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 168)
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 civil engineering, analyze these problems with a systematic and logical approach, evaluate various solutions considering multiple aspects, such as technical feasibility, ethical implications, sustainability, and practicality, and synthesize information to devise effective, efficient, and innovative solutions.
- **PO4:** Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO5:** Communication skills: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO6:** Research-related skills: Conduct original research in civil 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 civil 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 Civil 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 mechanics, structural analysis, estimation and environmental engineering to plan, analyze, design, prepare cost estimates and execute all kinds of Civil Engineering Projects
- **PSO2:** Able to analyse 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**
	1	Chemistry	CHY022C101	3	0	0	3
	2	Chemistry Lab	CHY022C111	0	0	2	1
	3	Mathematics - I	MAT022C102	3	1	0	4
	4	Biology for Engineers	CEE022C103	3	0	0	3
	5	Programming for Problem Solving	CSE022C104	2	0	0	3
	6	Programming for Problem Solving Lab	CSE022C114	0	0	2	1
	7	Manufacturing Workshop Practice	MEE022C115	0	0	4	2
	8	Universal Human Values	BHS022A103	3	0	0	**3**
	9	Sports and Yoga Lab/NSS	CEE022S117	0	0	2	1
							21
	Semester II						
	Sl No	**Course Title**	**Course Code**	**L**	**T**	**P**	**Credits**
	1	Physics	PHY022C201	3	1	0	4
	2	Physics Lab	PHY022C211	0	0	2	1
	3	Mathematics - II	MAT022C202	3	1	0	4
	4	Basic Electrical Eng.	CSE022C205	2	1	0	3
	5	Basic Electrical Eng. Lab	CSE022C215	0	0	2	1
	6	Eng. Graphics & Design	CEE022C204	1	0	0	1
	7	Eng. Graphics & Design Lab	CEE022C214	0	0	4	2
	8	English for Technical Writing	CEN982A203	2	0	0	2
	9	Design Thinking	COD022S216	0	0	2	1
	10	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**
	1	Engineering & Solid Mechanics	CEE022C301	3	0	2	4
	2	Civil Engineering Material Testing & Evaluation	CEE022C302	1	0	2	2
	3	Building Planning & CAD	CEE022C303	2	0	0	2
	4	Building Planning & CAD Lab	CEE022C313	0	0	2	1
	5	Fluid Mechanics	CEE022C304	3	0	0	3
	6	Fluid Mechanics Lab	CEE022C314	0	0	2	1
	7	Concrete Technology	CEE022C305	2	0	0	2
	8	Concrete Technology Lab	CEE022C315	0	0	2	1
	9	Mathematics for Civil Engineering	MAT022C306	3	1	0	4
	10	IKS-I	IKS022C305	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**
	1	Structural Analysis	CEE022C401	3	1	0	4
	2	Hydraulic Engineering	CEE022C402	3	0	0	3
	3	Hydraulic Engineering Lab	CEE022C412	0	0	2	1
	4	Transportation Engineering	CEE022C403	2	0	0	2
	5	Transportation Engineering Lab	CEE022C413	0	0	2	1
	6	Surveying and Geomatics	CEE022C404	3	0	0	3
	7	Surveying and Geomatics	CEE022C414	0	0	2	1
	8	Construction Engineering & Management	CEE022C405	3	0	0	3
	9	Geotechnical Engineering	CEE022C406	3	0	0	3

	10	Geotechnical Engineering Lab	CEE022C416	0	0	2	1
							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**
	1	Structural Design I	CEE022C501	3	0	0	3
	2	Structural Design I Lab	CEE022C511	0	0	2	1
	3	Environmental Engineering	CEE022C502	3	0	0	3
	4	Environmental Engineering Lab	CEE022C512	0	0	2	1
	5	Engineering Economics, Estimation & Costing	CEE022C503	3	0	0	3
	6	Engineering Economics, Estimation & Costing Lab	CEE022C513	0	0	2	1
	7	Hydrology & Water Resource Engineering	CEE022C504	3	0	0	3
	8	Plumbing (Water and Sanitation)	CEE022C505	3	0	2	4
	9	Open Elective	CEE022M505	3	0	0	3
							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**
	1	Structural Design II	CEE022C601	3	0	0	3
	1	Structural Design II Lab	CEE022C611	0	0	2	1
	2	Intelligent Transportation Systems	CEE022C602	3	0	0	3
	3	Sustainable & Green Construction	CEE022C603	3	1	0	4
	4	Program Elective-2(Basket)	CEE022D60X	3	0	2	4
	5	Program Elective-3(Basket)	CEE022D60X	3	1	0	4

	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**
	1	Robotics and Automation	CEE022C701	2	0	0	2
	2	Program Elective-4(Basket)	CEE022D60X	3	0	0	3
	3	Open Elective	CEE022D60X	3	0	0	3
	4	Internship Evaluation	CEE022C715	0	0	24	12
							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**
	1	Program Elective-5(Basket)	CEE022C801	3	1	0	4
	2	Program Elective-6(Basket)	CEE022C802	3	0	2	4
	3	Program Elective-7(Basket)	CEE022C803	3	0	0	3
	4	Open Elective(Basket)	CEE022D80X	3	0	0	3
	5	Project	CEE022C811	0	0	8	4
							18
	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	21
II	20
III	22
IV	22
V	22
VI	22
VII	20
VIII	18
Total	**167 credit**

Annexure II

List of suggestive Course under Programme Elective Courses:

I. Structural Engineering

1. Structural Analysis-I &II
2. Introduction to Finite Element analysis
3. Masonry Structures
4. Prestressed Concrete
5. Design of Steel Structures
6. Bridge Engineering, I & II
7. Structural Dynamics
8. Earthquake Engineering
9. Rehabilitation/Restoration of structures
10. Steel Concrete Composite structures

II. Construction Engineering & Management

1. Construction Productivity
2. Formwork Engineering
3. Construction Cost Analysis
4. Contracts Management
5. Energy Efficient Buildings

III. Geotechnical Engineering

1. Foundation Engineering

2. Earth Retaining Structures

IV. Transportation Engineering

1. Pavement Materials
2. Pavement Design
3. Geometric Design of Highways
4. Airport Planning and Design
5. Railway Engineering
6. Smart Cities

V. Environmental Engineering

1. Physico-Chemical Processes for Water and Wastewater Treatment
2. Biological Processes for Contaminant Removal
3. Rural Water Supply and Onsite Sanitation Systems
4. Solid and Hazardous Waste Management
5. Environmental Impact Assessment and Life Cycle Analyses
6. Industrial Waste Water Management

VI. Hydrology & Water Resources Engineering

1. Water Quality and Management
2. Surface Hydrology
3. Groundwater Engineering
4. Watershed Conservation and Management
5. Urban water Infrastructure
6. Integrated water resource management

VII. Hydraulics

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

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:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** the basic properties of chemical reactions	**BT 1**
CO 2	**Interpret** periodic properties such as ionization potential, electronegativity, oxidation states, electronegativity and bulk properties and processes using	**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 phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.	**17**
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,	**17**

		cyclization and ring openings. Synthesis of a commonly used drug molecule	
		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,	**11**

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

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

Text Books:

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

Reference Books:

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

Additional Readings:

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

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,**	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.,	**5**

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

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

Text Books:

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

Reference Books:

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

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	**17**

		and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application: Satellite manoeuvres.	
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, 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;	**11**
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: CEN982A203**
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-Design & Re-Create**	Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design. Feedback loop, Focus on User Experience, Address "ergonomic challenges, User focused design, rapid prototyping & testing, final product, Final Presentation – "Solving Practical Engineering Problem through Innovative Product Design & Creative Solution"	**06**
		TOTAL	**22**

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

Text Books:

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

Reference Books:

1. Christian Müller-Roterberg; *Design Thinking For Dummies*, 1st Edition, 2020, For Dummies

2. *A Text Book of DESIGN THINKING For B.TECH. 4th Year, Semester-VII, Suitable For All The 4th Year B-Tech Students*

Additional Reading:

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

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

SEMESTER -III

DETAILED SYLLABUS OF 3rd SEMESTER

Paper I/Subject Name: Engineering and Solid Mechanics		**Subject Code: CEE022C206**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objective of this Course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design

Prerequisites: Physics and Mathematics

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 concepts of stress and strain	**BT 1**
CO 2	Understand the concepts of bending moment and shear stress and develop BM and SF diagrams	**BT 2**
CO 3	Apply concept of bending moment to calculate bending stress, section modulus	**BT 3**
CO 4	Apply concept of shear stress and and torsion to calculate stresses	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**
I.	**Stresses and Strains**	Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications. Compound Stresses and Strains- Two-dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two-dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.	**12**
II.		Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without	**11**

	Bending moment and Shear Force Diagrams	overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.	
III.	**Flexural Stresses-Theory of simple bending**	– Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.	**12**
IV.	**Shear Stresses and Torsion**	Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections. Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.	**10**
		TOTAL	**45**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 15 NCH = 45 NCH	NA	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books

1. D.S. Bedi, "Strength of Materials", Khanna Book Publishing Co.
2. AICTE Prescribed Textbook: Physics (Introduction to Mechanics), Bhattarchaya, A.B., Khanna Book Publishing Co., 2023.
3. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.
4. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
5. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
6. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
7. Laboratory Manual of Testing Materials - William Kendrick Hall
8. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf – TMH 2002.
9. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi

Reference Books:

3. D.S. Prakash Rao, *Structural analysis: Unified approach*, Universities Press.
4. C.H. Norris, J.B. Wilbur, S. Utku, *Elementary Structural Analysis*, Tata McGraw Hill.
5. L. S. Negi and R. S. Jangid, *Structural Analysis*, Tata McGraw Hill, New Delhi.
6. C.K. Wang, *Intermediate Structural Analysis*, McGraw Hill, International Edition.
7. William M.C. McKenzie, *Examples in Structural Analysis*, CRC Press.

Paper I/Subject Name: Engineering and Solid Mechanics Lab		**Subject Code: CEE022C206**
L-T-P-C – 0-0-2-2	**Credit Units: 01**	**Scheme of Evaluation: Lab**

List of Experiments:

1. Tension test
2. Bending tests on simply supported beam and Cantilever beam.
3. Compression test on concrete
4. Impact test
5. Shear test
6. Investigation of Hook's law that is the proportional relation between force and stretching in elastic deformation,
7. Determination of torsion and deflection,
8. Measurement of forces on supports in statically determinate beam,
9. Determination of shear forces in beams,
10. Determination of bending moments in beams,
11. Measurement of deflections in statically determinate beam,
12. Measurement of strain in a bar
13. Bend test steel bar;
14. Yield/tensile strength of steel bar;

Paper I/Subject Name: Civil Engineering Material Testing & Evaluation **Subject Code: CEE022C202**

L-T-P-C – 1-0-2-2 **Credit Units: 02** **Scheme of Evaluation: TP**

Objective:

The objective of this course is to deal with an experimental determination and evaluation of mechanical characteristics and advanced behavior of metallic and non-metallic structural materials. The course deals with explanation of deformation and fracture behavior of structural materials. The main goal of this course is to provide students with all information concerning principle, way of measurement, as well as practical application of mechanical characteristics

Prerequisites: Basic knowledge of mathematics, physics, materials science, mechanics of solids, chemistry, and common testing methods.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define and** learn the Basic Properties of Materials	**BT 1**
CO 2	**Interpret** the different Engineering Materials considerations	**BT 2**
CO 3	**To apply** new techniques used in construction**.**	**BT 3**
CO 4	**Analyze** the engineering properties of Civil Engineering materials like aggregate, cement, concrete, steel, wood, plastic, paints, and other materials.	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**
I.	**Basic Properties of Materials**	Importance of materials in civil engineering construction; properties of materials- temperature, energy, specific heat, thermal conductivity, coefficient of thermal expansion; mechanical properties of metals- stress, strain, modulus of elasticity, elastic and plastic deformations, ductility, resilience and toughness, compressive, shear and torsional deformation, hardness; variability of material properties. aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.	**8**
II.	**Introduction to Engineering Materials**	Bricks, concrete blocks, Cements, Mortar, Aggregates, Pozzolanas, Concrete (plain, reinforced), Bitumen and asphaltic materials, floor and roofing tiles, Wood and wood product,	**7**

		Engineered wood products, Glass, glass fibres, glass wool, Plastics, Paints and Varnishes.	
III.	**New Techniques in Constructions**	Introduction, 3D printing, photo catalytic admixture, self-healing concrete, zero cement concrete, hemp lime, wood-glass epoxy composites, bamboo, Composite Materials: FRC, steel/concrete composite bridge decks, fiber reinforced plastics and structural insulated panels.	**7**
IV.	**Introduction to Material Testing**	Mechanical behavior and mechanical characteristics; Elasticity – principle and characteristics; Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi- brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundaments and characteristics; Brittle fracture of steel – temperature transition approach; Background of fracture mechanics; Discussion of fracture toughness testing – different materials; concept of fatigue of materials; Structural integrity assessment procedure and fracture mechanics	**8**
		TOTAL	**30**

Civil Engineering Material Testing & Evaluation Lab Syllabus

Total Lab Hours for the semester = 20 (2 hours per week)

Minimum 10 Laboratory experiments based on the following-

1. Gradation of coarse and fine aggregates
2. Different corresponding tests & need/application of these tests in design and quality control
3. Tensile Strength of materials & concrete composites
4. Compressive strength test on aggregates
5. Tension I - Elastic Behaviour of metals & materials
6. Tension II - Failure of Common Materials
7. Direct Shear - Frictional Behaviour
8. Concrete I - Early Age Properties
9. Concrete II - Compression and Indirect Tension
10. Compression – Directionality
11. Soil Classification
12. Consolidation and Strength Tests
13. Tension III - Heat Treatment
14. Torsion test
15. Hardness tests (Brinnel's and Rockwell)
16. Tests on closely coiled & open coiled springs
17. Theories of Failure and Corroboration with Experiments
18. Tests on unmodified bitumen and modified binders with polymers
19. Bituminous Mix Design and Tests on bituminous mixes - Marshall method
20. Concrete Mix Design as per BIS

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
2 * 15 NCH = 30 NCH	2 * 10 NCH = 20 NCH	8 * 3 NCH = 24 NCH (Problem Solving, Assignments, Quiz, Presentation, Case Study, Discussion)

Text Books

1. *Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.), R. Butterworth Heinemann*
2. *Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand& Bros, Fifth Edition*
3. *Sharma S.K., Civil Engineering Construction Materials, Khanna Publishing House.*

Reference Books:

1. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications
2. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
3. E.N. Dowling (1993), Mechanical Behaviour of Materials, Prentice Hall International Edition
4. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards (post 2000)

Paper I/Subject Name: Building Planning & CAD		Subject Code: CEE022C303
L-T-P-C – 2-0-2-3	Credit Units: 03	Scheme of Evaluation: TP

Objective:

The objective of this course is to equip students with the knowledge and skills necessary to effectively plan, design, and implement various aspects of building construction and services. Students will learn to apply principles of building planning, create detailed construction drawings, and manage essential building services.

Prerequisites: Engineering Graphics & Design and Basic Computer

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** drafting commands of AutoCAD.	**BT 1**
CO 2	**Explain** the concept of the built environment and apply principles from the National Building Code and green building standards to the planning and design of residential and public buildings.	**BT 2**
CO 3	**Develop** the ability to prepare detailed construction drawings, including plans, elevations, sections, and site plans, for various types of buildings such as residential, educational, healthcare, and entertainment structures.	**BT 3**
CO 4	**Examine** efficient water supply, drainage, and solid waste management systems for different building types, incorporating sustainable practices like wet and dry waste segregation and vermi-composting.	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**
I.	**Principles of Residential and Public Buildings**	Concept of built environment and its application in planning. Recommendation of National building code., Green building, Introduction-Benefits, National priorities, rating system, check list, Site selection and planning, Water efficiency, Energy efficiency, Materials, Indoor environmental quality, Innovation and design process.	**8**

II.	**Planning of Building**	Preparation of constructional details and drawings-plan, elevation, section, site plan, foundation plan, terrace plan, waterproofing treatment, typical door and window. Planning of building such as • Residential building –Load bearing structure, RCC framed structure. Building for Education – school, college. Library • Building for health –Dispensary, Hospital Industrial structure • Building for entertainment-Theatre, club house, sports club. Other structure - Office, Hostel, Guest house.	**7**
III.	**Building's Water Supply and Drainage & Solid Waste Collection and Disposal System.**	Design of water supply, waste water and storm water collection system for various types of buildings. Pumps and Pump House. Wet and dry solid waste segregation, Vermi-composting etc. Provision of Chutes. Accessibility in public Sanitation Systems.	**7**
IV.	**Fire Protection System** **Elevators** **Heating Ventilation and Air Conditioning** **Building Management System**	**Fire Protection System**: -Introduction, Fire protection, requirement of water quantity estimation. Systems of firefighting external and internal. Wet and dry risers, smoke alarm, Sprinkler system. Safety corridors in High-rise structures. **Elevators**: -Introduction, types of elevators. Essential features of lifts its size and requirement of minimum numbers, norms for safety doors, Operation and maintenance, Safety norms. Control systems, electrical requirement, and generator back-up, Escalators in Industry and in malls-multiplex. Design of Accessible Circulation System for differently abled publics. **Heating Ventilation and Air Conditioning**: - Ventilation, functional requirement, Heat balance system of ventilation, General rules and regulations in artificial ventilation system, Central air conditioning: - ducting and glass claddings. Operation and maintenance **Building Management System**: -Security Guard's Cabin, Postage collection boxes, Parking space.	**8**
TOTAL			**30**

Building Planning and Computer Aided Civil Engineering Drawings Lab Syllabus

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

Minimum 5 Laboratory based on the following-

1. Preparation of detailed constructional plan of a residential building.
2. Preparation of front elevation, detailed sectional view, site plan, foundation plan, terrace plan, waterproofing treatment, typical door and window.
3. Concept of perspective drawing- one point, two-point, three point and uses.
    - **Preparation of line plans of various public buildings like: Building for Education** – School, College. Library
    - **Building for health –Dispensary, Hospital Industrial structure Building for entertainment**- Theatre, Club House, Sports Club. Other Structure- Office, Hostel, Guest house.
4. Prepare layout for water supply and drainage for a residential building and for multistoried buildings.
5. Building's Solid Waste Collection and disposal system: Wet and dry solid waste segregation, Vermi-composting etc. Provision of Chutes.
6. Fire Protection System: Design of emergency exits and emergency vehicle routes with fire protection symbols

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

Text Books

1. Scott Onstott, AutoCAD 2018 and AutoCAD LT 2018 Essentials, Wiley (2017), (ISBN: 9788126569298)
2. M.G. Shah, Kale, Patki, Building Drawing with an Integrated Approach to Built Environment, Tata McGraw-Hill Education India, 5th edition, 2011, (ISBN: 9780071077873, 0071077871).
3. Building Services Environmental And Electro Mechanical Services, Second Revised, 2014, (ISBN: 9788175259805)

Reference Books:

1. Bureau of Indian Standards, " HAND BOOK OF FUNCTIONAL REQUIREMENTS OF BUILDINGS, (SP-41 & SP- 32)", BIS 1987 and 1989, (SP-41: ISBN: 8170610117)
2. Croome, J. D. & Roberts, B. M., "AIR-CONDITIONING AND VENTILATION OF BUILDINGS VOL-1". Pergamon Press, (ISBN: 0080247792)
3. SP-35 (1987): Handbook of Water supply & drainage-BIS, (SP- 35: ISBN: 8170610095)
4. N.B.C.-2016, Volume 1 & 2, BIS, (ISBN: 8170610990)

Paper I/Subject Name: Concrete Technology		**Subject Code: CEE022C305 (B.TECH)**
L-T-P-C – 2-0-2-3	**Credit Units: 03**	**Scheme of Evaluation: TP**

Objective:

To understand the fundamentals of concrete and its ingredients and to be able to design and concrete mixes of different grades

Prerequisites: Concepts of +2 level Physics

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 functional role of all ingredients of concrete and their use for normal and special purpose concrete.**	**BT 1**
CO 2	**Apply the principle of sustainability for the utilization of waste, novel and innovative materials for use in concrete.**	**BT 2**
CO 3	**Formulate concrete mix for normal and special purpose concrete.**	**BT 3**
CO 4	**4. Use of various non-destructive testing procedure for evaluation of concrete properties.**	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**
I.	*Properties of ingredients*	Properties of coarse and fine aggregates and their influence on concrete, types of cement and their use, Grades of ordinary Portland cement, Portland pozzolana cement, rapid hardening Portland cement, hydrophobic cement, low heat Portland cement and sulphate resisting Portland cement as per relevant I.S. codes. Types of aggregates and their properties. Testing of aggregates as per relevant IS Codes.	**8**
	Properties of different types of concrete	Concrete for structural work, light weight concrete, high density concrete, biological concrete, workability, durability and strength requirements, effect of w/c ratio on properties of fresh and hardened concrete, acceptability criteria, laboratory testing of fresh and hardened concrete, Fire resistant properties of hardened concrete.	
II.	**Concreting methods**	Process of manufacturing of concrete, transportation, placing, compaction and curing of	**7**

		concrete. Extreme weather concreting, special concreting methods, vacuum dewatering– underwater concrete, special form work., Plum Concrete, Self-Compacting Concrete	
	Admixtures	Plasticizers, Retarders, Accelerators and other Admixtures, Test on Admixtures, Chemistry and Compatibility with concrete. GGBS fly Ash, Metakaolin, Silica Fumes, crush sand,	
III.	**Ready mix concrete**	Requirements of ready-mix concrete, properties of RMC, transit mixer details, Automation, instrumentation and Layout of RMC plant.	**8**
	Concrete mix design	Mix Design for compressive strength by I.S. methods, road note method, British method, ACI Method, Mix design for flexural strength.	
IV.	**Concrete for repairs and rehabilitation of structures**	High Performance concrete, Polymer Concrete, Fiber Reinforced Concrete, Light weight concrete and its manufacture, Polymer Impregnated Cement Concrete, Polymer Modified cement concrete and Ferro Cement, Special Tests for concrete used for repairs and rehabilitation	**7**
	Non-destructive testing of concrete	Rebound hammer test, Ultrasonic pulse velocity test, Magnetic particle testing, Liquid penetration testing, Visual testing, Laser Testing methods, Leak Testing, Impact echo test, carbonation test, Half cell potentiometer and corrosion of steel, Core test and relevant provisions of I.S. codes.	
		TOTAL	**30**

Concrete Technology Lab Syllabus

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

Minimum 10 Laboratory experiments based on the following-

Objective: To determine the various parameters of road building materials and understand their physical properties.

1. Sieve analysis
2. Setting Time Test
3. Soundness Test
4. Workability
5. Compressive Strength Test
6. Concrete Mixing for Grade M25

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**

2 * 15 NCH = 30 NCH	2 * 15 NCH = 30 NCH	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books

1. **M.L. Gambhir, Concrete Technology, McGraw Hill Book Company, Fifth Edition, 2017. (ISBN- 1259062554, 978-1259062551).**
2. **M.S. Shetty, Concrete Technology, Theory and Practice, S. Chand Publication, Sixth Edition, 2018. (ISBN- 9788121900034,978-8121900034)**
3. **B.L. Gupta and A. Gupta, Concrete Technology, Jain Book Agency, 2013. (ISBN-8180140407, 978-8180140402).**

Recommended Reading

1. **A.R. Santhakumar, Concrete Technology, Oxford University Press, New Delhi, 2018. (ISBN-9780195671537, 978-0195671537).**

2. **A.M. Neville, Properties of Concrete, Pearson Publication, London, 2012. (ISBN- 978-0273755807, 9780273755807).**

3. **IS 10262-(2009) Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 2009.**
4. **IS10262 (2009), Mix Design**

5. **IS269 (2015), Ordinary Portland Cement (33 Grade).**

6. **IS12269 (2013), Ordinary Portland Cement (53 Grade).**

7. **IS650 (1991), Specification of Standard Sand. 8. IS383 (1970), Specification for Coarse and Fine aggregate.**

Paper I/Subject Name: Mathematics for Civil Engineering		**Subject Code: MAT022C306(BSC)**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: TP**

Objective:

The course aims to familiarize students with fundamental concepts of mathematics that they will encounter during their studies in the industry and engineering fields, as well as to help them efficiently understand new developments and breakthroughs in engineering and technology.

Prerequisites: (i) Physics (ii) Mathematics I and II

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 mathematical definitions and properties required in engineering	BT 1
CO 2	Understand the concepts of vectors, differential equations, important series and transformations, matrices	BT 2
CO 3	Apply these concepts in solving problems	BT 3
CO 4	Analyze these concepts to independently do problems and relate it to real life applications	BT 4

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**
I.	**Basic concepts of vector calculus**	Scalar and vector point function, differential operator, gradient, directional derivative, physical meaning of gradient, divergence, curl and Laplacian with their properties. Line Integrals, Surface Integral, Volume integral, Green's theorem, Gauss' theorem and Stoke's theorem & its applications.	**18**
II.		Definition of Fourier series, Orthogonal and orthonormal functions Fourier series with arbitrary period, in particular periodic function with period 2π	**18**

	Fourier series and partial differential equation	Fourier series of even and odd function Half range Fourier series. Second order PDE of mathematical physics (Heat, wave and Laplace equation, one dimensional with standard boundary conditions) Solution by separation of variable method using Fourier series.	
III.	**Laplace transforms and applications**	Introduction, Definition of the Laplace transform, Useful properties of Laplace transform (without proof): Linearity, Frist shifting theorem, Multiplication and division by t, transforms of derivatives and integrals, Heaviside unit step function, Dirac's delta function, second shifting theorem, Laplace transform of Periodic function. Inverse Laplace transform using partial fraction and Convolution theorem (without proof). Application to solve initial and boundary value problem involving ordinary differential equations with one dependent and constant coefficient.	**18**
IV.	**Matrices**	Eigen values Eigen vectors of square matrix, Cayley Hamilton's theorem and function of square matrix, Diagonalization of square matrix. Minimal Polynomial and Minimal Equation of a Matrix. Derogatory and Non-Derogatory Matrices.	**18**
TOTAL			**72**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
4 * 18 NCH = 72 NCH	**NIL**	**48 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)**

Text Books:

1. AICTE's Prescribed Textbook: Mathematics-I (Calculus & Linear Algebra), Reena Garg, Khanna Book Publishing Co., New Delhi, 2023.
2. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
3. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.

4. Kreyszing E., “Advanced Engineering Mathematics”, John Wiley & Sons, Singapore, Int.Student Ed. 1995. (ISBN 8126554231)

Reference Books:

1. Wiley C. R., “Advanced Engineering Mathematics”, McGraw Hill Inc., New York Ed.1993.
2. O’Neel Peter., “Advanced Engg. Mathematics”, Thompson, Singapore, Ind. Ed. 2002.
3. Greenbar Michael D., “Advanced Engg. Mathematics”, Pearson, Singapore, Ind. Ed.
4. Ramana D. V., “Higher Engg. Mathematics”, The MaGraw-Hill Inc., New Delhi, 2007. (ISBN 007063419X)
5. Marsden J. E., Tromba A., Weinstein A., “Basic multivariable calculus”, Springer, 1993. (ISBN 354097976X)
6. A. R. Vasishtha, A. K. Vasishtha, “Matrices”, Krishna Prakashan Media, 1991. (ISBN 8182837294)

Subject Name: Civil Engineering – Societal & Global Impact		**Subject Code: CEE022S307 (MC)**
L-T-P-C – 2-1-0-3	**Credit Units: 03**	**Scheme of Evaluation: TP**

Objective:

The course aims to help students understand the broad impact of civil engineering on society and the global stage. Civil engineering projects affect infrastructure, energy use, sustainability, employment, economic growth, and quality of life. Civil engineers must be aware of these impacts and take measures to ensure their work benefits society and the environment.

Prerequisites: NIL

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 development of civil engineering over time and its impact on society, focusing on key innovations and their role in sustainability.**	**BT 1**
CO 2	**Understand the principles of sustainable infrastructure, including energy, water, and transportation systems.**	**BT 2**
CO 3	**Apply sustainable techniques in waste management, pollution control, and construction to address modern engineering challenges.**	**BT 3**
CO 4	**Analyze these concepts to independently solve the global problems**	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**

I.	**Foundations of civil engineering**	**Overview of course and historical background, Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution: major civil engineering breakthroughs and innovations, Present-day world and future projections: Global warming, Ecosystems, sustainability, Evaluating future resource requirements, GIS and applications for monitoring systems, Human Development Index and ecological footprint: India vs. other countries**	**12**
II.	**Global development**	**Civil engineering- past, present, and future, Importance of civil engineering in global development, Ancient and modern marvels in civil engineering, Future vision for civil engineering: Smart cities, megacities, and futuristic visions for sustainable urbanization.**	**10**
III.	**Infrastructure development and sustainability**	**Habitats, megacities, smart cities, Transportation systems (Roads, Railways, Airports, Seaports, Tunnels), Energy generation systems: Hydro, Solar, Wind, Geothermal, Tidal water provisioning and telecommunication needs, Codes & Standards in infrastructure development, Innovations for sustainable Infrastructure**	**10**
IV.	**Environmental engineering and sustainability practices**	**Solid waste management, Water purification, Wastewater treatment, Flood control systems, Global warming phenomena, Pollution mitigation, Metrics and monitoring environmental impacts, Sustainability in built environments: LEED ratings, Climate control, Smart buildings, Civil Engineering projects: Environmental impact analysis, Waste reduction, GHG emission reduction, Project management and sustainability practices**	**13**
TOTAL			**45**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 15 NCH = 45 NCH	**NIL**	**8 * 3=24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)**

Text Books/Reference Books:

1. *Žiga* Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht
2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.
4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.
5. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options
6. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx
7. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014
8. Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable paradigm? Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. p 129-130
9. Blackmore J M., Plant R A J. (2008). Risk and resilience to enhance sustainability with application to urban water systems. J. Water Resources Planning and Management. ASCE. Vol. 134, No. 3, May.
10. Bogle D. (2010) UK's engineering Council guidance on sustainability. Proc ICE Engineering Sustainability 163. June Issue ES2 p61-63
11. Brown R R., Ashley R M., Farrelly M. (2011). Political and Professional Agency Entrapment: An Agenda for Urban Water Research. Water Resources Management. Vol. 23, No.4. European Water Resources Association (EWRA) ISSN 0920-4741.
12. Brugnach M., Dewulf A., Pahl-Wostl C., Taillieu T. (2008) Toward a relational concept of uncertainty: about knowing too little, knowing too differently and accepting not to know. Ecology and Society 13 (2): 30
13. Butler D., Davies J. (2011). Urban Drainage. Spon. 3rd Ed.
14. Cavill S., Sohail M. (2003) Accountability in the provision of urban services. Proc. ICE. Municipal Engineer 156. Issue ME4 paper 13445, p235-244.

SEMESTER -IV

Paper I/Subject Name: Structural Analysis		**Subject Code: CEE022C206**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objective of the course is to provide students with a comprehensive understanding of the fundamental principles and methods of structural analysis. The course aims to develop their ability to apply analytical techniques for determining internal forces, and deflections in structures under various loading conditions. Through the study of beams, columns, trusses, arches, suspension bridges students will be prepared to analyze and design real-world structural systems.

Prerequisites: Solid mechanics

Course Outcomes

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

SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Define structure types, loads, and basic theorems in structural analysis	**BT 1**
CO 2	Understand buckling concepts and theories for struts and columns	**BT 2**
CO 3	Apply influence lines to analyze beams, trusses, arches, and suspension bridges	**BT 3**

CO 4	Analyze indeterminate structures using stiffness and flexibility methods.	**BT 4**

Detailed Syllabus:

Modules	Topics	Course Content	Periods
I.	**General theorems of structural analysis**	Different types of structures, Loads on the structural system, static and kinematic indeterminacy, methods of analysis - equilibrium equations, compatibility requirements, introduction to force and displacement methods, energy methods - strain energy, principle of virtual work, Maxwell-Betti's reciprocal theorem, Castigliano's theorem, unit load method. Deflection of determinate beams, pin jointed trusses, and rigid jointed frames and various methods for calculation of deflection - double integration (Macaulay's) method, moment area method, conjugate beam method, principle of virtual work method and Castigliano's theorems.	**12**
II.	**Column, and Struts**	Struts subjected to axial loads, concept of buckling. Euler's buckling theory of struts with different boundary conditions. Rankine's buckling theory for columns. Struts subjected to eccentric and lateral loads and struts with initial curvature.	**11**
III.	**Moving loads and Influence lines**	Concepts of influence lines-ILD for reactions, SF and BM for determinate beams-ILD for axial forces in determinate trusses, Reactions, BM and SF in determinate beams using rolling loads concepts. Arches: Types of Arches, determination of normal thrust, radial shear and bending moment. Influence lines for normal thrust, shear force and bending moment for three hinged parabolic arch. Cables and Suspension bridges: cables with three hinged stiffening girders. ILD for three hinged stiffening girders.	**12**
IV.	**Stiffness and flexibility methods of structural analysis**	Flexibility coefficients and their use in the formulation of compatibility equations. Application of Castigliano's theorem of least work to propped cantilevers, fixed beams, continuous beams, simple pin jointed frames including effect of lack of fit of members, simple rigid jointed frames and two hinged arch. Stiffness coefficients and their use for formulation of equilibrium equation, direct stiffness method, slope deflection method, moment distribution method, applications of these methods to indeterminate beams, simple rigid jointed frames and rigid jointed	**10**

		frames with inclined members, including the effect of settlement/rotation of supports.	
			TOTAL **45**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 15 NCH = 45 NCH	NA	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books

5. C.S. Reddy, *Basic Structural Analysis*, Tata McGraw Hill.
6. R.C. Hibbeler, *Structural Analysis*, Pearson Education.

Reference Books:

8. D.S. Prakash Rao, *Structural analysis: Unified approach*, Universities Press.
9. C.H. Norris, J.B. Wilbur, S. Utku, *Elementary Structural Analysis*, Tata McGraw Hill.
10. L. S. Negi and R. S. Jangid, *Structural Analysis*, Tata McGraw Hill, New Delhi.
11. C.K. Wang, *Intermediate Structural Analysis*, McGraw Hill, International Edition.
12. William M.C. McKenzie, *Examples in Structural Analysis*, CRC Press.
13. D. Menon, *Structural Analysis*, Narosa Publishing House.
14. Bhavikatti, *Structual Analysis*, Vikas Publishing House Pvt. Ltd, New Delhi.

Subject Name: Hydraulic Engineering **Subject Code: MAT022C102 (BSC)**

L-T-P-C – 3-0-2-4 **Credit Units: 04** **Scheme of Evaluation: T**

Objective:

To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	• **Understand and analyze fluid flow behavior in pipes and open channels, including laminar and turbulent flow characteristics, boundary layer concepts, and flow measurement techniques.**	**BT 1**

CO 2	• **Apply principles of dimensional analysis and similitude for hydraulic modeling and solve problems related to fluid flow using appropriate theoretical and empirical methods.**	**BT 2**
CO 3	• **Evaluate uniform and non-uniform flow conditions in open channels, including flow classification, hydraulic jump phenomena, and energy and momentum principles.**	**BT 3**
CO 4	• **Design and analyze pipe networks, hydraulic structures, and flow control devices, and utilize computational tools to simulate fluid flow and optimize water resource systems.**	**BT 4 & 5**

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I.	Fundamentals of Soil Mechanics and Soil Properties	Laminar flow through circular pipes, annulus, and parallel plates, Stoke's law, measurement of viscosity, Reynolds experiment, transition from laminar to turbulent flow, definition of turbulence, scale and intensity of turbulence, causes of turbulence, instability and mechanism of turbulence, effect of turbulent flow in pipes, Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation, resistance to flow of fluid in smooth and rough pipes, Moody's diagram.	**16**
II.	Boundary Layer Theory and Dimensional Analysis	Assumption and concept of boundary layer theory, boundary-layer thickness, displacement thickness, momentum thickness, energy thickness, laminar and turbulent boundary layers on a flat plate, laminar sub-layer, smooth and rough boundaries, local and average friction coefficients, separation and control of boundary layers, dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods, dimensionless groups, similitude, model studies, types of models, application of dimensional analysis and model studies to fluid flow problems.	**17**
III.	Open Channel Flow and Hydraulic Phenomena	Introduction to open channel flow, comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, velocity distribution of channel section, uniform flow including continuity equation, energy equation, momentum equation, characteristics of uniform flow, Chezy's formula, Manning's formula, factors affecting Manning's roughness coefficient, most economical section of channel, computation of uniform flow and normal depth, non-uniform flow concepts such as specific energy, specific energy curve, critical flow, discharge curve, specific force, specific depth and critical depth, channel transitions, measurement of discharge and velocity using Venturi flume, standing wave flume, Parshall flume, broad crested weir, measurement of velocity by current meter, floats, hot-wire anemometer, gradually varied flow, dynamic equation of gradually varied flow, classification of channel bottom slopes and surface profiles, characteristics of surface profiles, computation of water surface profile by graphical, numerical and analytical methods including direct step, graphical integration and direct integration methods.	**16**

IV	Hydraulic Jumps, Flow through Pipes, and Computational Fluid Dynamics	Theory of hydraulic jump, elements and characteristics of hydraulic jump in a rectangular channel, length and height of jump, location of jump, types, applications and location of hydraulic jump, energy dissipation and other uses, surge as a moving hydraulic jump, positive and negative surges, dynamics of fluid flow including momentum principle and applications such as force on plates and pipe bends, moments of momentum equation, flow through pipes including loss of head through pipes, Darcy-Weisbach equation, minor losses, total energy equation, hydraulic gradient line, pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles, analysis of pipe networks including Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoir problem, computational fluid dynamics basics including basic equations of fluid dynamics, grid generation, introduction to inviscid incompressible flow, boundary layer flow as applicable to CFD, hydroinformatics concepts and scope of internet and web-based modeling in water resources engineering.	
		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)

Practical Work:

1. Flow Visualization
2. Studies in Wind Tunnel
3. Boundary Layer
4. Flow around an Aerofoil / circular cylinder
5. Uniform Flow
6. Velocity Distribution in Open channel flow
7. Venturi Flume
8. Standing Wave Flume
9. Gradually Varied Flow
10. Hydraulic Jump
11. Flow under Sluice Gate
12. Flow through pipes
13. Turbulent flow through pipes
14. Flow visualization
15. Laminar flow through pipes
16. Major losses / Minor losses in pipe

Text/Reference Books:

1. Fluid Mechanics, Sadhu Singh, Khanna Book Publishing Co., New Delhi
2. Fluid Machinery (Hydraulic Machines), Sadhu Sigh, Khanna Book Publishing

Co.,

3. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
4. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
5. Open channel Flow, K. Subramanya, Tata McGraw Hill.
6. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.
7. Burnside, C.D., "*Electromagnetic Distance Measurement*," Beekman Publishers, 1971.

Paper I/Subject Name: Transportation Engineering		**Subject Code: CEE022C403 (B.TECH)**
L-T-P-C – 2-0-2-3	**Credit Units: 03**	**Scheme of Evaluation: TP**

Objective:

To understand the importance of transportation and characteristics of road transport and know about the history of highway development, surveys and classification of roads. The course is designed to impart knowledge about the geometric design of highways, traffic characteristics and pavement materials

Prerequisites: Concepts of +2 level Physics

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Explain** various engineering surveys for highways.	**BT 1**
CO 2	**Illustrate** tests on highway materials.	**BT 2**
CO 3	**Understand** geometric design and alignment concepts.	**BT 3**
CO 4	**Emphasize** the importance of traffic volume studies and traffic regulation.	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**
I.	Highway development and planning	Highway development and planning-Classification of roads, road development in India, Current Road projects in India; highway alignment and project preparation.	**8**

	Geometric design of highways	Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems.	
II.	Accessibility to Differently Abled Publics.	Design of Access Routes &Walkways (Elements of walkways, Tactile Navigation Systems, BRT Systems, Pedestrian streets and other related aspects), Accessible Streets and Mobility Environments (Street Elements for Accessibility, dimensions and codes material, TGSIs), Inclusive Public Transportation System	**7**
	Traffic engineering & control.	Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems	
III.	Pavement materials	Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems	**8**
IV.	Design of pavements	Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems	**7**
TOTAL			**30**

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

- Carry out surveys involved in planning and highway alignment
- Design the geometric elements of highways and expressways
- Carry out traffic studies and implement traffic regulation and control measures and intersection design
- Characterize pavement materials and
- Design flexible and rigid pavements as per IRC

Transportation Engineering Lab Syllabus

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

Minimum 10 Laboratory experiments based on the following-

Objective: To determine the various parameters of road building materials and understand their physical properties.

1. Sieve analysis
2. Impact test
3. Crushing Strength test
4. Abrasion test
5. Water Absorption test
6. Specific gravity test
7. Flakiness Index test
8. Elongation Index test
9. CBR Test

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

Textbooks:

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. Kadiyalai, L.R., 'Transportation Engineering', Khanna Book Publishing Co., New Delhi (ISBN: 978-9382-609-858)
3. Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning,
4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley
5. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.

Paper I/Subject Name: Surveying and Geomatics	**Subject Code: CEE022C404 (B.TECH)**	
L-T-P-C – 3-0-2-4	**Credit Units: 04**	**Scheme of Evaluation: TP**

Objective:

The objective of this Course is to introduce students to the field of surveying as applied in civil engineering field. The course is also aimed at familiarizing students with various methods and instruments used for surveying.

Prerequisites: Concepts of +2 level Physics and Maths

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Explain the basics of surveying, including accurate measurements, field booking, and plotting.**	**BT 1**
CO 2	**Demonstrate proficiency in using survey instruments and tools.**	**BT 2**
CO 3	**Understand the relevance of geospatial information in civil engineering projects**	**BT 3**
CO 4	**Analyze survey data for decision-making and Explore different methods for data collection and processing in geomatics.**	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**
I.	***Introduction to Surveying***	**Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring:**	**14**

		Characteristics, methods, uses; areas and volumes.	
	Triangulation and Trilateration	**Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation - network- Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis single corrections.**	
II.	***Curves***	**Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves**	**14**
	Modern Field Survey Systems	**Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.**	
III.	***Photogrammetry Surveying***	**Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics, map substitutes.**	**8**
IV.	***Remote Sensing***	**Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.**	**9**
TOTAL			**45**

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

- **Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities**
- **Translate the knowledge gained for the implementation of Civil infrastructure facilities**

- **Relate the knowledge on Surveying to the new frontiers of science like Hydrographic surveying, Electronic Distance Measurement, Global Positioning System, Photogrammetry and Remote Sensing.**

Surveying and Geomatics Lab Syllabus

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

Minimum 10 Laboratory experiments based on the following-

Objective: To familiarize students with different surveying instruments and techniques like levelling, traversing, direct & indirect contouring etc.

1. **To Range a line more than one chain length and recording details in a field book.**
2. **Open and Closed Traversing using a Prismatic compass.**
3. **To determine the height of a building (accessible and inaccessible) using a theodolite.**
4. **Profile and Cross-section levelling using a dumpy level.**
5. **Repetition and Reiteration method of horizontal angle measurement by theodolite.**
6. **To locate a simple circular curve on field.**
7. **Plane table surveying**
8. **Indirect Contouring**
9. **Determination of area of an irregular boundary.**
10. **Total Station Demonstration/ Workshop.**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 15 NCH = 45 NCH	**2 * 15 NCH = 30 NCH**	**8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)**

Textbooks:

1 **Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.**

2 **Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011**

3 **Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010**

4 **Garg, P.K., Principles and Theory of Geoinformatics, Khanna Publishing House, 2019.**

5 **Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.**

6 **Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001.**

7 **Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.**

Subject Name: Construction Engineering & Management		**Subject Code: CEE022C405**
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objectives of the course are to acquaint the students with various aspects of Construction Engineering & Management. They'll gain insights into construction processes, stakeholder roles (including architects, engineers, contractors, and clients), and modern construction practices. Additionally, they'll learn about project dynamics, effective planning, cost optimization, contract administration, and the importance of strong communication skills within the construction industry.

Prerequisites: NIL

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** key concepts related to construction practices, project development, and stakeholder roles.	**BT 1**
CO 2	**Explain** modern construction practices, including techniques, materials, and safety protocols. Also be able to explain the dynamics of construction projects, such as the interplay between stakeholders, project objectives, and resource allocation	**BT 2**
CO 3	**Apply** knowledge by planning, controlling, and monitoring construction projects with respect to both time and cost. Will be able to put theoretical concepts into practical use during project execution.	**BT 3**
CO 4	**Analyze** construction projects from an economic perspective, considering costs, benefits, and optimization strategies. Also critically evaluate contract structures and address issues related to project administration.	**BT 4**

Detailed Syllabus:

Modules	Topics	Course Content	Periods
I.	**Basics of Construction** **Construction project planning**	Basics of Construction- Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution. Construction project planning- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion	**12**
II.	**Construction Methods basics:** **Construction Equipment basics:**	Construction Methods basics: Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges. Construction Equipment basics: Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities	**12**

III.	**Planning and organizing construction site and resources- Project Monitoring & Control-**	Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices in Construction. Project Monitoring & Control- Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.	**11**

IV.	**Contracts Management basics: Construction Costs:**	Contracts Management basics: Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods. Construction Costs: Make-up of construction costs; Classification of costs, time- cost trade-off in construction projects, compression and decompression.	**10**
TOTAL			**45**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 15 NCH = 45 NCH	NA	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books

1. Sharma, S.C. & Deodhar S.V., Construction Engineering and Management, Khanna Book Publishing Co., 2022.
2. Varghese, P.C., "*Building Construction"*, Prentice Hall India, 2007.
3. *National Building Code,* Bureau of Indian Standards, New Delhi, 2017.
4. Chudley, R., *Construction Technology,* ELBS Publishers, 2007.

Reference Books:

1. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
2. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
3. Rajoria, K.B., Case Studies in Construction Project Management, Khanna Publishing House, 2023.
4. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
5. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi

Subject Name: Geotechnical Engineering		**Subject Code: MAT022C102 (BSC)**
L-T-P-C – 2-0-2-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

 To introduce the fundamental concepts of soil mechanics, including soil formation, classification, and its physical and engineering properties relevant to civil engineering applications.

 To develop an understanding of the behavior of soils under various loading conditions, including concepts of permeability, seepage, stress distribution, and consolidation.

 To equip students with the ability to determine the shear strength of soils, enabling the analysis of slope stability, earth pressure, and bearing capacity problems.

 To provide hands-on experience in laboratory and field testing of soils, interpreting test results for practical engineering applications in foundation design and site investigation.

 To prepare students to analyze and design shallow and deep foundations, retaining structures, and other geotechnical systems with an understanding of soil-structure interaction.

 To foster awareness of modern tools and techniques in geotechnical investigations, including geophysical methods, ground improvement techniques, and sustainable geotechnical solutions.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	• **Apply the fundamental principles of soil mechanics to classify soils and analyze their physical and engineering properties relevant to civil engineering projects.**	**BT 1**

CO 2	• **Conduct laboratory and field tests to determine soil properties such as permeability, shear strength, compaction, and consolidation, and interpret the results for practical engineering applications.**	**BT 2**
CO 3	• **Analyze stress distribution, seepage, and effective stress in soil masses, and assess their impact on soil stability and foundation performance.**	**BT 3**
CO 4	• **Design safe and efficient shallow and deep foundation systems, retaining structures, and earthworks by integrating soil behavior analysis and modern geotechnical investigation techniques.**	**BT 4 & 5**

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I.	Fundamentals of Soil Mechanics and Soil Properties	Introduction to types of soils, their formation and deposition, definitions of soil mechanics, soil engineering, rock mechanics, and geotechnical engineering, scope of soil engineering, comparison and difference between soil and rock, basic definitions and relationships including soil as a three-phase system in terms of weight, volume, voids ratio, and porosity, definitions of moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, relationships between volume weight, voids ratio and moisture content, unit weight and percent air voids, saturation and moisture content, moisture content and specific gravity, determination of various parameters such as moisture content by oven dry method, pycnometer, sand bath method, torsional balance method, nuclear method, alcohol method and sensors, specific gravity by density bottle method, pycnometer method, measuring flask method, unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method.	**16**
II.	Soil Classification, Plasticity, and Permeability	Plasticity characteristics of soil including introduction to definitions such as plasticity of soil, consistency limits—liquid limit, plastic limit, shrinkage limit—plasticity, liquidity and consistency indices, flow and toughness indices, definitions of activity and sensitivity, determination of liquid limit, plastic limit and shrinkage limit, use of consistency limits, classification of soils with particle size classification, textural classification, unified soil classification system, Indian standard soil classification system, field identification of soils and general characteristics of soils in different groups, permeability of soil covering Darcy's law, validity of Darcy's law, determination of coefficient of permeability by laboratory methods such as constant-head and falling-head methods, field methods including pumping-in and pumping-out tests, permeability of stratified soils, factors affecting permeability of soil, seepage analysis including introduction to stream and potential functions, characteristics of flow nets, and graphical methods to plot flow nets.	**17**

III.	Soil Stresses, Compaction, and Consolidation	Effective stress principle including introduction, nature of effective stress, effect of water table, fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition, compaction of soil covering introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density, field compaction methods, compaction specifications and field control, stresses in soils including stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area, influence factors, isobars, Boussinesq's equation, Newmark's influence chart, contact pressure under rigid and flexible area, computation of displacements from elastic theory, consolidation of soil including introduction, comparison between compaction and consolidation, initial, primary and secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.	**16**
IV	Shear Strength, Slope Stability, and Soil Exploration	Shear strength covering Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests including direct shear test, merits of direct shear test, triaxial compression tests, behavior of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters, unconfined compression test, vane shear test, stability of slopes including introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure, Swedish circle method, friction circle method, stability numbers and charts, soil exploration including introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trial pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advanced soil exploration methods.	
		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)

Practical Work: List of tests on-

1. Field Density using Core Cutter method.
2. Field Density using Sand replacement method.
3. Natural moisture content using Oven Drying method.
4. Field identification of Fine-Grained soils.
5. Specific gravity of Soils.
6. Grain size distribution by Sieve Analysis.
7. Grain size distribution by Hydrometer Analysis.
8. Consistency limits by Liquid limit
9. Consistency limits by Plastic limit
10. Consistency limits by Shrinkage limit.

11. Permeability test using Constant-head test method.
12. Permeability test using Falling-head method.
13. Compaction test: Standard Proctor test.
14. Compaction test: Modified Proctor test.
15. Relative density.
16. Consolidation Test.
17. Triaxial Test (UU)
18. Vane shear test

19. Direct Shear Test

Unconfined Compression Strength Test.

Text/Reference Books:

1. Soil Mechanics by Craig R.F., Chapman & Hall
2. Elements of Land/ Soil Pollution by O.P. Gupta, Khanna Book Publishing.
3. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
4. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ
5. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning
6. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning
7. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy
8. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri.
9. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy

SEMESTER –V

Subject Name: Design of RCC Structures		**Subject Code: CEE022C501**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objective of the Design of Reinforced Cement Concrete (RCC) subject is to equip students with the knowledge and skills required to design safe, durable, and economical concrete structures. It focuses on understanding the properties of concrete and steel, applying design philosophies such as limit state and working stress methods, and designing structural elements like beams, slabs, columns, and footings. The course emphasizes the use of IS codes (especially IS 456:2000), ensures structural safety and serviceability, and teaches proper reinforcement detailing. It also prepares students to tackle practical site-related challenges and promotes the use of sustainable and cost-effective design practices.

Prerequisites: Knowledge of Strength of Materials, Structural Analysis, Engineering Mechanics, Construction Materials, and Mathematics is essential for studying RCC Design.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**To understand** the concepts and assumptions behind Working Stress and Limit State Methods for RCC design.	**BT 1**

CO 2	**To apply** IS code provisions for the design of beams, slabs, columns, and footings using RCC design methods.	**BT 2**
CO 3	**To analyze** structural members for strength and serviceability under various loading conditions.	**BT 3**
CO 4	**To create** detailed design and reinforcement drawings of RCC and prestressed concrete components.	**BT 4**

Detailed Syllabus:

Modules	Topics	Course Content	Periods
I.	**Working stress method and ultimate**	Reinforced Concrete Fundamentals (working Stress Method): Concept of reinforced concrete, stress strain characteristics of concrete and steel reinforcement, elastic theory, singly reinforced, balanced section, under reinforced section and over reinforced section.	**12**
II.	**Limit state method of design**	Concepts of probability and reliability, characteristic loads, characteristic strength, partial safety factors for loads and materials, limit states of collapse in flexure, direct compression, shear, limit states of serviceability in deflection and cracking, design of singly and doubly reinforced rectangular and T sections for flexure, design of members in shear and bond, design of columns for axial load, uni-axial bending moment, and bi-axial bending moment as per IS Code.	**12**
III.	**Limit state method of design**	Design of one-way and two-way slabs, design of beams subjected to bending and torsion, design of isolated square and rectangular footings subjected to axial load and moments, design of combined foundations, design of doglegged and open-well type staircases, design of flat slab, design of post-tensioned slab.	**11**

IV.	**Pre-stressed concrete**	Basic principles of pre-stressed concrete: materials used and their properties, methods and systems of pre-stressing. Losses in pre-stress, analysis of various types of sections subjected to pre-stress and external loads. Prestressed and post tensioned members, Different types of Prestressed sections, BoxSection, Girder	**10**
TOTAL			**45**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 15 NCH = 45 NCH	NA	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books

1 Jain and Jaikrishna, Plain and Reinforced Concrete, Vol. I, Nemchand Brothers.(ISBN-8185240086/978-8185240084).

2 Shrikhant Vanakudre, Prestressed Concrete (Materials, Analysis and Design), Khanna Publishing House, (ISBN: 9789386173317**)**

3 V. L. Shah and Karve, Limit State Design - Reinforced Concrete Structures Publications. (ISBN-9788190371711/8190371711).

4 N. Krishna Raju, Pre-stressed Concrete, Tata McGraw Hill. (ISBN-9789387886209/9387886204).

Recommended Reading

1. P. Dayaratnam, Design of Reinforced Concrete Structures, Oxford & IBH. (ISBN-9789386479785/9386479788).

2. T.Y. Lin, Design of Prestressed Concrete Structures, John Wiley and Sons Inc., 2010. (ISBN-788126528035/978-8126528035).

3. P.D. Arthur and V. Ramkrishnan, Ultimate Strength Design for Structural Concrete, Wheeler&Co. Pvt Ltd. (ISBN- 0273403230, 978-0273403234).

4. B.P. Hughes, Limit State Theory for Reinforced Concrete Design, Pitman. (ISBN-0273010239,978-0273010234).

5. IS456 (2000), Plain and Reinforced Concrete.

6. IS 875 (1987), Part I- Design Loads (Other than earthquake) for Buildings and Structures (DeadLoads).

7. IS 875 (1987), Part II- Design Loads (Other than earthquake) for Buildings and Structures(Imposed Loads).

8. IS 875 (2015), Part III- Design Loads (Other than earthquake) for Buildings and Structures(Wind Loads).

9. IS 875 (1987), Part IV- Design Loads (Other than earthquake) for Buildings and Structures(Snow Loads).

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Subject Name: Design of RCC Structures		**Subject Code: CEE022C501**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

The objective of the Design of Reinforced Cement Concrete (RCC) subject is to equip students with the knowledge and skills required to design safe, durable, and economical concrete structures. It focuses on understanding the properties of concrete and steel, applying design philosophies such as limit state and working stress methods, and designing structural elements like beams, slabs, columns, and footings. The course emphasizes the use of IS codes (especially IS 456:2000), ensures structural safety and serviceability, and teaches proper reinforcement detailing. It also prepares students to tackle practical site-related challenges and promotes the use of sustainable and cost-effective design practices.

Prerequisites: Knowledge of Strength of Materials, Structural Analysis, Engineering Mechanics, Construction Materials, and Mathematics is essential for studying RCC Design.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**To understand** the concepts and assumptions behind Working Stress and Limit State Methods for RCC design.	**BT 1**
CO 2	**To apply** IS code provisions for the design of beams, slabs, columns, and footings using RCC design methods.	**BT 2**
CO 3	**To analyze** structural members for strength and serviceability under various loading conditions.	**BT 3**
CO 4	**To create** detailed design and reinforcement drawings of RCC and prestressed concrete components.	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**
I.	**Working stress method and ultimate**	Reinforced Concrete Fundamentals (working Stress Method): Concept of reinforced concrete, stress strain characteristics of concrete and steel reinforcement, elastic theory, singly reinforced, balanced section, under reinforced section and over reinforced section.	**12**

II.	**Limit state method of design**	Concepts of probability and reliability, characteristic loads, characteristic strength, partial safety factors for loads and materials, limit states of collapse in flexure, direct compression, shear, limit states of serviceability in deflection and cracking, design of singly and doubly reinforced rectangular and T sections for flexure, design of members in shear and bond, design of columns for axial load, uni-axial bending moment, and bi-axial bending moment as per IS Code.	**12**
III.	**Limit state method of design**	Design of one-way and two-way slabs, design of beams subjected to bending and torsion, design of isolated square and rectangular footings subjected to axial load and moments, design of combined foundations, design of doglegged and open-well type staircases, design of flat slab, design of post-tensioned slab.	**11**
IV.	**Pre-stressed concrete**	Basic principles of pre-stressed concrete: materials used and their properties, methods and systems of pre-stressing. Losses in pre-stress, analysis of various types of sections subjected to pre-stress and external loads. Prestressed and post tensioned members, Different types of Prestressed sections, BoxSection, Girder	**10**
TOTAL			**45**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 15 NCH = 45 NCH	NA	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text Books

5 Jain and Jaikrishna, Plain and Reinforced Concrete, Vol. I, Nemchand Brothers.(ISBN-8185240086/978-8185240084).

6 Shrikhant Vanakudre, Prestressed Concrete (Materials, Analysis and Design), Khanna Publishing House, (ISBN: 9789386173317)

7 V. L. Shah and Karve, Limit State Design - Reinforced Concrete Structures Publications. (ISBN-9788190371711/8190371711).

8 N. Krishna Raju, Pre-stressed Concrete, Tata McGraw Hill. (ISBN-9789387886209/9387886204).

Recommended Reading

10. P. Dayaratnam, Design of Reinforced Concrete Structures, Oxford & IBH. (ISBN-9789386479785/9386479788).

11. T.Y. Lin, Design of Prestressed Concrete Structures, John Wiley and Sons Inc., 2010. (ISBN-788126528035/978-8126528035).

12. P.D. Arthur and V. Ramkrishnan, Ultimate Strength Design for Structural Concrete, Wheeler&Co. Pvt Ltd. (ISBN- 0273403230, 978-0273403234).

13. B.P. Hughes, Limit State Theory for Reinforced Concrete Design, Pitman. (ISBN-0273010239,978-0273010234).

14. IS456 (2000), Plain and Reinforced Concrete.

15. IS 875 (1987), Part I- Design Loads (Other than earthquake) for Buildings and Structures (DeadLoads).

16. IS 875 (1987), Part II- Design Loads (Other than earthquake) for Buildings and Structures(Imposed Loads).

17. IS 875 (2015), Part III- Design Loads (Other than earthquake) for Buildings and Structures(Wind Loads).

18. IS 875 (1987), Part IV- Design Loads (Other than earthquake) for Buildings and Structures(Snow Loads).

Structural Design –I- Laboratory

Course Outcomes

After completion of this course, students will be able to,

1. Analyze and design beam, column, slab, foundation, staircases and cantilever and counterfortretaining walls.
2. Draw detailed structural drawings for slab, beam, column, foundation, staircases and cantileverand counterfort retaining walls.

Course Contents

1. Design and drawing of singly reinforced, doubly reinforced rectangular and T-section simplysupported and continuous beam.
2. Design and drawing of one way, two way simply supported and continuous slab system.
3. Design and drawing of Dog-legged and open wall type staircases.
4. Design and drawing of columns and foundation.
5. Design and drawing of Retaining wall. (Cantilever and counterfort)

Text Books

1. Jain and Jaikrishna, Plain and Reinforced Concrete, Vol. I, Nemchand Brothers.(ISBN-8185240086/978-8185240084).
2. Shrikhant Vanakudre, Prestressed Concrete (Materials, Analysis and Design), Khanna Publishing House, (ISBN: 9789386173317)
3. V. L. Shah and Karve, Limit State Design - Reinforced Concrete Structures Publications. (ISBN- 9788190371711/8190371711).
4. N. Krishna Raju, Pre-stressed Concrete, Tata McGraw Hill.(ISBN- 9789387886209/9387886204).

Recommended Reading

1. P.Dayaratnam, Design of Reinforced Concrete Structures, Oxford & IBH. (ISBN-9789386479785/9386479788).
2. T.Y. Lin, Design of Prestressed Concrete Structures, John Wiley and Sons Inc., 2010. (ISBN-9788126528035/8126528036).
3. P.D.Arthur and V.Ramkrishnan, Ultimate Strength Design for Structural Concrete, Wheeler&Co. Pvt Ltd. (ISBN- 0273403230/978-0273403234).
4. B.P. Hughes, Limit State Theory for Reinforced Concrete Design, Pitman. (ISBN-0273010239/978-0273010234).

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Subject Name: Environmental Engineering	**Subject Code: CEE022C502**
L-T-P-C – 3-0-2-3	**Credit Units: 03**	**Scheme of Evaluation: TP**

Objective:

The objective of this course is to provide a comprehensive understanding of environmental engineering systems related to **water supply**, **wastewater**, **air**, **noise**, and **solid waste management**, along with associated infrastructure and regulatory frameworks. It covers sources and treatment of water, design of supply and sewerage systems, water quality standards, and wastewater treatment processes. The syllabus also includes air and noise pollution control, municipal and hazardous solid waste management, building plumbing systems, and the roles of government authorities in environmental regulation and infrastructure planning.

Prerequisites: Basic knowledge of chemistry, fluid mechanics, and environmental science is a prerequisite for studying Environmental Engineering.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	To **understand** the sources, quality parameters, and treatment methods of water and wastewater.	**BT 1**
CO 2	To **apply** design principles for water supply, sewerage, stormwater, and solid waste management systems.	**BT 2**
CO 3	**To analyze** the causes and impacts of air and noise pollution, and evaluate appropriate control measures.	**BT 3**

CO 4	**To design** integrated environmental engineering solutions considering plumbing, waste handling, and regulatory compliance.	**BT 4**

Detailed Syllabus:

Modules	Topics	Course Content	Periods
I.	**Water Supply and Treatment**	Topics include sources of water, water quality issues, water quality requirements for beneficial uses, water quality standards, water quality indices, and water safety plans. It also covers water supply systems, the need for planned water supply schemes, and water demand for domestic, industrial, and agricultural purposes. Additional topics include components of water supply systems, transmission of water, distribution systems, various valves used in water supply, service reservoirs and their design. Treatment processes include aeration, sedimentation, coagulation and flocculation, filtration, disinfection, and advanced treatment methods such as adsorption, ion exchange, and membrane processes.	**12**
II.	**Wastewater Engineering**	This module includes domestic and storm water, quantity of sewage, sewage flow variations, types and shapes of sewers, design parameters, operation and maintenance of sewers, sewage pumping, and sewerage systems. It also covers sewer appurtenances, design of sewerage systems, small bore systems, storm water quantification and design, sewage and sullage, and pollution due to improper sewage disposal. Further topics include National River Cleaning Plans, aerobic and anaerobic treatment systems, suspended and attached growth systems, sewage recycling, and quality requirements for various reuse purposes.	**12**
III.	**Air and Noise Pollution**	Topics covered include the composition and properties of air, quantification and monitoring of air pollutants, occupational and urban air pollution, automobile pollution, chemistry of combustion, automobile engines, fuel quality, and their operating conditions and interrelations. The	**11**

		module also addresses air quality standards, control measures for air pollution, and their limitations. It further includes basic concepts of noise pollution, noise measurement techniques, and noise control methods.	
IV.	**Solid Waste Management and Building Plumbing**	This module covers municipal solid waste (MSW), its composition, chemical and physical parameters, and management processes including collection, transport, treatment, and disposal. It also includes special MSW from commercial establishments, construction sites, and biomedical sources. Topics on environmental effects of solid waste, health hazards, segregation, source reduction, recovery, recycling, and integrated solid waste management are also addressed. Hazardous waste types and classifications are included. The module concludes with building plumbing systems, plumbing in high-rise buildings, pressure reducing valves, break pressure tanks, storage tanks, building drainage, fixtures and fittings, and the role of government authorities in water supply, sewerage disposal, and environmental pollution control.	**10**
TOTAL			**45**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 15 NCH = 45 NCH	NA	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Practical Work: List of Experiments

1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile,inorganic etc.
3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness
4. Analysis of ions: copper, chloride and sulfate
5. Optimum coagulant dose
6. Chemical Oxygen Demand (COD)
7. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
8. Break point Chlorination
9. Bacteriological quality measurement: MPN,
10. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx)
11. Ambient noise measurement

Text/Reference Books:

1. Environmental Engineering, M.P. Poonia, SC. Sharma, Santosh Kumar, Khanna Book Publishing Co., New Delhi.
2. Air Pollution and Control, Keshav Kant, Rajni Kant, Khanna Book Publishing Co., New Delhi.
3. Introduction to Environmental Engineering and Science by Gilbert Masters, PrenticeHall, New Jersey.
4. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
5. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw - Hill International Editions, New York 1985.
6. MetCalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse*, Tata McGraw-Hill, New Delhi.
7. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
8. Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999
9. Gupta, O.P., Elements of Water Pollution Control Engineering, Khanna Publishing House, New Delhi (ISBN: 9789386173225)
10. Gupta, O.P., Elements of Land/ Soil Pollution, Khanna Publishing House, New Delhi (ISBN: 9789382609735)
11. Gupta, O.P., Elements of Environmental Pollution Control, Khanna Publishing House, New Delhi (ISBN: 9789382609667)
12. Gupta, O.P., Khanna's Objective Types Questions & Answers in Environmental Engineering, Khanna Book Publishing Co.
13. Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication
14. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of UrbanDevelopment.

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Subject Name: Engineering Economics, Estimation & Costing
Subject Code: CEE022C503
L-T-P-C – 3-0-2-3 **Credit Units: 03** **Scheme of Evaluation: TP**

Objective:

The objective of this course is to provide students with a comprehensive understanding of engineering economics with a focus on its application in infrastructure and construction projects. It aims to equip learners with the ability to analyze and compare economic alternatives using techniques such as present worth, future worth, annual worth, benefit-cost ratio, life cycle costing, and breakeven analysis. The course also emphasizes understanding technical specifications, cost estimation, and rate analysis for various construction components. Additionally, it introduces students to the concepts of competitive bidding and tender preparation, enabling them to evaluate project costs effectively and prepare economically sound proposals.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	To understand fundamental economic principles and their application in the Indian context, particularly for public and private sector projects.	**BT 1**
CO 2	To apply techniques such as present worth, future worth, annual worth, benefit-cost ratio, life cycle cost, and breakeven analysis for evaluating project alternatives.	**BT 2**
CO 3	**To analyze** technical specifications and quantify the cost components of a structure through material estimation and rate analysis.	**BT 3**
CO 4	**To evaluate** tendering procedures and prepare competitive bidding proposals for construction projects.	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**
I.	**Fundamentals of Engineering Economics**	ntroduction to economics, importance of economics in engineering, economics of India, comparison between public sector and private sector, role of economics in infrastructure and construction projects.	**12**
II.	**Time Value of Money and Financial Analysis**	Perform and evaluate present worth, future worth, and annual worth analyses on one or more economic alternatives, carry out and evaluate benefit/cost analysis, life cycle cost analysis, breakeven analysis on one or more economic alternatives.	**12**

III.	**Cost Evaluation and Technical Specifications**	Understand the technical specifications for various works to be performed for a project, analyze how technical specifications impact the cost of a structure, quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates, build up the overall cost of the structure.	**11**
IV.	**Estimation, Bidding, and Project Costing**	Understand how competitive bidding works, prepare and submit a competitive bid proposal, comprehend procedures of tendering and contracting, apply cost estimation techniques in real-world construction projects.	**10**
TOTAL			**45**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 15 NCH = 45 NCH	NA	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Term Work Assignments may include:

1. Deriving an approximate estimate for a multistoried building by approximate methods.
2. Detailed estimate for the following with the required material survey for the same.
    a. Ground plus three storied RCC Framed structure building with blockwork walls
    b. bridge with minimum 2 spans
    c. factory building
    d. road work
    e. cross drainage work
    f. Ground plus three storied building with load-bearing wallsg Cost of finishes, MEP works for (f) above
3. Preparation of valuation report in standard Government form.
4. Assignments on rate analysis, specifications and simple estimates.
5. Detailed estimate of minor structure.
6. Preparation of Bar bending schedule.

Text/Reference Books:

1. Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House

2. Mankiw Gregory N. (2002), *Principles of Economics,* Thompson Asia
3. V. Mote, S. Paul, G. Gupta(2004), *Managerial Economics,* Tata McGraw Hill
4. Misra, S.K. and Puri (2009), *Indian Economy,* Himalaya
5. Pareek Saroj (2003), *Textbook of Business Economics,* Sunrise Publishers
6. M Chakravarty, Estimating, Costing Specifications & Valuation
7. Joy P K, Handbook of Construction Management, Macmillan
8. B.S. Patil, Building & Engineering Contracts
9. Relevant Indian Standard Specifications.
10. World Bank Approved Contract Documents.
11. FIDIC Contract Conditions.
12. Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration
13. Typical PWD Rate Analysis documents.
14. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations,2016
15. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016

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Subject Name: Hydrology and Water Resource Engineering		
Subject Code: CEE022C504		
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

The objective of this course is to provide students with a fundamental understanding of the hydrologic cycle and its components, including precipitation, evaporation, infiltration, runoff, and groundwater flow. It aims to equip students with analytical and design skills for planning and managing water resources systems such as reservoirs, canals, and flood control structures. The course also focuses on the application of hydrological models, data analysis techniques, and design methods in solving real-world problems related to water availability, distribution, and conservation.

Prerequisites: Basic knowledge of fluid mechanics and engineering mathematics.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**To understand** the components of the hydrologic cycle and the fundamental processes such as precipitation, evaporation, infiltration, runoff, and groundwater flow.	**BT 1**
CO 2	**To apply** analytical methods and hydrologic techniques for estimation of surface and groundwater flow, irrigation requirements, and reservoir design.	**BT 2**
CO 3	**To analyze** rainfall-runoff relationships, hydrographs, and well hydraulics using standard methods such as SCS-CN, unit hydrograph, and aquifer tests.	**BT 3**
CO 4	**To evaluate** the design and performance of water resources structures including canals, dams, spillways, and irrigation systems for efficient water distribution and flood control.	**BT 4**

Detailed Syllabus:

Modules	**Topics**	**Course Content**	**Periods**

I.	**Introduction and Precipitation**	hydrologic cycle, water-budget equation, history of hydrology, worldwater balance, applications in engineering, sources of data., forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth- area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.	**12**
II.	**Abstractions from precipitation and runoff**	evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices. runoff volume, SCS-CN method of estimating runoff volume, flow- duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, componentsof hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resourcesof India, environmental flows.	**12**
III.	**Ground water and well hydrology and Water withdrawals and uses**	forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests and water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Qualityof irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface,sub-surface, sprinkler and trickle / drip irrigation.	**11**

IV.	**Distribution systems and Dams and spillways**	canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy'sand Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining.Drainage of irrigated lands: necessity, methods and embankment dams: Classification, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.	**10**
TOTAL			**45**

Credit Distribution		
Lecture/ Tutorial	**Practicum**	**Experiential Learning**
3 * 15 NCH = 45 NCH	NA	8 * 3 NCH = 24 NCH (Problem Solving, Seminar, Case Study, Discussion, Internship, Projects)

Text/Reference Books:

1. K Subramanya, Engineering Hydrology, Mc-Graw Hill.O.P. Gupta, Elements of Water Pollution Control Engineering, Khanna Book Publishing Co.
2. O.P. Gupta, Multi-Choice Environmental Engineering, Khanna Book Publishing Co.
3. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.
4. K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc-Graw Hill.
5. Santosh Kumar, Irrigation Engineering, Khanna Book Publishing Co.
6. G L Asawa, Irrigation Engineering, Wiley Eastern
7. L W Mays, Water Resources Engineering, Wiley.
8. J D Zimmerman, Irrigation, John Wiley & Sons
9. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.

SEMESTER –VI

Subject Name: Design of Steel Structures		**Subject Code: MAT022C102 (BSC)**
L-T-P-C – 3-0-2-0	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective:

To impart knowledge and skills related to the design and detailing of structural steel connections, roofing systems, flooring systems, and columns with bases. The course emphasizes understanding load effects, structural behavior, and code-based design procedures for steel members and connections used in building construction.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Design and analyze bolted, welded, and riveted connections under axial and eccentric loads.**	**BT 1**
CO 2	**Evaluate and design roofing systems considering dead, imposed, and wind loads with proper detailing of trusses and their connections.**	**BT 2**
CO 3	**Develop appropriate floor systems using rolled steel sections, including the design of simply supported main and secondary beams.**	**BT 3**

CO 4	**Design steel columns and base plates, including detailing of lacing, battens, and column bases under axial and combined loading.**	**BT 4 & 5**

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I.	**Bolted and welded connections**	Introduction to riveted connection, design of bolted and welded connections, axially and eccentricallyloaded joints, simple connection of bracket plates to columns, beam to beam and beam to column connections, design of framed, unstiffened and stiffened seat connections.	**16**
II.	*Roofing system*	Imposed loads on flat and sloping roofs and floors, wind loads on sloping roofs and vertical cladding including effect of degree permeability and wind drag, analysis of pin-jointed trusses under various loading cases, computation of design forces in members, design and detailing of connections and supports.	**17**
III.	*Flooring system*	Concept of floor system with secondary beams, main beams and columns, design of simply supported beams using rolled steel sections.	**16**
IV	*Columns and bases*	Design of columns under axial loads using single or multiple rolled steel sections, design of lacing, battens, columns subjected to axial load and bending, design of slab and Gusseted base.	
		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. S.K. Duggal, Limit State Design of Steel Structures, Tata McGraw Hill Education Private Limited, 2017. (ISBN: 9789351343493/9351343499).
2. V.L. Shah and V. Gore, Limit State Design of Steel Structures IS:800-2007, Structures Publication, 2012. (ISBN: 8190371754).

Recommended Reading:

1. S.S. Bhavikatti, Design of Steel Structures, I.K. International Publishing House Limited, 2017.(ISBN: 9789385909559/938590955X).
2. N. Subramanian, Design of Steel Structures, Oxford University Press, 2011. (ISBN: 9780198068815/0198068816).
3. IS 800 (2007), General Construction in Steel- Code of Practice, Ced 7: Structural Engineering and Structural Section, Published by Bureau of Indian Standard ManakBhavan, New Delhi.
4. IS 875- Part 1 (1987): Dead Loads, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi.

IS 875- Part 2 (1987): Imposed Loads, Indian Standard Code of Practice for Design Loads(Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi.

5. IS 875- Part 3 (2017): Wind Loads, Indian Standard Code of Practice for Design Loads (Otherthan Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi.
6. IS 875- Part 4 (1987): Snow Loads, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi.
7. IS 875- Part 5 (1987): Special Loads and Combinations, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau ofIndian Standard Manak Bhavan, New Delhi

Subject Name: Intelligent Transportation Systems		**Subject Code: MAT022C102 (BSC)**
L-T-P-C – 3-0-0-0	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

- To introduce the fundamental concepts, architecture, and evolution of Intelligent Transportation Systems (ITS).
- To familiarize students with the technologies used for data collection, communication, and traffic management in ITS.
- To provide insights into functional areas and user services offered by ITS for traffic, transit, and safety management.

- To evaluate global ITS practices, emphasizing implementation strategies in both developed and developing countries.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand and explain the concept, objectives, and benefits of Intelligent Transportation Systems.**	**BT 1**
CO 2	**Apply knowledge of data collection and communication technologies such as AVL, AVI, GIS, and telecommunications in ITS infrastructure..**	**BT 2**
CO 3	**Analyze and categorize the functional components of ITS, including ATMS, ATIS, AVCS, CVO, APTS, and ARTS.**	**BT 3**
CO 4	**Evaluate global ITS applications and propose suitable ITS strategies for transportation challenges in developing countries.**	**BT 4 & 5**

Detailed Syllabus:

Modules	**Topics**	**Course Contents**	**Hours**
I.	**Introduction and Objectives of ITS**	Definition and scope of ITS, Objectives and evolution of ITS, Historical development and trends, Benefits and challenges of ITS implementation.	**16**
II.	*ITS Technologies and Data Collection*	ITS data collection techniques – Inductive loop detectors, cameras, RFID, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GPS, and GIS applications; Role of video data collection and smart sensors. Introduction to telecommunications in ITS, Importance of communication technologies, Information management, Role of Traffic Management Centres (TMC).	**17**
III.	*ITS Functional Areas and User Services*	Functional components: Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS). User needs and services: Traffic and travel management, Public transportation, Electronic payment systems, Commercial vehicle operations, Emergency response, Advanced safety systems, and integrated information management.	**16**

IV	*Automated Systems and Global ITS Practices*	Automated Highway Systems (AHS), Concepts of platooning, Vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communication, Integration and future trends in ITS. Overview of ITS implementation in developed countries (USA, Japan, EU), ITS strategies and applications in developing countries, Case studies.	
		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)

Textbooks / Recommended Readings:

1. ***Sussman, J. M.*** *– Perspective on Intelligent Transportation Systems (ITS), Springer, 2005.*
    - *A foundational text offering a broad perspective on ITS development, deployment, and future directions.*
2. ***Washington, S. P., Wolf, D., and Baker, D. R.*** *– Intelligent Transportation Systems: Cases and Lessons Learned, Transportation Research Board, 2004.*
    - *Provides real-world ITS case studies and lessons from global implementations.*
3. ***Chakroborty, P. and Das, A.*** *– Principles of Transportation Engineering, PHI Learning Pvt. Ltd., Latest Edition.*
    - *Includes chapters on traffic management and intelligent systems with an Indian context.*
4. ***Kantowitz, B. H. and Waugh, J.*** *– ITS: Intelligent Transportation Systems Architecture, McGraw-Hill, 1996.*
    - *Covers ITS system architecture, design, and technical framework.*
5. ***Mannering, F. and Washburn, S.*** *– Principles of Highway Engineering and Traffic Analysis, Wiley, Latest Edition.*
    - *A good supplemental resource with updated content on traffic analysis relevant to ITS.*
6. ***McQueen, B. and McQueen, M.*** *– Intelligent Transportation Systems Architecture, Artech House, 1999.*
    - *Focuses on technical and architectural frameworks for ITS deployment.*
7. ***ITS India Reports and Publications*** *– Ministry of Road Transport and Highways (MoRTH), Government of India.*
    - *Offers insights on ITS adoption, policies, and projects in the Indian context.*

Subject Name: Sustainable and Green Construction (BSC) **Subject Code: MAT022C102**

L-T-P-C – 3-1-0-0 **Credit Units: 04** **Scheme of Evaluation: T**

Objective:

To provide students with a comprehensive understanding of sustainable development principles and their application in construction practices. The course aims to equip learners with knowledge of environmental systems, sustainable building materials, energy and water efficiency, green certifications, policy frameworks, and the ethical and economic aspects of sustainable construction.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Explain the principles of sustainable development and assess their relevance in the context of construction.**	**BT 1**
CO 2	**Analyze and apply sustainable materials, energy-efficient technologies, and water management strategies in construction projects.**	**BT 2**
CO 3	**Evaluate green building standards, certifications, and environmental policies relevant to sustainable construction practices.**	**BT 3**
CO 4	**Integrate ethical, economic, and project management strategies to promote sustainability in construction and infrastructure development.**	**BT 4 & 5**

Detailed Syllabus:

Modules	**Topics**	**Course Contents**	**Hours**
I.	**Introduction to sustainable Development, Environment Science and Ecology, Sustainable construction Material and Technology:**	Definition and principles of sustainable development, Historical context and evolution of sustainability, Global and local challenges related to sustainability. Fundamentals of ecology, Biodiversity and conservation, Climate change and its impacts, Environmental pollution and waste management. Green building materials and technologies, Life cycle assessment of materials,	**16**

		Resource efficiency and waste reduction in construction, Low-impact construction methods	
II.	**Energy Efficiency in Buildings, Water Management in Construction, Sustainable Site Planning**	Principles of energy-efficient design, Renewable energy integration in building design, Energy-efficient HVAC systems, Building energy modeling and simulation Sustainable water use in construction processes, Rainwater harvesting and greywater recycling, Water-efficient construction practices, Strategies for mitigating water pollution on construction sites Site selection and evaluation for sustainable construction, green space planning and landscaping, Sustainable stormwater management,	**17**
III.	**Sustainable Building Design, Construction and Demolition Waste Management, Building Certifications and Standards, Environmental Regulations and Policy**	Principles of green building design, Passive design strategies for energy efficiency, Daylighting and natural ventilation, Integration of sustainable technologies in design. Waste reduction and recycling in construction, Responsible demolition practices,Circular economy concepts in construction. LEED (Leadership in Energy and Environmental Design) certification, BREEAM (Building Research Establishment Environmental Assessment Method), Other regional and international green building certifications, Building codes and regulations for sustainable construction - Environmental impact assessments - Government policies promoting green construction	**16**
IV	**Economics of Sustainable Construction, Project Management for Sustainable**	Cost-benefit analysis for green building projects - Financial incentives for sustainable construction - Business models for green technologies in construction Sustainable project planning and execution - Stakeholder engagement and communication -	

	Construction, Ethics and Social Responsibility in Construction	Monitoring and evaluating sustainability performance, Ethical considerations in sustainable construction - Social impacts of green construction projects - Community engagement andstakeholder involvement	
		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)

Textbooks / Recommended Readings:

1. ***Charles J. Kibert – Sustainable Construction: Green Building Design and Delivery, Wiley, Latest Edition.***
2. ***Edward A. McBean and Anjali A. Lalani – Sustainability and Sustainable Development, CRC Press.***
3. ***Barbara A. Richardson – Sustainable Building Systems and Construction for Designers, Fairchild Books.***
4. ***Richard Heinberg & David Fridley – Our Renewable Future: Laying the Path for One Hundred Percent Clean Energy, Island Press.***
5. ***Mehta, P. Kumar, and Monteiro, Paulo J.M. – Concrete: Microstructure, Properties, and Materials, McGraw Hill Education.***
6. ***Gottfried, David – Greed to Green: How Cities, Businesses, and Homes Can Save the Planet, Gibbs Smith.***
7. ***Yudelson, Jerry – Green Building A to Z: Understanding the Language of Green Building, New Society Publishers.***
8. ***M. Asif & T. Muneer – Energy Supply, Its Demand and Security Issues, Elsevier.***

SEMESTER –VII

Subject Name: **Robotics and Automation**		Subject Code: MAT022C102 (BSC)
L-T-P-C – 2-0-0-0	Credit Units: 02	Scheme of Evaluation: T

Objective:

To introduce the fundamental concepts of robotics and automation with a focus on civil engineering applications, enabling students to understand, apply, and innovate automation technologies in construction, structural health monitoring, geotechnical operations, and disaster response.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand the foundational principles of robotics, automation, and their relevance in civil engineering applications.**	**BT 1**
CO 2	**Analyze the function and integration of sensors, actuators, and robotic systems in construction and infrastructure.**	**BT 2**
CO 3	**Apply knowledge of UAVs, automated systems, and AI tools in surveying, inspection, geotechnical analysis, and disaster response.**	**BT 3**
CO 4	**Evaluate ethical, legal, and collaborative aspects of human-robot interaction and automation in civil engineering projects.**	**BT 4 & 5**

Detailed Syllabus:

Modules	Topics	Course Contents	Hours
I.	**Introduction to Robotics and Automation, Fundamentals of Civil Engineering,**	**Introduction to Robotics and Automation**: Definition and basic principles of robotics and automation, Historical perspective and evolution, Applications in civil engineering **Fundamentals of Civil Engineering:** Overview of civil engineering disciplines	**16**

	Sensors and Actuators	(structural,geotechnical, transportation, etc.), Basic principles of construction and infrastructure development **Sensors and Actuators:** Types of sensors used in civil engineering applications, Actuators andtheir role in automation, Integration of sensors and actuators in robotic systems	
II.	**Robot Kinematics and Dynamics, Robotics in Construction, Automation in Structural Engineering**	**Robot Kinematics and Dynamics:** Basics of robot motion and manipulation, Forward andinverse kinematics, Dynamics of robot motion **Robotics in Construction:** Autonomous construction vehicles, Robotic construction equipment,Robotic assembly and fabrication in construction **Automation in Structural Engineering**: Automated inspection and maintenance of structures, Robotic construction of buildings and bridges, Structural health monitoring using automation	**17**
III.	**Unmanned Aerial Vehicles (UAVs) in Civil Engineering, Automation in Geotechnical Engineering, Human-Robot Collaboration**	**Unmanned Aerial Vehicles (UAVs) in Civil Engineering:** Aerial surveying and mapping, UAVs for site inspection and monitoring, Applications in geotechnical engineering and slope stability analysis **Automation in Geotechnical Engineering:** Automated soil sampling and testing, Autonomous drilling and excavation in geotechnical applications, Robotics in tunneling and underground construction **Human-Robot Collaboration:** Collaborative robots (cobots) in civil engineering, Safety considerations in human-robot interaction, Case studies of	**16**

		successful human-robot collaboration in construction	
IV	**Robotics in Disaster Response and Recovery, Machine Learning and Artificial Intelligence in Civil Engineering, Legal and Ethical Considerations**	**Robotics in Disaster Response and Recovery**: Use of robots in disaster-stricken areas, Search and rescue robotics, Automated infrastructure inspection after disasters **Machine Learning and Artificial Intelligence in Civil Engineering**: Introduction to machine learning and AI, Applications in predictive maintenance, AI-driven decision-making in civil engineering projects **Legal and Ethical Considerations**: Regulations and standards for robotics in civil engineering, Ethical considerations in the use of automation, Liability and safety standards	
			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)

Textbook:

1 Sabrie Soloman, Advanced Robotics, Khanna Book Publishing Co., 2023.

2 John J. Craig, Introduction to Robotics, Pearson Education Inc., Asia, 3rd Edition, 2005.

3 Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University

Press, 2006.

4 Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, 2019.

5 M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Book Publishing, 2023.

6 S. Mukherjee, Robotics Process Automation, Khanna Book Publishing, 2021.

Dr. Rajiv Chopra, Data Science with AI, ML, DL, Khanna Book Publishing, 2023