THE ASSAM
ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF ENGINEERING & TECHNOLOGY
(RSET)

DEPARTMENT OF CIVIL ENGINEERING

COURSE STRUCTURE & SYLLABUS

(BASED ON NATIONAL EDUCATION POLICY 2020)

FOR

Bachelor of Technology
in
Civil Engineering

W.E.F

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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 practises 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, Mett.

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 B.Tech. in Civil Engineering (CE) program offered by the Department of Civil Engineering under the Royal School of Engineering and Technology, RGU, is prepared in accordance with model curriculum framework of AICTE, 2024 along with the basic guidelines of National Education Policy (NEP) 2020, enabling the learners to gain professional competency with multi-disciplinary approach catering the minimum requirement (Program Specific Criteria) of Lead Societies like ACM and other Professional Bodies as per the Engineering Accreditation Commission (EAC) of ABET and NBA. In addition, the curriculum and syllabi are designed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Professional Bodies, Research Organizations and Parents to capture their voice of the respective stakeholders. The Curriculum design, delivery, and assessment, the three major pillars of academic system are completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes to facilitate the learners to achieve their Professional and Career Accomplishments.

Section 1: Overview

1. 1. Introduction:

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 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 (CE) Course:

The Bachelor of Technology (B. Tech.) in Civil Engineering (CE) is meticulously crafted in accordance with the AICTE 2024 model curriculum policy and the National Education Policy (NEP) 2020, aiming to develop highly skilled and adaptable engineers equipped for the rapidly evolving infrastructure landscape. The curriculum blends core technical competencies in civil engineering—including cover various aspects of planning, design, construction, and maintenance of infrastructure and built environments. —with interdisciplinary learning from areas such as structural engineering, structural analysis and design software, hydraulic engineering, geotechnical engineering and transportation engineering. Emphasis on practical experience is ensured through labs, project-based learning, and industry internships.

Aligned with NEP 2020, the B. Tech. in CE incorporates a flexible academic structure that supports interdisciplinary education and provides students with choices in courses and projects. This flexibility allows students to tailor their education to their interests and career goals. Additionally, the program includes courses in ethics, communication, and management, preparing graduates to be socially responsible and effective in diverse workplace environments. This degree program encourages lifelong learning and includes provisions for credit-based recognition of MOOCs, online learning, and hands-on workshop experiences, fostering an environment where students are prepared to continuously adapt and thrive in a dynamic world.

1.1.3 Vision

To offer globally integrated opportunities in the domain of civil engineering, fostering the development of students as global citizens with the skills and perspectives needed to thrive in an interconnected world.

1.1.4 Mission

- To achieve academic excelence in civil engineering through dynamic curriculum, research-driven initiatives, and industry-aligned programs;
- To instill ethical values and a spirit of community service
- To give back responsible leaders equipped to drive positive change and innovation in the global infrastructure landscape.

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

1 Hr. Lecture (L) per week 1 credit	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits
2 Hours Practical (Lab) per week	1 credit

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 Courses

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, civil engineering students might choose electives in earthquake engineering, structural dynamics, 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.

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 are encouraged to take 2 courses in IKS in the 3rd and 4th semester.

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 4-year duration with Single Major, with multiple entry and exit options, with appropriate certifications:

Table 1: Degree and Exit Opitions

NHEQF Level	Semester	Exit Option	Credits	Additional Credits for exit students	List of exit courses
4.5	Sem I &II	U.G Certificate	40	6-8	1. Materials and Civil Engineering (3-0-0 = 3 Credits) 2. Testing of Civil Engineering Materials (0 - 0 -4 = 2 Credits) 3. Introduction to construction methodology and technics (3-0-0= 3 Credits) 4. Introduction to construction equipment's (3-0-0 = 3 Credits) 5. Site Supervision work (0 -0- 4= 2 Credits) 6. Survey Work (0-0-4 = 2 Credits) 7. Bar-Bending schedule work (0- 0 -4 = 2 Credits) 8. Introduction to Geodetic Surveying and Remote sensing (2-0-4=3 Credits) 9. Application of Autonomous Vehicle and Safety Regulations (2-0-2 = 3credits)
5.0	Sem III &IV	U.G Diploma	44	6-8	1. Advance Concrete Technology. (2-0-4 = 3 Credits) 2. Fundamentals of structural Design (2-0-0= 2Credits) 3. Quantity Survey and Estimation (2-0-4= 3 Credits) 4. Transportation Engineering (2-0-4= 3 Credits) 5. Geotechnical Engineering (2-0-4 = 3 Credits) 6. Sustainable Construction and Lean Construction (3 - 0-0 = 3 credits) 7. Prefabricated structures (3-0-0= 3 Credits) 8. Environmental Impact Assessment (3-0-0 = 3 Credits) 9. Digital Construction lab (0-0-6 = 3 Credits) 10. Introduction to Building Information Modeling (BIM) (2-0-4 = 4 Credits)

5.5	Sem V & VI	B.E Vocational	44	6-8	1. Advance Concrete Technology. (2-0-4 = 3 Credits) 2. Design of RCC and Steel Structures (3-0-2 = 4 credits) 3. Formwork Engineering (2-0-2 = 3 credits) 4. Airports and Harbor (3-0-0 = 3 credits) 5. Construction Management and Safety (3-0-0 = 3 Credits) 6. Water Resource Management (3-0-0 = 3 credits) 7. Air and Noice pollution control engineering (3-0-0 = 3 credits) 8. Tunnel Engineering (3-0-0 = 3 Credits) 9. Introduction and Application of AI, ML and IOT for Civil Engineering (3-0-0 = 3 Credits) 10. Sustainable and green construction (3-0 -0 = 3 Credits)
6.0	Sem VII & VIII	B.E/B.Tech	40	--	
		B.E/B.Tech - Minor/ Honor's/ Research	18	--	

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.
- **Studio activities:** Studio activities involve the engagement of students in creative or artistic activities. Every student is engaged in performing a creative activity to obtain a specific outcome. Studio-based activities involve visual- or aesthetic-focused experiential work.
- **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.
- **Community engagement and service:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity. The curricular component of 'community engagement and service' will involve activities that would 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.

Table 2: Structure of Undergraduate Engineering program:

S.No.	Category	Abbreviation	Breakup of Credits (Total 164)
1	Humanities and Social Sciences including Management courses	HSMC	06
2	Basic Science Courses	BSC	20
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	ESC	24
4	Professional core courses	PCC	60
5	Professional Elective courses relevant to chosen specialization/branch	PEC	20
6	Indian Knowledge System	IKS	04
7	Multidisciplinary Open Electives Courses	OEC	12
8	Project work, seminar and internship in industry or appropriate work place/ academic and research institutions in India/abroad	PROJ	18
9	Mandatory Non Credit Courses – Audit Course	MC	4
	Total		**168***

Note:

1. Honors/minor 18-20 credits to be acquired through MOOCs from third semester (3 credits per semester)
2. Six-month of mandatory internship to be evaluated in 7th semester (10 credits)

Section 4
Levels 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.
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.
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 computer science, 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 computer science and 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.
- **PO8**: Leadership and readiness/qualities: Exhibit readiness for professional success in the field of computer science and 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 Computer Science and 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:** Able to apply the knowledge of programming languages, data structures and Algorithms, network security, data science, networks and software engineering principles for software product development.
- **PSO2:** Able to analyze and formulate solutions to real world and socially relevant problems over multi-disciplinary domains by using latest technologies.
- **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: 6: 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

Table 6. Semester wise and component wise distribution of credit (Four Year UGP - Single Major) [6]

First Year	**Semester I**						
	Sl No	**Course Title**	**Course Code**	**L**	**T**	**P**	**Credits**
	Basic Science Courses (BSC)						
	1	Chemistry - I	CHY022C101	3	0	2	4
	2	Mathematics - I	MAT022C102	3	1	0	4
	3	Biology for Engineers	CEE022C103	3	0	0	3
	Engineering Science Course (ESC)						
	4	Programming for Problem Solving	CSE022C104	2	0	4	4
	5	Workshop Practice	MEE022C115	0	0	4	2
	Humanities/Social Science including Management Course (HSMC)						
	6	Universal Human Values	BHS (HSMC)	2	0	0	2
	Mandatory Courses (MC)/ Skill Enhancement Courses						
	7	Sports and Yoga	CEE022C117(MC)	0	0	2	1
							20
	Semester II						
	Sl No	**Course Title**	**Course Code**	**L**	**T**	**P**	**Credits**
	Basic Science Courses (BSC)						
	1	Physics I	PHY022C201	3	0	2	4
	2	Mathematics - II	MAT022C202	3	1	0	4
	Engineering Science Course (ESC)						
	3	Basic Electrical Eng.	CSE022C203	3	0	2	4
	4	Eng. Graphics & Design	CEE022C204	2	0	4	4
	Humanities/Social Science including Management Course (HSMC)						
	5	English for Technical Writing	CEN	2	0	0	2
	Mandatory Courses (MC)/ Skill Enhancement Courses						
	6	Design Thinking	DES022S206	0	0	2	1
	7	Ideation Lab	CEE022S217	0	0	2	1
							20

	1	**Honours (Optional) [To be obtained through MOOCS]**		**3**	**0**	**0**	**3**
Second Year	**Semester III**						
	Sl No	**Course Title**	**Course Code**	**L**	**T**	**P**	**Credits**
	Engineering Science Course (ESC)						
	1	Engineering & Solid Mechanics	CEE022C301	2	0	2	3
	2	Civil Engineering Material Testing & Evaluation	CEE022C302	1	0	2	2
	Professional Core Courses (PCC)						
	3	Building Planning & CAD	CEE022C303	2	0	2	3
	4	Fluid Mechanics	CEE022C304	3	0	2	3
	5	Concrete Technology	CEE022C305	2	0	2	3
	Basic Science Courses (BSC)						
	6	Mathematics for Civil Engineering	MAT022C306	3	0	0	3
	Mandatory Courses (MC)/ Skill Enhancement Courses						
	7	Civil Engineering Societal & Global Impact	CEE022S307	2	1	0	3
	Humanities/Social Science including Management Course (HSMC)						
	8	CEN/BHS	CEN	2	0	0	2
							22
	1	**Honours (Optional) [To be obtained through MOOCS]**		**3**	**0**	**0**	**3**
	Semester IV						
	Sl No	**CourseTitle**	**Course Code**	**L**	**T**	**P**	**Credits**
	Professional Core Courses (PCC)						
	1	Structural Analysis	CEE022C401	3	0	0	3
	2	Hydraulic Engineering	CEE022C402	3	0	2	4
	3	Transportation Engineering	CEE022C403	2	0	2	3
	4	Surveying and Geomatics	CEE022C404	3	0	2	4
	5	Construction Engineering & Management	CEE022C405	3	0	0	3
	Multidisciplinary Open Elective (OEC)						
	6	Open Elective (Basket Course)	XX(OEC)	3	0	0	3
	Humanities/Social Science including Management Course (HSMC)						
	7	CEN/BHS	CEN(HSMC)	2	0	0	2
							22

	1	**Honours (Optional) [To be obtained through MOOCS]**		**3**	**0**	**0**	**3**
Third Year	**Semester V**						
	Sl No	**Course Title**	**Course Code**	**L**	**T**	**P**	**Credits**
	Professional Core Courses (PCC)						
	1	Structural Design I	CEE022C501(PCC)	3	0	2	4
	2	Environmental Engineering	CEE022C502(PCC)	3	0	2	4
	3	Engineering Economics, Estimation & Costing	CEE022C503(PCC)	2	0	2	3
	4	Hydrology & Water Resource Engineering	CEE022C504(PCC)	3	0	0	3
	Professional Elective Course (PEC)						
	5	Professional Elective I	CEE022D50X(PEC)	3	0	0	3
	Multidisciplinary Open Elective (OEC)						
	6	VAC I (Basket Course)	XX(OEC)	2	1	0	3
	7	Instrumentation and Sensor Technologies for Civil Engg.	CEE022S505(MC)	2	0	0	2
							22
	1	**Honours (Optional) [To be obtained through MOOCS]**		**3**	**0**	**0**	**3**
	Semester VI						
	Sl No	**Course Title**	**Course Code**	**L**	**T**	**P**	**Credits**
	Professional Core Courses (PCC)						
	1	Structural Design II	CEE022C601(PCC)	3	0	2	4
	2	Intelligent Transportation Systems	CEE022C602(PCC)	3	0	0	3
	3	Sustainable & Green Construction	CEE022C601(PCC)	3	1	0	4
	Professional Elective Course (PEC)						
	4	Professional Elective II	CEE022D60X(PEC)	3	1	0	4
	5	Professional Elective III	CEE022D60X(PEC)	3	1	0	4
	Multidisciplinary Open Elective(OEC)						
	6	Open Elective (Basket Course)	XX(OEC)	3	0	0	3
							22
	1	**Honours (Optional) [To be obtained through MOOCS]**		**3**	**0**	**0**	**3**

Fourth Year	**Semester VII**						
	Sl No	**Course Title**	**Course Code**	**L**	**T**	**P**	**Credits**
	Professional Core Courses (PCC)						
	1	Robotics and Automation	CEE022C701(PCC)	3	1	0	4
	Professional Elective Course (PEC)						
	2	Professional Elective IV	CEE022D60X(PEC)	3	0	0	3
	3	Professional Elective V	CEE022D60X(PEC)	3	0	0	3
	Internship						
	4	Internship Evaluation	CEE022C715(INT)	0	0	20	10
							20
	1	**Honours (Optional) [To be obtained through MOOCS]**		**3**	**0**	**0**	**3**
	Semester VIII						
	Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
	Professional Core Courses (PCC)						
	1	Structural Dynamics	CEE022C801(PCC)	3	0	0	3
	2	Environmental Law and Policy	CEE022C802(PCC)	3	0	0	3
	3	Total Station & GPS Surveying	CEE022C803(PCC)	3	0	0	3
	Professional Elective Course (PEC)						
	4	Professional Elective VI	CEE022D80X(PEC)	3	0	0	3
	Project						
	5	Project	CEE022C811(PROJ)	0	0	16	8
							20
	1	**Honours (Optional) [To be obtained through MOOCS]**		**3**	**0**	**0**	**3**
							168

Note: A student will be eligible to get UG Degree with Honors if he/she completes and additional 18-20 credits. This should be acquired through MOOCs platforms.

Also, a student must undergo a mandatory 6 months of internship in the Industry/Research Institutions, evaluation of which will be done by 7th semester.

Annexure I

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**

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

Annexure II

List of suggestive Course under Programme Elective Courses:

I. Structural Engineering

1. Structural Analysis-I &II
2. Advanced Structural Analysis
3. Structural Analysis by Matrix Methods
4. Structural Mechanics
5. Reliability Analysis of Structures
6. Engineering Risk & Uncertainty
7. Decision and Risk Analysis
8. Introduction to Finite Element analysis
9. Engineering Materials for Sustainability
10. Metal Structure Behavior- I &II
11. Masonry Structures
12. Reinforced Concrete
13. Advanced Concrete Technology
14. Design of Concrete Structures-I &II
15. Prestressed Concrete
16. Design of Steel Structures
17. Bridge Engineering, I & II
18. Industrial Structures
19. Design of Structural Systems
20. Structural Dynamics
21. Earthquake Engineering
22. Rehabilitation/Restoration of structures

II. Construction Engineering & Management

1. Construction Productivity
2. Building Construction Practice
3. Formwork Engineering
4. Construction Cost Analysis
5. Sustainable Construction Methods
6. Construction Engineering Materials
7. Contracts Management
8. Construction Equipment& Automation
9. Digitalized construction Lab
10. Construction Project Planning Systems.
11. Advanced Construction Techniques
12. Energy Efficient Buildings

III. Geotechnical Engineering

1. Foundation Engineering
2. Geotechnical Design
3. Structural Geology
4. Offshore Engineering
5. Rock Mechanics
6. Environmental Geo-technology

7. Ground Improvement Techniques
8. Soil Dynamics and Machine Foundation
9. Earth Retaining Structures
10. Tunnelling Engineering

IV. Geo Informatics

11. Total station and GPS surveying
12. Remote sensing
13. Satellite Image Processing
14. Cartography and GIS
15. Photogrammetry
16. Airborne and Terrestrial laser mapping
17. Hydrographic surveying

IV. Transportation Engineering

1. Pavement Materials
2. Pavement Design
3. Public Transportation Systems
4. Traffic Engineering and Management
5. Urban Transportation Planning.
6. Geometric Design of Highways
7. Airport Planning and Design
8. Railway Engineering
9. Intelligent Transportation Systems
10. Highway Construction and Management
11. Port and Harbor Engineering
12. High Speed Rail Engineering
13. Transportation Economics
14. Infrastructure Planning and Design
15. Smart Cities

V. Environmental Engineering

1. Environmental Systems
2. Transport of Water and Wastewater
3. Environmental Laws and Policy
4. Physico-Chemical Processes for Water and Wastewater Treatment
5. Biological Processes for Contaminant Removal
6. Rural Water Supply and Onsite Sanitation Systems
7. Water and Air Quality Modelling
8. Solid and Hazardous Waste Management
9. Air and Noise Pollution Control Engineering
10. Environmental Impact Assessment and Life Cycle Analyses
11. Sustainable Engineering & Technology.
12. Climate change adaptation and Mitigation Participatory
13. Industrial Waste Water Management
14. Environment Health and Safety
15. Ecological Engineering

VI. Hydrology & Water Resources Engineering

1. Water Quality and Management
2. Surface Hydrology

3. Environmental Fluid Mechanics
4. Water Resources Field Methods
5. Water Resource Management
6. Groundwater Engineering
7. Watershed Conservation and Management
8. Urban water Infrastructure
9. Integrated water resource management

VII. Hydraulics

1. Design of hydraulic structures/Irrigation Engineering
2. Pipeline Engineering
3. Open Channel flow
4. River Engineering
5. Hydraulic modelling
6. Basics of computational hydraulics
7. Transients in closed conduits
8. Urban Hydrology and Hydraulics
9. Groundwater

VIII. Ocean Engineering

1. Ocean Wave Dynamics
2. Marine Geotechnical Engineering
3. Coastal Engineering
4. Off Shore structures
5. Port Harbor Engineering
6. Coastal Hazards and Mitigation
7. Coastal Zone Management and Remote Sensing

IX. Diversified Course

1. Steel Concrete Composite structures
2. Finance for Engineering
3. Earth and Rockfill Dams
4. Computational Fluid Dynamics
5. Rainwater harvesting
6. Transport and environment
7. Environment Quality Monitoring.
8. Evaluating Accessibility / Universal Design in Built Environments

SYLLABUS OF I & II SEMESTER

DETAILED SYLLABUS OF 1st 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:		
Sl 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	**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	**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. Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical	**17**

		phenomena. Potential energy surfaces of H3, H2F 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 the demonstrate of 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/maths.pdf

Paper III/Subject Name: Programming for Problem Solving	Subject Code: CSE022C104(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

Paper IV/Subject Name: Biology for Engineers		Subject Code: CEE022C103 (BSC)
L-T-P-C – 3-0-0-3	Credit Units: 03	Scheme of Evaluation: T

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/aryabhatta-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 (ESC)		Subject Code: MEE022C115
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

Paper VI/Subject Name: Universal Human Values		Subject Code: BHS (HSMC)
L-T-P-C – 2-0-0-2	Credit Units: 02	Scheme of Evaluation: T

Objective:

The objectives of the course are to help the students appreciate the essential complementarily 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-today 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**
III	**Harmony in the Family & Society**	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-Human Relationship Understanding Harmony in the Society, Vision for the	**11**

		Universal Human Order, Exploring Systems to fulfil Human Goal	
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

Paper VII/Subject Name: Sports and Yoga		Subject Code: CEE022C117 (MC)
L-T-P-C – 0-0-2-1	Credit Units: 01	Scheme of Evaluation: P

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, o 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, ffect 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, o Newton's Law of Motion & its application in sports. o 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**
		Meaning & Importance of Yoga, Elements of Yoga, Asanas, Pranayama, Meditation & Yogic Kriyas, yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana &	

III	**Yoga & Lifestyle**	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

DETAILED SYLLABUS OF 2nd 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 acoustics.	**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 = - 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 independence from Newton's laws, and their necessity in describing rigid body motion; Examples.	**16**

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

Paper II/Subject Name: Mathematics-I		Subject Code: MAT022C202(BSC)
L-T-P-C – 3-1-0-4	Credit Units: 04	Scheme of Evaluation: T

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/Iyear/111223.pdf

Paper III/Subject Basic Electrical Engineering		Subject Code: CSE022C203(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 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**	Electrical Circuit Elements – The resistance element, the inductance element, the capacitance element. Voltage & Current source, practical & ideal voltage and current sources, source transformation. Kirchhoff's Laws, Analysis of simple circuits with DC excitation – series circuit, parallel circuit, voltage and current divider rule, star -delta conversion, Maxwells mesh current method, nodal voltage analysis , Network Theorems – Thevenin's Theorem, Nortons Theorem, Superposition theorem	**12**
II.	**AC Circuits**	AC fundamentals – generation of alternating voltage, representation of sinusoidal waveform, concept of frequency, cycle, time period, instantaneous value, average value, peak value, RMS value, phasor representation. Single phase AC Circuits – analysis of single-phase AC circuits consisting of R-L-C parameters, apparent power, real power, reactive power, power factor and its significance. Analysis of R-C series circuit, R-L-C series circuit, analysis of AC parallel circuits	**20**

III.	**Electrical Machines:**	Principle of operation and construction of single-phase transformers. EMF equation, losses, efficiency and voltage regulation. DC Machines – Constructional details of a DC Machine; EMF Equation of a DC machine, Types of DC Machines, Applications of DC Generators, operation of a DC machine as a motor, Torque equation, importance of back emf, speed equation, speed regulation, starting a DC motor, types of DC Motor, applications of DC motors	**20**
IV.	**Electrical Installations:**	Electrical Power Supply System. Three phase four wire distribution system. Protection of electrical installations against overload, short circuit and earth fault. Protective devices for overload, short circuit, earth fault and electric shock – SFU, MCB, ELCB. Earthing – difference between neutral wire & earth wire, methods of earthing of domestic fittings and appliances. Types of wires, cables and wiring used in electrical installations.	**14**
		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 Φ,P and Q and draw the phasor diagram	**2**
IV	Study of R-L-C Parallel circuit and determine R,L,C,cos Φ,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

Paper IV/Subject Name: Engineering Graphics & Design		Subject Code: CEE022C204(ESC)
L-T-P-C – 2-0-4-4	Credit Units: 04	Scheme of Evaluation: TP

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 Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines,	**11**

		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/it/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 Heasly, *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

Paper VI/Subject Name: Design Thinking		Subject Code: DES022S206 (MC)
L-T-P-C – 0-0-2-1	Credit Units: 01	Scheme of Evaluation: P

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-**	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 &	**06**

	Design & Re-Create	testing, final product, Final Presentation – "Solving Practical Engineering Problem through Innovative Product Design & Creative Solution"	
		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

Paper VII/Subject Name: IDEA Lab Workshop		Subject Code: MEE022S217 (MC)
L-T-P-C – 0-0-2-1	Credit Units: 01	Scheme of Evaluation: P

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