure VI

List of IKS Courses

Annexure VII

Salient points for framing the Course Curriculum
Committee for framing diploma/UG/PG &PhD Curriculum

SYLLABUS OF I & II SEMESTER

DETAILED SYLLABUS OF 1st SEMESTER

Paper I/Subject Name: Physics	Subject Code: PHY022C201 (BSC)
L-T-P-C – 3-0-2-4	Credit Units: 04
	Scheme of Evaluation: TP

Objective:

The objectives of the course are to make the students enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology

Prerequisites: Concepts of Physics of +2 level

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Study the basic concepts of Physics.	BT 1
CO 2	Understand the basic concepts of Physics.	BT 2
CO 3	Solve problems in wave mechanics.	BT 3
CO 4	Analyse knowledge in calculating red and blue shift and also in	BT 4

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I.	Classical Mechanics and Dynamics	Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton’s laws and its completeness in describing particle motion; Form invariance of Newton’s Second Law; Solving Newton’s equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates. Potential energy function; $F = - \text{Grad } V$, equipotential surfaces and meaning of gradient; Conservative and non- conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application: Satellite manoeuvres.	17
II.	Advanced Dynamics and Oscillatory Motion	Non-inertial frames of reference; Rotating coordinate system: Five-term acceleration formula. Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum; Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly- damped oscillators; Forced oscillations and resonance.	16
III.	Rigid Body Dynamics and Kinematics	Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler’s laws of motion, their	16

		independence from Newton's laws, and their necessity in describing rigid body motion; Examples.	
IV	Advanced Rigid Body Dynamics: Three-Dimensional Motion	Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.	17
TOTAL			66

Physics Lab Syllabus

Detailed Syllabus:

Experiment	Experiment Title	Lab Hours
I	Determination of Moment of Inertia of a given solid about its own axis by using M.I. Table	2
II	Determination of Young's Modulus using Searle's Apparatus	2
III	Determination of Rigidity of Modulus of the material of the given rod by Statistical method	2
IV	Determination of Powers of Given lenses using an Optical Bench i. Concave Lens, ii Convex Lens	2
V	Determination of Resistance of a Galvanometer using Post Office Box.	2
VI	To determine the mechanical equivalent of heat by Joule's calorimeter	2
VII	Determination of ratio of E.M.F of two cells using Potentiometer.	2
VIII	To determination of the focal length of a convex mirror with the help of an auxiliary lens.	2
IX	Determination of Horizontal Components of Earth's Magnetic field using Magnetometer	2
X	Determination of coefficient of Viscosity of water by Capillary Flow Method	2

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
3 * 22 NCH = 66 NCH	2 * 15 NCH = 30 NCH	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books:

1. Engineering Mechanics, 2nd ed. – D.S. Bedi, M.P. Poonia

2. Basic Mechanical Engineering – S.C. Sharma, M.P. Poonia
3. Engineering Mechanics, 2nd ed. — MK Harbola
4. Introduction to Mechanics — MK Verma
5. An Introduction to Mechanics — D Kleppner & R Kolenkow
6. Principles of Mechanics — JL Synge & BA Griffiths
7. Mechanics — JP Den Hartog
8. Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
9. Mechanical Vibrations — JP Den Hartog
10. Theory of Vibrations with Applications — WT Thomson

Reference Books:

1. Singh A.K. and Malik Hitendra Engineering Physics, 2nd Edition, 2016, McGraw Hill Education Private Limited. New Delhi.
2. Gaur R.K and Gupta S.L, Engineering Physics, 2015, Dhanpat Rai publication, New Delhi.
3. Arthur Beiser, Shobhit Mahajan, S. Rai. Choudhury, Concept of Modern physics, 6th Edition, 2009, McGraw-Hill education Private limited. New Delhi.
4. M Ghosh & D Bhattacharya, A Textbook of Oscillations, Waves and Acoustics, 5th Edition, 2016, S. Chand publication.

Additional Readings

1. <https://www.griet.ac.in/nodes/Engineering%20Physics%20Notes.pdf>
2. https://mrcet.com/downloads/digital_notes/HS/R20/Engineering%20Physics.pdf
3. NPTEL Course on Introduction To Electromagnetic Theory by Prof. Manoj Harbola, IIT Kanpur
4. NPTEL Course on Engineering Mechanics by Prof. Manoj Harbola, IIT Kanpur

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	ENGINEERING MECHANICS	PROF. MANOJ HARBOLA	IIT KANPUR

Objective:

The objectives of the course are to teach the students Mathematics fundamentals necessary to formulate, solve and analyze engineering problems.

Prerequisites: Concepts of Mathematics of +2 level

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Define basic terminologies of calculus	BT 1
CO 2	Understand the applications of differential and integral calculus in different fields of Engineering.	BT 2
CO 3	Apply the single and multivariable differential and Integral calculus in engineering problems.	BT 3
CO 4	Analyze and assess the patterns in series.	BT 4 & 5

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I	Basic Calculus:	Curvature, evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's Theorem, Mean value theorems and applications; Extreme values of functions; Linear approximation; Indeterminate forms and L'Hospital's rule.	10
II	Sequences and Series:	Limits of sequence of numbers, Calculation of limits, Infinite series; Tests for convergence; Power series, Taylor and Maclaurin series; Taylor theorem, convergence of Taylor series, error estimates.	20
III	Multivariable Calculus (Differentiation):	Limit, continuity and partial derivatives, directional derivatives, gradient, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.	10
IV	Multivariable Calculus (Integration):	Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Gradient, curl and divergence, Theorems of Green, Gauss and Stokes.	20
TOTAL			60

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
4 * 15 NCH = 60 NCH	2 * 15 NCH = 30 NCH	8 * 4 NCH = 32 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books:

1. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
2. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. A text book of Engineering Mathematics, Bali N. P. and Narayan Iyenger N., 9th Edition, 2016, Laxmi Publication.
9. Mathematical Methods for Physics and Engineering: A Comprehensive Guide, K. F. Riley, M. P. Hobson, 3rd Edition, 2006, Cambridge University Press

Reference Books:

1. Grewal B. S., *Higher Engineering Mathematics*, 43rd Edition, 2014, Khanna Publishers.
2. Raisinghania M.D., *Ordinary and Partial Differential Equations*, 17th Edition, 2014, S. Chand and Co., New Delhi.
3. Narayna S., *A Text Book of Vector Calculus*, Revised Edition, 2009, S. Chand & Co., New Delhi.

Additional Readings:

1. https://mrcet.com/downloads/digital_notes/HS/R-18%20Mathematics-II.pdf
2. http://www.bosecuttack.in/studentcorner/LECTURE_NOTE.MATH2.2ND_SEM_1_.pdf
3. <https://www.srividyaengg.ac.in/coursematerial/year/111223.pdf>

Objective:

The objectives of the course are to make students understand the basic electrical terminologies and familiarize them with the basic concepts of D.C., single-phase and three-phase A.C. networks.

Prerequisites: Basic concepts of D.C. networks of Class XII, Electromagnetic Induction and A.C. Fundamentals etc.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Recall the basic concepts of electrical engineering	BT 1
CO 2	Understand the concept behind basic electric and magnetic circuits.	BT 2
CO 3	Apply the working principles of electrical machines and power converters in real-life.	BT 3
CO 4	Analyze DC circuits using Ohm's Law and Kirchhoff's Laws, and understand the principles of electromagnetism	CO 4

Detailed Syllabus:

Modules	Topic	Course Content	Hours
I.	DC Circuits	D. C. Circuits covering, Ohm's Law and Kirchhoff's Laws; Analysis of series, parallel and series-parallel circuits excited by independent voltage sources; Power and energy; Electromagnetism covering, Faradays Laws, Lenz's Law, Fleming's Rules, Statically and dynamically induced EMF; Concepts of self-inductance, mutual inductance and coefficient of coupling; Energy stored in magnetic fields.	16
II.	AC Circuits	Single Phase A.C. Circuits covering, Generation of sinusoidal voltage- definition of average value, root mean square value, form factor and peak factor of sinusoidal voltage and current and phasor representation of alternating quantities; Analysis with phasor diagrams of R, L, C, RL, RC and RLC circuits; Real power, reactive power, apparent power and power factor, series, parallel and series- parallel circuits; Three Phase A.C. Circuits covering, Necessity and Advantages of three phase systems, Generation of three phase power, definition of Phase sequence, balanced supply and balanced load; Relationship between line and phase values of balanced star and delta connections; Power in balanced three phase circuits, measurement of power by two wattmeter method;	16

III.	Electrical Machines:	Principle of operation and construction of single-phase transformers (core and shell types). EMF equation, losses, efficiency and voltage regulation; Synchronous Generators covering, Principle of operation; Types and constructional features; EMF equation; working principle of DC machine as a generator and a motor; Types and constructional features; EMF equation of generator, relation between EMF induced and terminal voltage enumerating the brush drop and drop due to armature reaction; DC motor working principle; Back EMF and its significance, torque equation; Types of D.C. motors, characteristics and applications; Necessity of a starter for DC motor	17
IV.	Electrical Installations:	Three Phase Induction Motors covering; Concept of rotating magnetic field; Principle of operation, types and constructional features; Slip and its significance; Applications of squirrel cage and slip ring motors; Necessity of a starter, star-delta starter. Sources of Electrical Power covering, Introduction to Wind, Solar, Fuel cell, Tidal, Geothermal, Hydroelectric, Thermal-steam, diesel, gas, nuclear power plants; Concept of cogeneration, and distributed generation;	17
TOTAL			66

Basic Electrical Engineering Lab Syllabus

Total Lab Hours for the semester = 30 (2 hours per week)

Minimum 10 Laboratory experiments based on the following-

Lab	Experiments	Hours
I	To verify Thevenin's Theorem for DC network	2
II	To verify Maximum Power Transfer Theorem for DC network	2
III	Study of R-L-C Series circuit and determine R,L,C, $\cos \Phi$, P and Q and draw the phasor diagram	2
IV	Study of R-L-C Parallel circuit and determine R,L,C, $\cos \Phi$, P and Q and draw the phasor diagram	2
V	Calibration of a milli-ammeter as a voltmeter.	2
VI	To determine the ohmic and effective resistance (armature winding)	2
VII	To study the characteristics of a filament lamp	2
VIII	To measure the power in a single-phase load using one wattmeter	2
IX	To measure the insulation resistance using Megger	2
X	Demonstration of house wiring	2
TOTAL		20

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
3 * 22 NCH = 66 NCH	2 * 15 NCH = 30 NCH	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books:

1. A Text Book of Electrical Technology, Thereja, B.L., 1st Edition revised, 2008, S Chand & Company Ltd. Ram Nagar; New Delhi.
2. Basic Electrical Engineering, D. P. Kothari, I. J.Nagrath, 3rd Edition, 2009, Tata McGraw-Hill

Reference Books:

1. D. C. Kulshreshtha, *Basic Electrical Engineering*, 1st Edition, 2009, McGraw-Hill
2. E. Hughes, *Electrical and Electronics Technology*, 10th Edition, 2011, Pearson Publication

Additional Readings:

1. https://mrcet.com/downloads/digital_notes/HS/Basic%20Electrical%20Engineering%20R-20.pdf
2. https://www.cet.edu.in/noticefiles/231_BASIC_ELECTRICAL_ENGG-min.pdf
3. NPTEL Course on Basic Electrical Circuits by Prof. Nagendra Krishnapura, IITM
4. NPTEL Course on Fundamentals of Electrical Engineering by Prof. Debapriya Das, IIT, Kharagpur

Objective:

The objectives of the course are to make students understand the process of drawing projections and sections and basic engineering drawing formats and to convert sketches to engineered drawings.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Relate with the concepts of drawings and projections	BT 1
CO 2	Understand the dimension and figures using the drawing instruments and acquire visualisation skills, projection of points, etc.	BT 2
CO 3	Utilize engineering curves in tracing the paths of simple machine components.	BT 3
CO 4	Analyse and assess sketches to convert them to engineered drawings.	BT 4

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I.	Introduction and Projections	Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales; Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Covering those inclined to both the Planes-Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc	11
II.	Angular Solids and Isometric Projections	Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only). Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	11
III.	Overview of Computer Graphics	Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The	11

		Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]. Consisting of set up of the drawing page and the printer, including scale settings, setting up of Modules and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	
IV	Customisation and CAD drawing	Covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computeraided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;	11
TOTAL			44

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
2 * 22 NCH = 44 NCH	4 * 15 NCH = 60 NCH	8 * 2 NCH = 16 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books:

1. Engineering Drawing; Bhatt, N.D, 53rd Edition, 2016, Charotar Publishing House

Reference Books:

1. Jolhe Dhananjay A; Engineering drawing, 5th Edition, 2010, Tata McGraw-Hill Education Pvt. Ltd., New Delhi

Additional Readings:

1. https://mrcet.com/downloads/digital_notes/HS/Engineering%20Graphics%20Manual%20final.pdf
2. <https://www.pvpsiddhartha.ac.in/autonomus14/1-1/IT1L3.pdf>
3. NPTEL Course on Engineering Drawing and Computer Graphics by Prof. Rajaram Lakkaraju, IIT, Kharagpur
4. NPTEL Course on Engineering Graphics by Prof. Nihar Ranjan Patra, IIT, Kanpur

Paper V/Subject Name: English for Technical Writing	Subject Code: CEN
L-T-P-C – 2-0-0-2	Credit Units: 02
	Scheme of Evaluation: T

Objective:

The objectives of the course are to provide learning environment to practice listening, speaking, reading and writing skills, to assist the students to carry on the tasks and activities through guided instructions and materials and to effectively integrate English language learning with employability skills and training.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Define the various forms of communication	BT 1
CO 2	Understand basic proficiency in English.	BT 2
CO 3	Develop reading and listening comprehension, writing and speaking skills.	BT 3
CO 4	Analyze the type of communication	BT 4

Detailed Syllabus:

Modules	Topics	Course content	Hours
I	Vocabulary Building	The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations.	10
II	Basic Writing Skills	Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, creating coherence, organizing principles of paragraphs in documents, Techniques for writing precisely, Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés	10
III	Writing Practices	Nature and Style of sensible Writing, Describing, Defining 1.3. Classifying, providing examples or evidence, Writing introduction and conclusion, Comprehension, Précis Writing, Essay Writing.	10

IV	Oral Communication	Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations	10
TOTAL			40

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
2*20 NCH = 40 NCH	-	20 NCH (Problem Solving, Internship, Seminar, Case Study, Discussion)

Text Book:

1. Effective Communication Skills. Kul Bhushan Kumar, 2022, Khanna Book Publishing
2. Practical English Usage, Michael Swan. 1995, OUP

Reference Books:

1. F.T. Wood, *Remedial English Grammar.*, 2007, Macmillan.
2. William Zinsser, *On Writing Well*, 2001, Harper Resource Book.
3. Liz Hamp-Lyons and Ben Heasley, *Study Writing*, 2006,
4. Sanjay Kumar and PushpLata, *Communication Skills*, 2011, Oxford University Press.

Additional Readings:

1. AICTE's Prescribed Textbook: English (with Lab Manual), Khanna Book Publishing Co., https://khannabooks.com/index.php?route=product/product&path=99_105&product_id=480
2. NPTEL Course on English Language for Competitive Exams by Prof. by Aysha Iqbal, IIT, Madras
3. NPTEL Course on Technical English for Engineers by Prof. by Aysha Iqbal, IIT, Madras

Objective:

The objectives of the course are to provide the students with new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products which are useful for a student in preparing for an engineering career.

Prerequisites: None

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Tell the utility of design thinking	BT 1
CO 2	Compare and classify the various learning styles and memory techniques	BT 2
CO 3	Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products	BT 3
CO 4	Analyze emotional experience and inspect emotional expressions to better understand users while designing innovative products	BT 4

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I.	Insight to Learning, Remembering Memory and Emotions	Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting. Understanding the Memory process, Problems in retention, Memory enhancement techniques. Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers	05
II.	Basis of Design Thinking	Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test. Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving	05
III.	Process of Prototype Design & Testing	Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Assignment – Engineering Product Design. What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing. Understanding Individual differences & Uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences.	06

IV	Customer-Centric Design, Feedback, Re-Design & Re-Create	Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design. Feedback loop, Focus on User Experience, Address “ergonomic challenges, User focused design, rapid prototyping & testing, final product, Final Presentation – “Solving Practical Engineering Problem through Innovative Product Design & Creative Solution”	06
TOTAL			22

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
	1 * 22 NCH = 22 NCH	8 * 1 NCH = 8 NCH (Seminar, Case Study, Discussion, Internship)

Text Books:

1. Developing Thinking Skills (The Way to Success), E. Balaguruswamy, 1st Edition, 2022, Khanna Publishing House
2. Design Thinking for Engineering: A practical guide; Iñigo Cuiñas, Manuel José Fernández Iglesias, 2023, Institution of Engineering and Technology
3. Design Thinking For Strategic Innovation: What They Can't Teach You at Business or Design School, Idris Mootee, 1st Edition, 2014, Adams Media

Reference Books:

1. Christian Müller-Roterberg; *Design Thinking For Dummies*, 1st Edition, 2020, For Dummies
2. *A Text Book of DESIGN THINKING For B.TECH. 4th Year, Semester-VII, Suitable For All The 4th Year B-Tech Students*

Additional Reading:

1. https://www.tutorialspoint.com/hi/design_thinking/design_thinking_tutorial.pdf

Objective:

The objectives of the course are to spread the culture of innovation among students, & other stakeholders, to motivate students to ideate and pursue creativity and to train students to become imaginative, creative, and capable of converting their ideas into prototypes.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Label the basic technologies used for innovate	BT 1
CO 2	Understand and use tools for designing electronic systems, including schematic design, PCB layout, and documentation.	BT 2
CO 3	Apply advanced prototyping technologies, including Arduino and Raspberry Pi programming, power supply design, and 3D printing	BT 3
CO4	Analyze the tools taught	BT 4

Detailed Syllabus:

The theory component will include the following:

- Electronic component familiarization, Understanding electronic system design flow. Schematic design and PCB layout and Gerber creation using EagleCAD. Documentation using Doxygen, Google Docs, Overleaf. Version control tools - GIT and GitHub.
- Basic 2D and 3D designing using CAD tools such as FreeCAD, Sketchup, Prusa Slicer, FlatCAM, Inkspace, OpenBSP and VeriCUT.
- Introduction to basic hand tools - Tape measure, combination square, Vernier calliper, hammers, fasteners, wrenches, pliers, saws, tube cutter, chisels, vice and clamps, tapping and threading. Adhesives
- Introduction to Power tools: Power saws, band saw, jigsaw, angle grinder, belt sander, bench grinder, rotary tools. Various types of drill bits
- Familiarization and use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal and function generator. Logic analyzer and MSO. Bench power supply (with 4-wire output)
- Circuit prototyping using (a) breadboard, (b) Zero PCB (c) 'Manhattan' style and (d) custom PCB. Single, double and multilayer PCBs. Single and double-sided PCB prototype fabrication in the lab. Soldering using soldering iron/station. Soldering using a temperature controlled reflow oven. Automated circuit assembly and soldering using pick and place machines.
- Mechanical cutting processes - 3-axis CNC routing, basic turning, milling, drilling and grinding operations, Laser cutting, Laser engraving etc. Basic welding and brazing and other joining techniques for assembly. Concept of Lab aboard a Box.
- Electronic circuit building blocks including common sensors. Arduino and Raspberry Pi programming and use. Digital Input and output. Measuring time and events. PWM. Serial communication. Analog input. Interrupts programming. Power Supply design (Linear and Switching types), Wireless power supply, USB PD, Solar panels, Battery types and charging.
- 3D printing and prototyping technology – 3D printing using FDM, SLS and SLA. Basics of 3D scanning, point cloud data generation for reverse engineering. Prototyping using subtractive cutting processes. 2D

and 3D Structures for prototype building using Laser cutter and CNC routers. Basics of IPR and patents; Accessing and utilizing patent information in IDEA Lab

Total Lab Hours for the semester = 22 (2 hours per week)

Minimum 08 Laboratory experiments based on the following-

1. Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.
2. Machining of 3D geometry on soft material such as soft wood or modelling wax.
3. 3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.
4. 2D profile cutting of press fit box/casing in acrylic (3 or 6mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.
5. 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
6. Familiarity and use of welding equipment.
7. Familiarity and use of normal and wood lathe.
8. Embedded programming using Arduino and/or Raspberry Pi.
9. Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
-	1 * 22 NCH = 22 NCH	8 * 1 NCH = 8 NCH (Seminar, Case Study, Discussion, Internship)

Text/ Reference Books

1. Chris Hackett, *The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects*, Reprint Edition, 2018, Weldon Owen
2. Paul Horowitz, Winfield Hill, *The Art of Electronics*, 3rd Edition, 2015, Cambridge University Press
3. Simon Monk, *Programming Arduino: Getting Started with Sketches*, 2nd Edition, 2016, McGraw Hill TABH
4. Simon Monk, *Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards*, 2014, McGraw Hill Education
5. Scott Chacon, Ben Straub, *Pro Git*, 2nd Edition, 2014, APRESS
6. Chapman W.A.J, *Workshop Technology*, 5th Edition, 2002, CBS Publishers and distributors

Additional Reading:

1. <https://www.aicte-india.org/sites/default/files/IDC/idealab/AICTE%20-%20IDEA%20LAB%20User%20Manual.pdf>
2. <https://vignaniit.edu.in/idealab.php>

DETAILED SYLLABUS OF 2ND SEMESTER

Paper I/Subject Name: Chemistry

Subject Code: CHY022C101(BSC)

L-T-P-C – 3-0-2-4

Credit Units: 04

Scheme of Evaluation: TP

Objective:

The objectives of the course are to s to acquaint the students with the basic phenomenon/concepts of chemistry, the student faces during course of their study in the industry and Engineering field and to understand the new developments and breakthroughs efficiently in engineering and technology.

Prerequisites: Concepts of +2 level Chemistry

Course Outcomes

On successful completion of the course the students will be able to:

SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Define the basic properties of chemical reactions	BT 1
CO 2	Interpret periodic properties such as ionization potential, electronegativity, oxidation states, electronegativity and bulk properties and processes using thermodynamic	BT 2
CO 3	Experiment with major chemical reactions that are used in the synthesis of molecules.	BT 3
CO 4	Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular	BT 4

Detailed Syllabus:

Modules	Topics	Course Content	Periods
I.	Atomic and Molecular Structure	Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.	16
II.	Spectroscopic Techniques and Applications, Intermolecular Forces and Potential Energy Surfaces	Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques. Diffraction and scattering.	17

		Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H ₃ , H ₂ F and HCN and trajectories on these surfaces.	
III.	Use of free Energy in Chemical Equilibria and Periodic Properties	Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and EMF. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams. Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries	16
IV.	Stereochemistry, Organic Reactions and Synthesis of a Drug Molecule	Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds. Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule	17
TOTAL			66

Chemistry Lab Syllabus

Total Lab Hours for the semester = 30 (2 hours per week)

Minimum 10 Laboratory experiments based on the following-

1. Determination of surface tension and viscosity.
2. Thin layer chromatography.
3. Ion exchange column for removal of hardness of water.
4. Determination of chloride content of water.
5. Colligative properties using freezing point depression.
6. Determination of the rate constant of a reaction.
7. Determination of cell constant and conductance of solutions.
8. Potentiometry - determination of redox potentials and EMFs.
9. Synthesis of a polymer/drug.
10. Saponification/acid value of an oil.

11. Chemical analysis of a salt.
12. Lattice structures and packing of spheres.
13. Models of potential energy surfaces.
14. Chemical oscillations- Iodine clock reaction.
15. Determination of the partition coefficient of a substance between two immiscible liquids.
16. Adsorption of acetic acid by charcoal.
17. Use of the capillary viscosimeters to demonstrate the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
3 * 22 NCH = 66 NCH	2 * 15 NCH = 30 NCH	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books

1. *A Textbook of Physical Chemistry*, Negi A.S. and Anand S.C., 2nd Edition, 2007, New Age International
2. *Concise Inorganic Chemistry*, Lee J.D., 5th Edition, 2008, John Wiley and Sons Ltd.

Reference Books:

1. Atkins, P.W. and Paula, J. De, *Physical Chemistry*, 10th Edition, 2014, Oxford University Press
2. Huheey, J.E. Keiter, E.A. Keiter, R.L Medhi, O.K., *Inorganic Chemistry Principles of Structure and Reactivity*, 4th Edition, 2006, Pearson Education

Additional Readings:

1. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition, <http://bcs.whfreeman.com/vollhardtschore5e/default.asp>
2. NPTEL Course on Chemistry - I by Prof. Mangala Sunder Krishnan, IITM

Paper II/Subject Name: Mathematics-II

Subject Code: MAT022C102 (BSC)

L-T-P-C – 3-1-0-4

Credit Units: 04

Scheme of Evaluation: T

Objective:

The objectives of the course are to enable students to achieve conceptual understanding and to retain the best traditions of traditional calculus.

Prerequisites: level Concepts of Mathematics I

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	List the methodologies used for solving various equations	BT 1
CO 2	Understand essential tool of matrices and linear algebra in a comprehensive manner	BT 2
CO 3	Utilize the essential tools in the field of applied sciences and related fields.	BT 3
CO 4	Analyze and evaluate the qualitative behavior of solutions of systems of differential equations and interpret in the context of an underlying model.	BT 4 & 5

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I.	Matrices	Linear Systems of Equations; Linear Independence; Rank of a Matrix; Determinant, Inverse of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Orthogonal transformation; Diagonalization of matrices; Cayley-Hamilton Theorem.	16
II.	First order ordinary differential equations & Ordinary differential equations of higher orders	Exact, linear and Bernoulli's equations. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients: Euler-Cauchy equations, solution by variation of parameters; Power series solutions: Legendre's equations and Legendre polynomials, Frobenius method, Bessel's equation and Bessel's functions of the first kind and their properties.	17

III.	Complex Variable – Differentiation:	Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.	16
IV	Complex Variable – Integration:	Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville’s theorem and Maximum-Modulus theorem (without proof); Taylor’s series, zeros of analytic functions, singularities, Laurent’s series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.	17
TOTAL			66

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
3*22 NCH = 66 NCH	1*15 NCH = 15 NCH	8 * 3 NCH = 24 NCH (Problem Solving, Internship, Seminar, Case Study, Discussion)

Text Books:

1. A text book of Engineering Mathematics, Bali N. P. and Narayan Iyenger N., 9th Edition, 2016, Laxmi Publication.
2. Mathematical Methods for Physics and Engineering: A Comprehensive Guide, K. F. Riley, M. P. Hobson, 3rd Edition, 2006, Cambridge University Press
3. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
4. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.

Reference Books:

1. Grewal B. S., Higher Engineering Mathematics, 43rd Edition, 2014, Khanna Publishers.
2. Das B. C. & Mukherjee B. N., Differential Calculus, 55th Edition, U. N. Dhur & Sons Pvt. Ltd.
3. Das B. C. & Mukherjee B. N., Integral Calculus, 57th Edition, U. N. Dhur & Sons Pvt. Ltd
4. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2006.
5. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
6. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
7. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
8. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
9. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
10. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
11. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
12. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Additional Readings:

1. https://mrcet.com/downloads/digital_notes/HS/Mathematics-I.
2. <https://www.vidyalankar.org/gate/assets/docs/notes/math.pdf>

Paper III/Subject Name: Programming for Problem Solving**Subject Code: CSE022C103(ESC)****L-T-P-C – 3-0-2-4****Credit Units: 04****Scheme of Evaluation: TP****Objective:**

The objectives of the course are to make the students capable of using C programming to solve basic as well as advanced computing problems.

Prerequisites: None**Course Outcomes**

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	List the various constructs used in programming	BT 1
CO 2	Demonstrate the working of C programming language.	BT 2
CO 3	Apply the programming concepts to solve various problems.	BT 3
CO 4	Analyze and debug the errors while writing the programs.	BT 4

Detailed Syllabus:

Modules	Topics	Course content	Hours
I	Fundamentals of Programming	Introduction to Programming; Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.	15
II	Expressions, Conditional Operators and Loops	Arithmetic expressions and precedence. Conditional Branching and Loops. Writing and evaluation of conditionals and consequent branching. Iteration and loops. Arrays, Arrays (1-D, 2-D), Character arrays and Strings	15
III	Functions, Recursion, Sorting	Basic Algorithms, Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required). Function, Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference. Recursion, Recursion as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.	15

IV	Advanced Programming Concepts using C	Structures, Defining structures and Array of Structures, Pointers, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation), File handling.	15
TOTAL			60

Programming for Problem Solving Lab Syllabus

Detailed Syllabus:

Total Lab Hours for the semester = 30 (2 hours per week)

Minimum 20 Laboratory experiments based on the following-

1. Character set, Tokens, Keywords and Identifiers, Constants, variables, data types, statements, comments, declaration of storage class, assigning values to variables.
2. Managing I/O, reading and writing characters, formatted Input/output.
3. Arithmetic operators, relational operators, logical operators, assignment operators, increment & decrement operators, conditional operators, bitwise operators, special operators.
4. Importance of decision making, decision making with if statement, if-else statement, nested if-else statements, switch-case statement.
5. Importance of iterative statements, the while statement, do-while statement, for statement, nested for looping.
6. Significance of Arrays, creation and use of one & two-dimensional arrays
7. Declaration and use of string variables, reading and writing strings.
8. Benefits of user-defined functions, creation and use of user-defined functions, parameter passing, return types.
9. Use of Pointers, declaration & initialization of pointer variables, accessing a variable through its pointer.
10. Defining, opening & closing files in C.

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
3*20 NCH = 60 NCH	2*15 NCH = 30 NCH	30 NCH (Problem Solving, Internship, Seminar, Case Study, Discussion)

Text Book:

1. *Computer Fundamentals and Programming in C*, Reema Thareja, 2nd Edition, 2016, Oxford University Press, Delhi.

Reference Books:

1. E Balaguruswamy, *Computing Fundamentals and C Programming*, 1st Edition, 2017, McGraw Hill.
2. Venugopal and Prasad, *Mastering C*, 2nd Edition, 2017, Tata McGraw Hill.
3. Yashawant Kanetkar, *Let us C*, 15th Edition, 2017, BPB.

Additional Readings:

1. https://mrcet.com/downloads/digital_notes/HS/Programming%20for%20Problem%20Solving.pdf
2. NPTEL course on Introduction to Programming in C by Prof. Satyadev Nandakumar, IIT, Kanpur
3. NPTEL course on Problem Solving Through Programming in C by Prof. Anupam Basu, IIT, Kharagpur

Objective:

The objectives of the course are to familiarize the students with the basic biological concepts and their engineering applications and provide an appreciation of how biological systems can be re-designed as substitute products for natural systems.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Define the basic terminologies used in Biology	BT 1
CO 2	Demonstrate the basic biological concepts via relevant industrial applications and case studies.	BT 2
CO 3	Apply the concepts of biomimetics for specific requirements.	BT 3
CO 4	Assess the principles of design and development, for exploring novel bioengineering projects.	BT 4

Detailed Syllabus:

Modules	Topics	Course content	Hours
I	Biomolecules and their Applications	Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching).	15
II	Human Organ Systems and Bio Designs	Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis).	15

III	Nature- Bioinspired Materials and Mechanisms	Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swimsuits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs).	15
IV	Trends In Bioengineering	Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Selfhealing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).	15
TOTAL			60

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
3*20 NCH = 60 NCH	-	30 NCH (Problem Solving, Internship, Seminar, Case Study, Discussion)

Text Book:

1. *Biology for Engineers*, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., 2012, Tata McGraw-Hill, New Delhi,
2. *Biology for Engineers*, Arthur T. Johnson, 2nd Edition, 2018, CRC Press

Reference Books:

1. Sohini Singh and Tanu Allen, *Biology for Engineers*, 2014, Vayu Education of India, New Delhi
2. Yoseph Bar-Cohen, *Biomimetics: Nature-Based Innovation*, 1st Edition, 2012, CRC Press

Additional Readings:

1. <https://www.studocu.com/in/document/aryabhata-knowledge-university/btechit-btechcse/biology-notes-for-engineers/61016774>
2. <https://www.aminotes.com/2017/02/biology-for-engineers-module-1-cocepts.html>
3. <https://topperworld.in/b-tech-biology-notes/>

Paper V/Subject Name: Manufacturing Practices Workshop

Subject Code: MEE022C105 (ESC)

L-T-P-C – 0-0-4-2

Credit Units: 02

Scheme of Evaluation: P

Objective:

The objectives of the course are to provide exposure to the students with hands-on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Label the various techniques used under mechanical engineering	BT 1
CO 2	Understand the different manufacturing processes which are commonly employed in the industry	BT 2
CO 3	Utilize tools, instruments and techniques learnt to perform basic household chores in terms of house wiring, carpentry etc	BT 3
CO 4	Experiment using the tools and techniques learnt for various purposes and decide on the best prospect.	BT 4

Detailed Syllabus:

Total Lab Hours for the semester = 40 (4 hours per week)

Minimum 10 Laboratory experiments based on the following-

The lecture sessions will be on the following topics:

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods.
- CNC machining, Additive manufacturing.
- Fitting operations & power tools.
- Electrical & Electronics.
- Carpentry.
- Plastic moulding, glass cutting.
- Metal casting.
- Welding (arc welding & gas welding), brazing g topics:

And the lab sessions will on the topics:

- Machine shop
- Fitting shop
- Carpentry
- Electrical & Electronics
- Welding shop (Arc welding + Gas welding)
- Casting
- Smithy
- Plastic moulding & Glass Cutting

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
-	4*15 NCH = 60 NCH	20 NCH (Problem Solving, Internship, Seminar, Case Study, Discussion)

Text Books:

1. Elements of Workshop Technology, Hajra Choudhury, S K, Hajra Choudhury, A K, 14th Edition, 2007, Mumbai Media Promoters
2. Manufacturing Technology – I, Gowri P. Hariharan and A. Suresh Babu, 2008, Pearson Education.

Reference Books:

1. Roy A. Lindberg, Processes and Materials of Manufacture”, 4th Edition, 1998, Prentice Hall India,

Additional Readings:

1. <http://mm-coep.vlabs.ac.in/LaserSpotWelding/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20Micromachining%20laboratory>
2. <http://fab-coep.vlabs.ac.in/exp7/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20FAB%20laboratory>

Objective:

The objectives of the course are to help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Define the basic need of human values in real life	BT 1
CO 2	Understand the importance of following the basic universal human values	BT 2
CO 3	Apply the holistic understanding in one's day-to-day life so as to keep oneself happy and to socialize with nature, society, etc	BT 3
CO 4	Analyze the harmony within human beings by distinguishing the needs of the self and the body.	BT 4

Detailed Syllabus:

Modules	Topics	Course content	Periods
I	Value Education	Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Sharing about Oneself, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Exploring Human Consciousness, Happiness and Prosperity – Current Scenario, Lectured, Method to fulfil the Basic Human Aspirations, Exploring Natural Acceptance	11
II	Harmony in Human Being	Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, Exploring the difference of Needs of Self and Body, The Body as an Instrument of the Self Understanding Harmony in the Self, Exploring Sources of Imagination in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health, Exploring Harmony of Self with the Body	11
		Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship”, Exploring the Feeling of Trust, 'Respect' – as the Right Evaluation, Exploring the Feeling of Respect, Other Feelings, Justice in Human-to-	

III	Harmony in the Family & Society	Human Relationship Understanding Harmony in the Society, Vision for the Universal Human Order, Exploring Systems to fulfil Human Goal	11
IV	Harmony in Nature & Implications of Holistic Understanding	Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Exploring the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence, Exploring Co-existence in Existence. Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, Exploring Ethical Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Exploring Humanistic Models in Education, Holistic Technologies, Production Systems and Management Models- Typical Case Studies, Strategies for Transition towards Value-based Life and Profession Exploring Steps of Transition towards Universal Human Order	11
TOTAL			44

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
2 * 22 NCH = 44 NCH	-	8 * 2 NCH = 16 NCH (Seminar, Case Study, Discussion, Internship)

Text Books:

1. *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi

Reference Books:

1. *Human Values*, A.N. Tripathi, 3rd Edition, 2019, New Age Intl. Publishers, New Delhi,

Additional Readings:

1. <https://uhv.org.in/uhv2notes>
2. <https://fdp-si.aicte-india.org/UHV-II%20Class%20Note.php>

Objective:

The objectives of the course are to make the students understand the importance of sound health and fitness principles as they relate to better health, to expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness and to develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Prerequisites: None

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Choose the best form of yoga/ exercise for them	BT 1
CO 2	Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination	BT 2
CO 3	Experiment with different forms of yoga to keep oneself physically fit and mentally strong	BT 3
CO 4	Assess current personal fitness levels	BT 4

Detailed Syllabus:

Modules	Topics	Course content	Periods
I	Physical Education, Olympic Movement, Fitness, Wellness & Lifestyle	Meaning & definition of Physical Education. Aims & Objectives of Physical Education. Changing trends in Physical Education, Ancient & Modern Olympics (Summer & Winter), Olympic Symbols, Ideals, Objectives & Values, Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc., Meaning & Importance of Physical Fitness & Wellness, Components of Physical fitness, Components of Health-related fitness, Components of wellness, Preventing Health Threats through Lifestyle Change, Concept of Positive Lifestyle.	5
II	Anatomy & Physiology in Physical Education, Sports, Yoga & Postures	Define Anatomy, Physiology & Its Importance, effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.), Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports, Newton's Law of Motion & its application in sports. Friction and its effects in Sports, Meaning and Concept of Postures, Causes of Bad Posture. Advantages & disadvantages of weight training. Concept & advantages of Correct Posture. Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis. Corrective Measures for Postural Deformities	5

III	Yoga & Lifestyle	Meaning & Importance of Yoga, Elements of Yoga, Asanas, Pranayama, Meditation & Yogic Kriyas, yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana) Relaxation Techniques for improving concentration - Yog-nidra, Asanas as preventive measures. Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana. Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana. Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana. Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana. Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.	5
IV	Training, Planning and Psychology in Sports	Meaning of Training, Warming up and limbering down, Skill, Technique & Style, Meaning and Objectives of Planning. Tournament – Knock-Out, League/Round Robin & Combination. Definition & Importance of Psychology in Physical Edu. & Sports, Define & Differentiate Between Growth & Development, Adolescent Problems & Their Management, Emotion: Concept, Type & Controlling of emotions, Meaning, Concept & Types of Aggressions in Sports. Psychological benefits of exercise. Anxiety & Fear and its effects on Sports Performance. Motivation, its type & techniques. Understanding Stress & Coping Strategies	5
TOTAL			20

Credit Distribution		
Lecture/ Tutorial	Practicum	Experiential Learning
	1*20 NCH = 20 NCH	10 NCH (Problem Solving, Internship, Seminar, Case Study, Discussion)

Text Books:

1. *Modern Trends and Physical Education*, Ajmer Singh, Gill J.S, Bains J, 4th Edition, 2012, Kalyani Publishers

Reference Books:

1. B.K.S. Iyengar, *Light on Yoga*, 2006, Thorsons