Regulations and Curriculum for

Master of Technology (M. Tech.)

in

Structural Engineering

REGULATIONS GOVERNING
THE DEGREE OF MASTER OF TECHNOLOGY (M.Tech.)

UNDER OUTCOME BASED EDUCATION (OBE)

AND

CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME

OF

NMAM INSTITUTE OF TECHNOLOGY, NITTE

(Effective from academic year 2022 -23)

(Deemed to be University under Section 3 of UGC Act, 1956)
(Placed under Category 'A' by MHRD, Govt. of India, Accredited with 'A+' Grade by NAAC)
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VISION

To build a humane society through excellence in the education and healthcare

MISSION

To develop
Nitte (Deemed to be University)
As a centre of excellence imparting quality education,
Generating competent, skilled manpower to face the scientific and social
challenges with a high degree of credibility, integrity,
ethical standards and social concern

NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Off-campus Centre, Nitte (Deemed to be University)

NITTE-574110, Karkala Taluk, Udupi District, Karnataka, India

Vision Statement

Pursuing Excellence, Empowering people, Partnering in Community Development

Mission Statement

To develop N.M.A.M. Institute of Technology, Nitte, as Centre of Excellence by imparting Quality Education to generate Competent, Skilled and Humane Manpower to face emerging Scientific, Technological, Managerial and Social Challenges with Credibility, Integrity, Ethics and Social Concern.

M. Tech. Regulations and Curriculum

Batch

2022 – 2024

With Scheme of Teaching & Examination

REGULATIONS: 2022
for
M. Tech. Programs
(Academic year 2022-23)

COMMON TO ALL
M.Tech. DEGREE PROGRAMS
CHOICE BASED CREDIT SYSTEM (CBCS)

Key Information

Program Title	Master of Technology, abbreviated as M.Tech.
Short description	Two-year, four semester Choice Based Credit System (CBCS) type of Postgraduate Engineering Degree Program taught in English
Program Code	M.Tech. (Structural Engineering)
Revision version	2022.01 These regulations may be modified from time to time as mandated by the policies of the University. Revisions are to be recommended by the Board of Studies for **…** and approved by the Academic Council.
Effective from	12-09-2022
Approvals	Approved by the Board of Management and Academic Council of NITTE (Deemed to be University), vide notification no….
Program offered at	NMAM Institute of Technology, Nitte Off Campus centre, Nitte (Deemed to be University)
Grievance and dispute resolution	All disputes arising from this set of regulations shall be addressed to the Board of Management. The decision of the Board of Management is final and binding on all parties concerned. Further, any legal disputes arising out of this set of regulations shall be limited to jurisdiction of Courts of Mangalore only

Contents

1. INTRODUCTION:

1.1 The general regulations are common to all Degree of Master of Technology Program under Outcome Based Education (OBE) and Choice Based Credit System (CBCS) conducted by Nitte (Deemed to be University), at the NMAM Institute of Technology, Nitte off Campus Centre and shall be called "Nitte(DU) Regulations for M.Tech.- 2022".

1.2 The provisions contained in this set of regulations govern the policies and procedures on the Registration of students, imparting Instructions of course, conducting of the examination and evaluation and certification of students' performance and all amendments there to leading to the said degree program(s)

1.3 This set of Regulations, on approval by the Academic Council and Governing Council, shall supersede all the corresponding earlier sets of regulations of the M.Tech. Degree program (of Nitte (DU)) along with all the amendments thereto, and shall be binding on all students undergoing M.Tech. Degree Program (s) (Choice Based Credit System) conducted at the NMAMIT, Nitte with effect from its date of approval and is applicable for students admitted to 1st year after September 2022. This set of regulations may evolve and get modified or changed through appropriate approvals from the Academic Council / Governing Council from time to time, and shall be binding on all stake holders, (the Students, Faculty, Staff of Departments of NMAMIT, Nitte). The decision of the Academic Council/ Governing Council shall be final and binding.

1.4 In order to guarantee fairness and justice to the parties concerned in view of the periodic evolutionary refinements, any specific issues or matters of concern shall be addressed separately, by the appropriate authorities, as and when found necessary.

1.5 The Academic Council may consider any issues or matters of Concern relating to any or all the academic activities of the NMAMIT courses for appropriate action, irrespective of whether a reference is made here in this set of Regulations or otherwise.

1.6 The course shall be called **Master of Technology** program abbreviated as M.Tech. (subject of specialization) – Choice Based Credit System.

2. DEFINITIONS OF KEYWORDS:

The following are the definitions/descriptions that have been followed for the different terms used in the Regulations of M.Tech. Programs:

2.1 **Program:** Is an educational program in a particular stream/branch of Engineering/branch of specialization leading to award of Degree. It involves events/activities, comprising of lectures/ tutorials/ laboratory work/ field work, outreach activities/ project work/ vocational training/ viva/ seminars/ Internship/ assignments/ presentations/ self-study etc., or a combination of some of these.

2.2 **Branch:** Means Specialization or discipline of M. Tech Degree Program, like Electrical Vehicle Technology, Structural Engineering, Machine Design, etc.

2.3 **Semester:** Refers to one of the two sessions of an academic year (vide: serial number 4), each session being of sixteen weeks duration (with working days greater than or equal to 90). The odd semester may be scheduled from August/September and even semester from February/March of the year.

2.4 **Academic Year:** Refers to the sessions of two consecutive semesters (odd followed by an even) including periods of vacation.

2.5 **Course:** Refers to usually referred to as 'subjects' and is a component of a program. All Courses need not carry the same credit weightage. The Courses should define learning objectives and learning outcomes. A Course may be designed to comprise lectures/ tutorials/ laboratory work/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars/ term papers/ assignments/ presentations/ self-study etc.. or a combination of some of these.

2.6 **Credit:** Refers to a unit by which the Course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of lecture or two hours of laboratory/ practical Courses/ tutorials/ fieldwork per week etc.

2.7 **Audit Courses:** Means Knowledge/ Skill enhancing Courses without the benefit of credit for a Course.

2.8 **Choice Based Credit System (CBCS):** Refers to customizing the Course work, through Core, Elective and soft skill Courses, to provide necessary support for the students to achieve their goals.

2.9 **Course Registration:** Refers to formal registration for the Courses of a semester (Credits) by every student under the supervision of a Faculty Advisor (also called Mentor, Counsellor etc.,) in each Semester for the Institution to maintain proper record.

2.10 Course Evaluation: Means Continuous Internal Evaluation (CIE) and Semester End Examinations (SEE) to constitute the major evaluations prescribed for each Course. CIE and SEE to carry 50 % and 50 % respectively, to enable each Course to be evaluated for 100 marks, irrespective of its Credits.

2.11 Continuous Internal Evaluation (CIE): Refers to evaluation of students' achievement in the learning process. CIE shall be by the Course Instructor and includes tests, homework, problem solving, group discussion, quiz, mini-project and seminar throughout the Semester, with weightage for the different components being fixed at the University level.

2.12 Semester End Examinations (SEE): Refers to examination conducted at the University level covering the entire Course Syllabus. For this purpose, Syllabi to be modularized and SEE questions to be set from each module, with a choice confined to the concerned module only. SEE is also termed as university examination.

2.13 Make Up Examination: Refers to examination conducted for the candidates who has a CIE>=35 marks and may have missed to attend the SEE covering the entire course syllabus. The standard of Make Up Examination is same as that of the SEE.

2.14 Supplementary Examination: Refers to the examination conducted to assist slow learners and/or failed students through make up courses for a duration of 8 weeks. This comprises of both the CIE & SEE and will be conducted after the completion of First year M.Tech. even semester.

2.15 Credit Based System (CBS): Refers to quantification of Course work, after a student completes teaching – learning process, followed by passing in both CIE and SEE. Under CBS, the requirement for awarding Degree is prescribed in terms of total number of credits to be earned by the students.

2.16 Credit Representation: Refers to Credit Values for different academic activities considered, as per the Table.1. Credits for seminar, project phases, project viva–voce and internship shall be as specified in the Scheme of Teaching and Examination.

Table 1: Credit Values				
Theory/Lectures (L) (hours/week/Semester)	**Tutorials (T) (hours/week/ Semester)**	**Laboratory /Practical (P) (hours/week/ Semester)**	**Credits (L: T:P)**	**Total Credits**
4	0	0	4:0:0	4
3	0	0	3:0:0	3
2	2	0	2:1:0	3
2	0	2	2:0:1	3
2	2	2	2:1:1	4
0	0	2	0:0:1	1
NOTE: Activities like, practical training, study tour and participation in Guest lectures not to carry any credits.				

2.17 Letter Grade: It is an index of the performance of students in a said Course. Grades are denoted by letters O, A+, A, B+, B, C and F.

2.18 Grading: Grade refers to qualitative measure of achievement of a student in each Course, based on the percentage of marks secured in (CIE+SEE). Grading is done by Absolute Grading. The rubric attached to letter grades are as follows:

Letter Grade	O	A+	A	B+	B	C	F
Academic Level	Outstanding	Excellent	Very Good	Good	Above Average	Average	Fail

2.19 Grade Point (GP): Refers to a numerical weightage allotted to each letter grade on a 10-point scale as under.

Letter Grade and corresponding Grade Points on a typical 10 – Point scale							
Letter Grade	O	A+	A	B+	B	C	F
Grade Point	10	09	08	07	06	05	00

2.20 Passing Standards: Refers to passing a Course only when getting GP greater than or equal to 05 (as per serial number 2.20).

2.21 Credit Point: Is the product of grade point (GP) and number of credits for a Course i.e., Credit points CrP = GP × Credits for the Course.

2.22 Semester Grade Point Average (SGPA): Refers to a measure of academic performance of student/s in a semester. It is the ratio of total credit points secured by a student in various Courses of a semester and the total Course credits taken during that semester.

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

2.24 Grade Card: Refers to a certificate showing the grades earned by a student. A grade card shall be issued to all the registered students after every semester. The grade card will display the program details (Course code, title, number of credits, grades secured) along with SGPA of that semester and CGPA earned till that semester.

2.25 University: Nitte (Deemed to be University), Mangalore. NMAM Institute of Technology is an off-campus centre of Nitte (DU) and located at Nitte.

3. CLAUSE	
CLAUSE	**PARTICULARS**
22NMT1.0	**DURATION AND CREDITS OF THE PROGRAM OF STUDY** There shall be one category of program: Full-time Program (FT) **Full-time Program:** The Program shall extend over a period of four semesters (2 years). First Semester: i) 16 weeks – Class Work according to the scheme. ii) 4 weeks – Revision holidays and examinations iii) 2 weeks – Vacation **Second Semester:** i) 16 weeks – Class Work according to the scheme ii) 4 weeks – Revision holidays and examinations. **Summer Semester/Vacation** i) 4 weeks — Class work, Examination & Display of Grades **Third Semester: 20 weeks** i) 8 weeks — Industrial Training/Mini Project ii) 12 weeks — Project Part-I

<table>
<tr><td></td><td>— Industrial Training/Mini Project evaluation, Seminar on Special Topic Evaluation & Project Part-I Evaluation
Fourth Semester: 24 weeks
i) 22 weeks — Project Part-II
ii) 2 weeks – Submission, viva -voce
Prescribed Number of Credits for the Program: 80
The number of credits to be completed for the award of Degree shall be 80.</td></tr>
<tr><td>22NMT1.1</td><td>M.Tech Degree Programs are offered in the following specialization and the respective program hosting departments are listed below:
<table>
<tr><th><u>Program</u></th><th><u>Department</u></th></tr>
<tr><td>i) Computer Science & Engineering</td><td>Computer Science & Engineering</td></tr>
<tr><td>ii) Constructional Technology</td><td>Civil Engineering</td></tr>
<tr><td>iii) Structural Engineering</td><td>Civil Engineering</td></tr>
<tr><td>iv) VLSI Design & Embedded Systems</td><td>Electronics and Communication Engineering</td></tr>
<tr><td>v) Machine Design</td><td>Mechanical Engineering</td></tr>
<tr><td>vi) Energy Systems Engineering</td><td>Mechanical Engineering</td></tr>
<tr><td>vii) Cyber security</td><td>Computer Science Engineering</td></tr>
<tr><td>viii) Electric Vehicle Technology</td><td>Electrical and Electronics Engineering</td></tr>
</table>
The provisions of these Regulations shall be applicable to any new specialization that may be introduced from time to time and appended to the above list.</td></tr>
<tr><td>22NMT1.2</td><td>Maximum Duration for Program Completion:
A full-time candidate shall be allowed a maximum duration of 4 years from the I semester of admission to become eligible for the award of master’s degree, failing which he/she may discontinue of register once again as a fresh candidate to I semester of the program.</td></tr>
<tr><td>22NMT2.0</td><td>ELIGIBILITY FOR ADMISSION
(As per the Government orders issued from time to time):
Admission to I year/ I semester Master of Technology Program shall be open to all the candidates who have passed B.E./ B. Tech. Examinations (in relevant field) or any other recognized University/ Institution. AMIE in respective</td></tr>
</table>

	branches shall be equivalent to B.E./ B. Tech. Programs for admission to M.Tech. The decision of the equivalence committee shall be the final in establishing the eligibility of candidates for a particular Program. For the foreign Degrees, Equivalence certificate from the Association of Indian Universities shall be a must.
22NMT2.1	Admission to M.Tech. Program shall be open to the candidates who have passed the prescribed qualifying examination with not less than 50% of the marks in the aggregate of all the years of the Degree examination. Rounding off percentage secured in qualifying examination is not permissible.
22NMT2.2	**For admissions under GATE/ NUCAT qualification** The candidates should be GATE qualified or should have appeared for the NUCAT Entrance Examination conducted by Nitte (Deemed to be University) [Nitte (DU)]
22NMT2.3	**For admissions under Sponsored Quota:** The candidates should be GATE qualified or should have appeared for the NUCAT Entrance Examination conducted by Nitte (DU)
22NMT2.4	The candidates, who are qualified in the GATE Examination for the appropriate branch of engineering, shall be given priority. They are exempted from taking NUCAT Entrance Examination. In case a GATE qualified Candidate appears for entrance examination and become qualified to claim a seat under entrance examination quota, he/she will be considered in the order of merit along with other candidates appeared for the entrance examination.
22NMT2.5	If sufficient number of GATE qualified candidates are not available, the remaining vacant seats shall be filled from amongst the candidates appeared for NUCAT Entrance Examination in the order of merit.
22NMT2.6	Engineering graduates other than the Karnataka candidates shall get their Eligibility verified from Nitte (DU) to seek admission to M.Tech. Program at NMAMIT, Nitte
22NMT2.7	**Admission to vacant seats:** Seats remaining vacant (unfilled), after the completion of admission process through GATE/NUCAT Entrance Exam, the remaining seats shall be filled by Candidates based on merit in the entrance test conducted at the Institution level. An admission Committee, consisting of

<table>
<tr><td></td><td>the Principal, Head of the concerned Department and the subject experts, shall oversee admissions.</td></tr>
<tr><td>22NMT3.0</td><td>REGISTRATION:
Every student after consulting his Faculty-Advisor in parent department is required to register for the approved courses with the Departmental Post Graduate Committee (DPGC) of Parent Department at the commencement of each Semester on the days fixed for such registration and notified in the academic calendar.</td></tr>
<tr><td>22NMT3.1</td><td>Lower and Upper Limits for Course Credits Registered in a Semester.
Course Credit Assignment:
All courses comprise of specific Lecture/ Tutorial/ Practical (L-T-P) schedule. The course credits are fixed based on the following norms.
Lecture/Tutorials/ Practical:
(i) a 1-hour Lecture per week is assigned 1.0 Credit.
(ii) a 2-hour Tutorial session per week is assigned 1.0 Credit.
(iii) a 2-hour Lab. session per week is assigned 1.0 credits
For example, a theory course with L-T-P schedule of 3-2-0 hours will be assigned 4.0 credits.
A laboratory practical course with L-T-P schedule of 0-0-2 hours will be assigned 1.0 credit.
Calculation of Contact Hours / Week – A Typical Example
<table>
<tr><th colspan="5">Typical Academic Load (I & II Semester)</th></tr>
<tr><th>No. of Courses</th><th>LTP</th><th>Credits Per course</th><th>Total Credits</th><th>Contact Hours per Week</th></tr>
<tr><td>2 Lecture Courses</td><td>4-0-0</td><td>04</td><td>08</td><td>08</td></tr>
<tr><td>2 Lab Courses</td><td>0-0-2</td><td>01</td><td>02</td><td>04</td></tr>
<tr><td>1 Research based Course</td><td>0-0-4</td><td>02</td><td>02</td><td>04</td></tr>
<tr><td>3 Elective Courses</td><td>3-0-0</td><td>03</td><td>09</td><td>09</td></tr>
<tr><td>1 Audit Course</td><td>2-0-0</td><td>0</td><td>0</td><td>02</td></tr>
<tr><td>Total: 9 Courses</td><td></td><td></td><td>21</td><td>27</td></tr>
</table>
A student must register, as advised by Faculty Advisor, between a minimum of 16 credits and up to a Maximum of 28 credits. However, the minimum/</td></tr>
</table>

	maximum Credit limit can be relaxed by the Dean (Academic) on the recommendations of the DPGC, only under extremely exceptional circumstances.
22NMT3.2	**Mandatory Pre-Registration for higher semester:** In order to facilitate proper planning of the academic activities of the Semester, it is necessary for the students to declare their intention to register for courses of higher semesters (2nd and above) at least two weeks before the end of the current semester choosing the courses offered by each department in the next higher semester which is displayed on the Departmental Notice Board at least 4 weeks prior to the last working day of the semester. Students who fail to register on or before the specified date will have to pay a late fee. Registration in absentia is allowed only in exceptional cases with the permission of the Dean (Academic). Registration to a higher semester is allowed only if the student fulfills the following conditions- i) Satisfied all the academic requirements to continue with the program of studies without termination ii) Cleared all institute, hostel and library dues and fines, if any, of the previous semester. iii) Paid all required advance payments of the Institute and the hostel for the current semester. Has not been debarred from registering on any specific grounds by the Institute.
22NMT3.3	**Course Pre-Requisites:** In order for a student to register for some course(s), it may be required either to have completed satisfactorily or to have prior earned credits in some specified course(s). In such instances, the DPGC shall specify clearly, any such course pre-requisites, as part of the curriculum.
22NMT3.4	Students who do not register before the dead line day of registration may be permitted LATE Registration up to the notified day in academic calendar on payment of late fee.
22NMT3.5	REGISTRATION in ABSENTIA will be allowed only in exceptional cases on the recommendation of DPGC through the authorized representative of the student.

22NMT3.6	Medium of Instruction/Evaluation/etc. shall be English.
22NMT4.0	**COURSES:** The curriculum of the Program shall be any combination of following type of courses: i) **Professional Core Courses (PCC)** - relevant to the chosen specialization/ branch [May be split into Hard (no choice) and Soft (with choice), if required]. The core course is to be compulsorily studied by a student and is mandatory to complete the requirements of a program in a said discipline of study. ii) **Professional Electives Courses (PEC)** - relevant to the chosen specialization/ branch: these are the courses, which can be chosen from the pool of papers. It shall be supportive to the discipline/ providing extended scope/enabling an exposure to some other discipline / domain / nurturing student skills. iii) **Research Experience** Through Practice-I and Research Experience Through Practice-II iv) **Project Work** v) **Seminar** vi) **Audit Courses (AC):** a) The Audit course can be any credit course offered by the program to which the candidate is admitted (other than the courses considered for completing the prescribed program credits) or other programs offered in the institution, where the student is studying. b) The students are required to register for one audit course during I and II semesters. Students who have registered to audit the courses, considered on par with students registered to the same course for credit, must satisfy attendance and CIE requirements. However, they need not have to appear for SEE. c) Registration for any audit course shall be completed at the beginning of I and II semesters. The Department should intimate the Controller of Examination about the registration at the beginning of the semester and obtain a formal approval for inclusion of the audit course/s in the Grade card issued to the students

vii) **Internship/ Mini Project:** Preferably at an industry/ R&D organization/IT company/ Government organization of significant repute or at the Research Centre of parent Institution for a specified period mentioned in Scheme of Teaching and Examination.

22NMT4.1

Program Structure:

The number of credits to be registered in a semester is between 16 and 28

Minimum Credit Requirement for the M.Tech. Degree is 80.

The total course package for an M.Tech. Degree Program will typically consist of the following components.

Course type	Range %	Suggested Credits
i) Program Core Courses	20 - 25	20
ii) Program Elective Courses	18 - 20	15
iii) Elective Courses (MOOCS)	4	03
iv) Industrial Internship/Research Internship/Mini Project	10	08
v) Project	35	28
vi) Seminar	2.5	02
vii) Research Experience Through Practice	5	04
viii)Audit courses (two courses)	-	-
Total credits		80

The Department Post Graduate Committee (DPGC) will discuss and recommend the exact credits offered for the program for the above components, the semester-wise distribution among them, as well as the syllabi of all postgraduate courses offered by the department from time to time before sending the same to the Board of Studies (BOS).

The BOS will consider the proposals from the departments and make recommendations to the Academic Council for consideration and approval.

Mandatory Learning Courses:

These are courses that must be completed by the student at appropriate time as suggested by the Faculty Adviser or the DPGC. Courses that come under the category are as following:

Industrial Training:

This is a 08-credit course. A full-time student will complete the Industrial Training (or a Mini Project) at appropriate time stipulated by DPGC and register for it in the following Semester and shall also submit a bound copy of training report certified by the authority of Training Organization. The duration and the details, including the assessment scheme, shall be decided by the faculty advisor, with approval from DPGC.

Seminar:

This also carries 2-credits to be completed at appropriate time stipulated by DPGC. The student will make presentations on topics of academic interest, as suggested by DPGC.

Research Experience through Practice-I and Research Experience through Practice-II:

- Research Experience through Practice-I and II are 2-credit courses in the first and second semesters respectively.
- The student will work under a faculty supervisor approved by the DPGC and submits a research proposal at the end of the first semester which is evaluated jointly by the faculty supervisor and a co-examiner.
- Students shall be offered inputs like how to conduct a literature survey, how to identify a research problem, how to write a research paper, research report, research proposal, and systematic way of conducting research etc.
- Department specific/PG Program specific skill sets required for carrying out a research work may be offered to the students like software tools for system/device simulation and analysis, software/ hardware tools for signal acquisition, data processing, control simulation, Testing/measuring equipment used in research and Testing/measuring procedure.
- At the end of Research Experience through Practice-I in the first semester, M. Tech. students should be able to identify a research problem, with clear objectives and methodologies backed by extensive literature review.
- Two internal examiners will evaluate the Research Experience through Practice-I out of which one will be the guide and the other examiner will a faculty member who is having expertise in the research area of the student

	being evaluated. The research proposal report and the research proposal presentation are evaluated for 100 marks in the first semester. • The student will work on the proposed research in the second semester and submit a research paper at the end of the second semester which is evaluated jointly by the faculty supervisor and a co-examiner. • In the second semester, the students are expected to carry out Mathematical modelling / Design calculations / computer simulations / Preliminary experimentation / testing of the research problems identified during Research Experience through Practice-I carried out in the first semester. At the end of the second semester, students are expected to write a full research paper based on the Mathematical modelling/ Design calculations/computer simulations/Preliminary experimentation/testing carried out during second semester. The research paper submitted by the student and the presentation of the research work carried out is evaluated for 100 marks in the second semester.
22NMT5.0	**INTERNSHIP/MINI PROJECT:** The student shall undergo Internship/Mini Project as per the Scheme of Teaching and Examination. 1. The internship can be carried out in any industry/R&D Organization/Research Institute/Institute of national repute/R&D Centre of Parent Institute. 2. The Department/college shall nominate a faculty to facilitate, guide and supervise students under internship. 3. The students shall report the progress of the internship/Mini Project to the internal guide in regular intervals and seek his/her advice. 4. The Internship shall be completed during the period specified in Scheme of Teaching and Examination. 5. After completion of Internship/mini project, students shall submit a report to the Head of the Department with the approval of both internal and external guides and with the approval of internal guide if the Internship/Mini-Project is carried out in the Institute.

	6. The Internship/Mini Project will be evaluated jointly by two internal examiners appointed by the Head of the Department/Controller of Examination. 7. The Internship/Mini Project report and the presentation by the student will be evaluated for 50 marks each immediately after completion of the Internship/Mini Project. The students are permitted to carry out the internship anywhere in India or Abroad. The Institution will not provide any kind of Financial Assistance to any student for Internship/Mini Project and for the conduct of Viva-Voce on internship.
22NMT5.1	**Failing to undergo Internship/Mini Project:** Securing a pass grade in Internship/Mini Project is mandatory as a partial requirement for the award of Degree. Internship/Mini Project Securing a pass grade in Internship/Mini Project is mandatory. If any student fails to undergo/complete the Internship/Mini Project, he/she shall be considered as fail in that Course.
22NMT6.0	**SEMINAR:** Securing a pass grade in Seminar is mandatory as a partial requirement for the award of Degree. i) Each candidate shall deliver seminar as per the Scheme of Teaching and Examination on the topics chosen from the relevant fields for about 30 minutes. The Head of the Department shall make arrangements for conducting seminars through concerned faculty members of the department. The Panel of Examiners constituted for the purpose by the Head of the Department shall award the CIE marks for the seminar.
22NMT7.0	**PROJECT WORK:** Securing a pass grade in Project Work is mandatory as a partial requirement for the award of Degree. Project work shall be on individual basis.

	Project Part-I and Part-II: **Project Part-I: (In third Semester)** The duration of the Project Part-I is of 12 weeks as notified in the academic calendar. The evaluation of the Project Part-I will be done during the end of third semester. Each department will prepare the Panel of Examiners in advance and also prepare the Project Part-I evaluation schedule indicating the names of the students, their USN, Title of the Project, Name of the Examiners, and time and Venue of the evaluation which will be submitted to the Controller of Examination Office in advance. Project Part-I evaluation will be done by two internal Examiners, one of them will be the Guide and other is preferably one of the experts in the area of PG Project being evaluated. The mark distribution of Project Phase-I evaluation is: 100 marks for report and 100 marks for presentation jointly awarded by the both the examiners. **Project Part-II: (In the fourth Semester)** The total duration of Project Part-II is of 22 weeks as notified in the academic calendar. There will be two Continuous Internal Evaluation of Project Part-II in fourth semester followed by Semester End Evaluation of the Project Phase-II, namely, Project Progress Evaluation-I (PPE-I), Project Progress Evaluation -II(PPE-II) and SEE. The same Panel of Examiners which was formed during Project Part-I evaluation is to be continued for the Project Progress Evaluation in the fourth semester. PPE-I and PPE-II will be scheduled as per the academic calendar and will be evaluated for 100 marks each (50 marks for report and 50 marks for presentation jointly conducted by the two internal examiners). Each department will prepare the Panel of Examiners in advance and also prepare the Project Part-II Project Progress Evaluation Schedule indicating the names of the students, their USN, Title of the Project, Name of the Examiners, and time and Venue of the evaluation as per the format which will be submitted to the Controller of Examination Office in advance.

	For the Off-Campus projects, the Internal Guide should visit the organization in which the M.Tech Student is carrying out his Project at least once during the project term. The candidate shall submit a soft copy of the dissertation work to the Institute. The soft copy of the dissertation should contain the entire Dissertation in monolithic form as a PDF file (not separate chapters). The Guide, after checking the report for completeness shall check the report for Plagiarism content. The allowable plagiarism index is less than or equal to 25%. If the check indicates a plagiarism index greater than 25%, the guide should advice the student to resubmit the dissertation after modifying the report. The report has to be once again checked for the plagiarism content and the signed hard copy of the Plagiarism Report along with the two hard copies of the dissertation is to be submitted to the Head of the Institution through the Head of the Department. The dissertation will be evaluated by two examiners, one of the examiners shall be the Guide of the candidate and the other examiner shall be an external expert in the area of the dissertation being evaluated. The guide shall submit panel of two approved external examiners to the office of the Controller of Examination through the head of the Department. The Controller of Examination will randomly select one of the external examiners and invites him/her formally for the evaluation of the dissertation and Viva-Voce examination giving sufficient time for the external examiner for reading the dissertation.
22NMT7.1	The dissertation will be evaluated by two examiners, one of the examiners shall be the guide of the candidate and the other examiner shall be preferably an external expert in the area of the dissertation being evaluated. The evaluation of the dissertation shall be made independently by each examiner.
22NMT7.2	Examiners shall evaluate the dissertation normally within a period of not more than two weeks from the date of receipt of dissertation through email.
22NMT7.3	The examiners shall independently submit the marks for the dissertation during the viva-voce examination date
22NMT7.4	Sum of the marks awarded by the two examiners shall be the final evaluation marks for the Dissertation.

22NMT7.5	(a) Viva-voce examination of the candidate shall be conducted, if the dissertation work and the reports are accepted by the external examiner. (b) If the external examiner finds that the dissertation work is not up to the expected standard and the minimum passing marks cannot be awarded, the dissertation shall not be accepted for SEE. (c) If the dissertation is rejected during the Project Part II, then the Second Examiner (external) will be appointed by the COE against whom the candidate has to re-present the same dissertation. The decision of the Second Examiner (external) will be final. If the second examiner (external) accepts the dissertation, then the viva-voce examination of the candidate shall be conducted as per the norms. If the second examiner (external) rejects the dissertation, then the student has to take an extension for a minimum period of 3 months and re-work on the project. After the completion of the extension period, viva-voce examination of the candidate shall be conducted as per the norms, if the dissertation work is accepted by the external examiner.
22NMT7.6	The candidate, whose dissertation is rejected, can rework on the same topic or choose another topic of dissertation under the same Guide or new Guide if necessary. In such an event, the report shall be submitted within four years from the date of admission to the Program.
22NMT7.7	Viva-voce examination of the candidate shall be conducted jointly by the external examiner and internal examiner/ guide at a mutually convenient date.
22NMT7.8	The relative weightages for the evaluation of dissertation and the performance at the viva-voce shall be as per the scheme of teaching and examination.
22NMT7.9	The marks awarded by both the Examiners at the viva-voce Examination shall be sent jointly to the office of Controller of Examination immediately after the examination.
22NMT7.10	Examination fee as fixed from time to time by the Institute for evaluation of dissertation report and conduct of viva-voce shall be remitted to the Institute as per the instructions of Dean-Academics, from time to time.
22NMT7.11	The candidates who fail to submit the dissertation work within the stipulated time have to apply for the extension of the Project duration through the Guide

	and the head of the department to the Office of the Controller of Examination. Such candidate is not eligible to be considered for the award of rank.
22NMT8.0	**ATTENDANCE REQUIREMENT:** 1. Each semester is considered as a unit and the candidate has to put in a minimum attendance of 85% in each subject with a provision of condoning 10% of the attendance by Principal for reasons such as medical grounds, participation in University level sports, cultural activities, seminars, workshops and paper presentation etc. 2. The basis for the calculation of the attendance shall be the period of term prescribed by the institution in its calendar of events. For the first semester students, the same is reckoned from the date of admission to the course 3. The students shall be informed about their attendance position in the first week of every month by the College so that the students shall be cautioned to make up the shortage. 4. The head of the department shall notify regularly, the list of such candidates who fall short of attendance. The list of the candidates falling short of attendance shall be sent to the Principal with a copy to Controller of Examinations. 5. A candidate having shortage of attendance (<75%) in any course(s) registered shall not be allowed to appear for SEE of such course(s). Such students will be awarded 'N' grade in these courses. 6. He/she shall have to repeat those course(s) with 'N' grade and shall re-register for the same course(s) core or elective, as the case may be when the particular course is offered next either in a main (odd/even) or summer semester. 7. If a candidate, for any reason, discontinues the course in the middle he/she may be permitted to register to continue the course along with subsequent batch, subject to the condition that he/she shall complete the class work, lab work and seminar including the submission of dissertation within maximum stipulated period. Such candidate is not eligible to be considered for the award of rank.

22NMT9.0	**ADD/ DROP/ AUDIT OPTIONS:** 1. ADD-option: A student has the option to ADD courses for registration till the date specified for late registration. 2. DROP-option: A student has the option to DROP courses from registration until one week after the mid-semester examination. AUDIT-option: A student can register for auditing a course, or a course can even be converted from credit to audit or from audit to credit, with the consent of faculty advisor and course instructor until one week after the mid-semester exam. However, CORE courses shall not be made available for audit. It is not mandatory for the student to go through the regular process of evaluation in an audit course. However, the student has to keep the minimum attendance requirement, as stipulated by the corresponding DPGC for getting the 'U' grade awarded in a course, failing which that course will not be listed in the Grade Card.
22NMT10.0	**ABSENCE DURING THE SEMESTER:** **Leave of Absence** (a) If the period of leave is more than two days and less than three weeks, prior application for leave shall have to be submitted to the Head of the Department concerned, with the recommendation of the Faculty-Advisor stating fully the reasons for the leave request along with supporting documents. It will be the responsibility of the student to intimate the course instructors, Head of the Department and also Chief Warden of the hostel, regarding his absence before availing leave.
22NMT10.1	**Absence during Mid-Semester Examinations:** A student who has been absent from a Mid-Semester Examination (MSE) due to illness and other contingencies may give a request for additional MSE within two working days of such absence to the office of the respective Head of the Department (HOD) with necessary supporting documents and certification from authorized personnel. The HOD may consider such requests depending on the merits of the case, may permit the additional Mid-Semester Examination for the concerned student.

22NMT10.2	**Absence during Semester End Examination:** In case of absence for a Semester End Examination, on medical grounds or other special circumstances the student can apply for 'I' grade in that course with necessary supporting documents and certifications by authorized personnel to the Controller of Examination through Chairman of The Department. The Controller of Examination may consider the request depending on the merits of the case and permit the make-up Semester End Examination for the concerned student. The student may subsequently complete all course requirements within the date stipulated by DPGC (which may be extended till first week of next semester under special circumstances) and 'I' grade will then be converted to an appropriate letter grade. If such an application for the 'I' grade is not made by the student, then a letter grade will be awarded based on his in-semester performance.
22NMT11.0	**WITHDRAWAL FROM THE PROGRAM:** **Temporary Withdrawal:** A student who has been admitted to a Post Graduate Degree program of the College may be permitted to withdraw temporarily, for a period of one semester or more on the grounds of prolonged illness or grave calamity in the family etc. The student should abide by the applicable rules and regulations of the college/University at the time of Temporary Withdrawal.
22NMT11.1	**Permanent Withdrawal:** Any student who withdraws admission before the closing date of admission for the Academic Session is eligible for the refund of the deposits only. Fees once paid will not be refunded on any account. Once the admission for the year is closed, the following conditions govern withdrawal of admissions: a) A student who wants to leave the College for good, will be permitted to do so (and can take Transfer Certificate from the College, if needed), only after remitting the Tuition fees as applicable for all the remaining semesters and clearing all other dues, if any. b) Those students who have received any scholarship, stipend or other forms of assistance from the College shall repay all such amounts in addition to those mentioned in (a) above.

	The decision of the Principal of the Institute regarding withdrawal of a student is final and binding.
22NMT12.0	**EVALUATION SYSTEM:** **Continuous Internal Evaluation (CIE) and Semester End Evaluation (SEE)**
22NMT12.1	For all the theory and laboratory courses, the CIE marks shall be 50. For Research Experience through Practice-I, Research Experience through Practice-II, seminar, Industrial Training/Mini Project, the CIE marks shall be 100. For Project Phase-I, the CIE Marks shall be 200 For Project Phase-II, the CIE Marks shall be 200 and for SEE 200
22NMT12.2	CIE Marks for courses shall be based on a) Tests MSE-I and MSE-II (for 30 Marks): MSE in a theory course, for 30 marks, shall be based on two tests covering the entire syllabus. Assignments, Quizzes, Simulations, Experimentations, Mini project, oral examinations, field work etc., (for 20 Marks) conducted in respective courses.
22NMT12.3	a) An additional MSE may be conducted for those students absent for valid reasons/ with prior permission. b) For those students who could not score minimum required CIE marks (25 marks), an additional MSE may be conducted, however the maximum CIE marks shall be restricted to 25 out of 50.
22NMT12.4	The candidates shall write the Tests in Blue Book/s. The Blue book/s and other documents relating to award of CIE marks shall be preserved by the Head of the Department for at least six months after the announcement of University results and made available for verification at the directions of the Controller of Examination.
22NMT12.5	Every page of the CIE marks list shall bear the signatures of the concerned Teacher and Head of the Department.
22NMT12.6	The CIE marks list shall be displayed on the Notice Board and corrections, if any, shall be incorporated before submitting to the office of the Controller of Examination (COE).
22NMT12.7	The CIE marks shall be sent to the office of the COE well in advance before the commencement of Semester End Examinations. No corrections of the CIE

	marks shall be entertained after the submission of marks list to the Office of the COE.
22NMT12.8	Candidates obtaining less than 50% of the CIE marks in any course (Theory /Laboratory/ Seminar/ Internship/ Project) shall not be eligible to appear for the Semester end examination in that course/s. In such cases, the Head of the Department shall arrange for the improvement of CIE marks in the course/ Laboratory when offered in the subsequent semester subject to the maximum duration allowed for completion of a M.Tech. program.
22NMT12.9	**Semester End Evaluation:** There shall be a Semester End Examination at the end of each semester.
22NMT12.10	There shall be double valuation of theory papers. The theory Answer booklets shall be valued independently by two examiners appointed by the Controller of Examination.
22NMT12.11	If the difference between the marks awarded by the two examiners is not more than 15 per cent of the maximum marks, the marks awarded to the candidate shall be the average of two evaluations.
22NMT12.12	If the difference between the marks awarded by the two examiners is more than 15 per cent of the maximum marks, the answer booklet shall be evaluated by a third Examiner appointed by the Controller of Examination. The average of the marks of nearest two valuations shall be considered as the marks secured by the candidate. In case, if one of the three marks falls exactly midway between the other two, then the highest two marks shall be taken for averaging.
22NMT12.13	**Summer Semester:** Summer semester is primarily to assist weak and/or students having N/F grade in courses, for a duration of 4 weeks after the completion of regular even SEE. The institute may also offer Add-on/ Audit Courses during this semester.
22NMT12.14	Each candidate shall obtain not less than 50% of the maximum marks (25 marks) prescribed for the CIE of each subject, including seminars. CIE Marks shall be based on assignments, tests, oral examinations and seminar (minimum of two are compulsory) conducted in respective subjects. The candidates obtaining less than 50% of the CIE marks in any subject shall not be eligible to appear for the SEE in that subject(s). Only in such cases, the Controller of Examination may arrange for reregistering the subject(s) in

	subsequent semester or may refer to DPGC for necessary remedial measures. The candidates shall write the Internal Assessment Test in Blue Books, and this shall be maintained by the Head of the Department for at least six months after the announcement of result and is available for verification. The CIE marks sheet shall bear the signature of the concerned Teacher and the Chairman of the Department. The CIE marks list shall be displayed on the Notice Board and corrections, if any, shall be incorporated before sending to the Controller of Examinations.
22NMT12.15	The Academic Performance Evaluation of a student shall be according to a Letter Grading System, based on the Class Performance Distribution. The Letter grades O, A+, A, B+, B, C and F indicate the level of academic achievement, assessed on a decimal (0-10) scale. The Letter grade awarded to a student in a course, for which he has registered shall be based on his performance in quizzes, tutorials, assignments etc., as applicable, in addition to two mid-semester examination and one semester end examination. The distribution of weightage among these components may be as follows: Semester End Examination (SEE) 50% Continuous Internal Evaluation (CIE) (i) Quizzes, Tutorials, Assignments etc., 20% (ii) Mid-semester Examination: 30% Any variation, other than the above distribution, requires the approval of the pertinent DPGC and Academic Council. The letter grade awarded to a student in a 0-0-P (Practical) course, is based on an appropriate continuous evaluation scheme that the course instructor shall evolve, with the approval of the pertinent DPGC. The course Instructor shall announce in the class, and/or display in the display boards or at the website, the details of the Evaluation Scheme, including the distribution of the weightage for each of the components, and method of conversion from the raw scores to the letter-grades; within the first week of the semester in which the course is offered, so that there are no ambiguities in communicating the same to all the students concerned.

22NMT12.16	**The Transitional Grades** 'I', 'W' and 'X' would be awarded in the following cases. These would be converted into one or the other of the letter grades (O-F) after the student completes the course requirements. **Grade "I":** To a student having attendance ≥85% and CIE ≥ 70%, in a course, but remained absent from SEE for valid & convincing reasons acceptable to the College, like: i. Illness or accident, which disabled him/her from attending SEE. ii. A calamity in the family at the time of SEE, which required the student to be away from the College. iii. However, the committee chaired by the Principal is authorized to relax the requirement of CIE ≥ 70% if the student is hospitalized or advised long term rest after discharge from the hospital by the Doctor. iv. Students who remain absent for Semester End Examinations due to valid reasons and those who are absent due to health reasons are required to submit the necessary documents along with their request to the Controller of Examinations to write Make up Examinations within 2 working days of that examination for which he or she is absent, failing which they will not be given permission. • **Grade "W":** To a student having satisfactory attendance at classes but withdrawing from that course before the prescribed date in a semester as per Faculty Advice. • **Grade "X":** To a student having attendance ≥85% and CIE ≥ 70%, in a course but SEE performance could result in a 'F' grade in the course. (No "F" grade awarded in this case, but student's performance record will be maintained separately).
22NMT12.17	**The Make Up Examination** facility would be available to students who may have missed to attend the SEE of one or more courses in a semester for valid reasons and given the 'I' grade. Also, students having the 'X' grade shall also be eligible to take advantage of this facility. The makeup examination would be held as per dates notified in the Academic Calendar. However, it should be made possible to hold a make-up examination at any other time in the semester with the permission of the Academic Council of the College. In all these cases, the standard of SEE would be the same as the normal SEE.

22NMT12.18	All the 'W' grades awarded to the students would be eligible for conversion to the appropriate letter grades only after the concerned students re-register for these courses in a main/summer semester and fulfil the passing standards for their CIE and (CIE+SEE).
22NMT12.19	The suggested passing standards are CIE to have >=50% and CIE+SEE to have a grade better or at least equal to C. For maintaining high standards, the students scoring less than 50% in CIE are advised to withdraw and to reregister for the course when offered next. The letter grade 'W' to be entered in the grade card against the subject and not to be taken into account while calculating SGPA & CGPA
22NMT12.20	**Rules for grace marks** a) Grace marks up to 1% of the maximum total marks in the examination or 10 marks whichever is less shall be awarded to the failed course(s), provided on award of such grace marks the candidate passes in that course(s) and examination. For the students who have secured a minimum pass grade in all the courses without any grace marks, there shall be a provision to award grace marks of 0.5% of maximum marks or 5 marks whichever is less in a semester for improvement of Grade Point (GP) in the course(s) registered in that semester. (Excluding Project work and Internship)
22NMT13.0	**LETTER GRADES AND GRADE POINTS:** The Institute adopts absolute grading system wherein the marks are converted to grades, and every semester result will be declared with semester grade point average (SGPA) and Cumulative Grade Point Average (CGPA). The CGPA will be calculated for every semester, except for the first semester. The grading system with the letter grades and the assigned range of marks under absolute grading system are as given below:

Letter Grade	**Grade- Points**	**Raw Scores %**	**Level of Academic Achievement**
O	10	≥90	Out standing
A+	09	80-89	Excellent
A	08	70-79	Very Good

	<table><tr><td>B+</td><td>07</td><td>60-69</td><td>Good</td></tr><tr><td>B</td><td>06</td><td>55-59</td><td>Above average</td></tr><tr><td>C</td><td>05</td><td>50-54</td><td>Average</td></tr><tr><td>F</td><td>00</td><td><50</td><td>Fail</td></tr><tr><td>U</td><td></td><td></td><td>Audited</td></tr></table> A student obtaining Grade F in a Course shall be considered fail and is required to reappear in subsequent SEE. Whatever the letter grade secured by the student during his /her reappearance shall be retained. However, the number of attempts taken to clear a Course shall be indicated in the grade cards/ transcripts. **Earned Credits:** This refers to the credits assigned to the course in which a student has obtained any one of the letter grades O, A+ A, B+, B and C
22NMT14.0	**PROMOTION AND ELIGIBILITY:**
22NMT14.1	**Promotion:** **a)** All students are promoted to their next semester or year of their program, irrespective of the academic performance. However, for submission for M.Tech. Major Project report in 4th semester, student should have completed all the courses up to 3rd semester
22NMT14.2	**The mandatory non-credit courses,** if any, shall not be considered for the award of class, calculation of SGPA and CGPA. However, a pass grade (PP) in the above courses is mandatory for the award of Degree.
22NMT15.0	**ELIGIBILITY FOR PASSING AND AWARD OF DEGREE:**
22NMT15.1	1. A student who obtains any grade O to C shall be considered as passed and if a student secures F grade in any of the head of passing, he/she has to reappear in that head for SEE 2. A student shall be declared successful at the end of the program for the award of Degree only on obtaining CGPA≥5.00, with none of the courses remaining with F grade. In case, the CGPA falls below 5.00, the student shall be permitted to appear again for SEE for required number of courses (other than seminar and practical) and times, subject to the provision of University, to make up CGPA≥5.0. The

	student should reject the SEE results of previous attempt and obtain written permission form the Controller of Examinations to reappear to the subsequent SEE.
22NMT15.2	For a pass in a theory course, the student shall secure a minimum of 40% of the maximum marks prescribed in the Semester End Examination and 50% of marks in CIE and 50% in the aggregate of CIE and SEE marks. The minimum passing grade in a course is C.
22NMT15.3	For a pass in Internship/ Practical/ Project/ Dissertation/ Viva-voce examination, a student shall secure a minimum of 50% of the maximum marks prescribed for the SEE in Internship/ Practical/ Project/ Dissertation/ Viva-voce. The minimum passing grade in a course is C.
22NMT15.4	For a pass, a candidate shall obtain a minimum of 50% of maximum marks in Seminar.
22NMT15.5	IV Semester full time candidates having backlog courses are permitted to upload the dissertation report and to appear for SEE. The IV semester grade card shall be released only when the candidate completes all the backlog courses and become eligible for the award of Degree.
22NMT15.6	**Eligibility for Award of Degree:** A student shall be declared to have completed the Degree of Master of Technology, provided the student has undergone the stipulated course work as per the regulations and has earned the prescribed credits, as per the scheme of teaching and examination of the program
22NMT16.0	**EVALUATION OF PERFORMANCE:** **Computation of SGPA and CGPA** SGPA and CGPA: The credit index can be used further for calculating the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA), both being important academic performance indices of the student. While SGPA is equal to the credit index for a semester divided by the total number of credits registered by the student in that semester, CGPA gives the sum total of credit indices of all the previous semesters divided by the total number of credits registered in all these semesters. Both the equations together facilitate the declaration of academic performance of a student, at the end of a semester and at the end of successive semesters respectively

	SGPA is computed as follows: $$SGPA = \frac{\sum[(\text{Course credit}) x (\text{Grade point})] \text{ for all courses with Letter grades including F in that semester}}{\sum[(\text{Course credits})] \text{ for all courses with Letter grades ncluding F in that semester}}$$ **CGPA is computed as follows:** $$CGPA = \frac{\sum[(\text{Course credit}) x (\text{Grade point})] \text{ for all courses with Letter grades except F}}{\sum[(\text{Course credits})] \text{ for all courses with Letter grades except F}}$$
22NMT16.1	**Communication of Grades:** • The SGPA and CGPA respectively, facilitate the declaration of academic performance of a student at the end of a semester and at the end of successive semesters. Both of them would be normally calculated to the second decimal position, so that the CGPA, in particular, can be made use of in rank ordering the students' performance in the Institute. If two students get the same CGPA, the tie could be resolved by considering the number of times a student has obtained higher SGPA, But, if it is still not resolved, the number of times a student has obtained higher grades like O, A, B etc. could be taken into account.
22NMT16.2	**Appeal for Review of Grades:** a) The entire process of evaluation shall be made transparent, and a mechanism for review of grade is incorporated in the evaluation system. The student shall apply for the revaluation of the answer paper within the prescribed time after announcement of the results and by paying the prescribed fees. The respective DPGC conducts the revaluation process and submits a report to the office of the controller. Based on the revaluation results, the modifications of the grades obtained if any is announced and is incorporated in the grade card. If the student obtains improved grade points, then the fee amount will be refunded to the student.
22NMT16.3	**Grade Card:** Based on the secured letter grades, grade points, SGPA and CGPA, a grade card for each semester shall be issued. On specific request on paying prescribed fee, a transcript indicating the performance in all semesters may be issued.

22NMT16.4	**Conversions of Grades into Percentage and Class Equivalence** Conversion formula for the conversion of CGPA into percentage is given below: Percentage of marks secured, P = CGPA Earned × 10 **Illustration: for CGPA of 8.18**: P = CGPA Earned 8.18 × 10 = 81.8 %
22NMT17.0	**DEGREE REQUIREMENTS:** The Degree requirements of a student for the M.Tech Degree program are as follows: 1. College Requirements: i) Minimum Earned Credit Requirement for M.Tech. Degree is 80 ii) Satisfactory completion of all Mandatory Learning courses 2. Program Requirements: i) Minimum Earned Credit Requirements on all core courses, ii) Elective Courses and major project as specified by the DPGC. The maximum duration for a student for complying to the Degree requirements is 8 semesters from the date of first registration for his first semester.
22NMT18.0	**TERMINATION FROM THE PROGRAM/READMISSION:** A student shall be required to leave the College without the award of the Degree, under the following circumstances: ii) Failing to complete the degree requirements in double the duration of the program Based on disciplinary action suggested by the Academic Council/Governing Council.
22NMT19.0	**GRADUATION REQUIREMENTS AND CONVOCATION:** 1. A student shall be declared to be eligible for the award of the Degree if he has a) Fulfilled Degree Requirements b) No Dues to the College, Departments, Hostels, Library Central Computer Centre and any other center c) No disciplinary action pending against him. 2. The award of the Degree must be recommended by the Academic council and approved by Governing Council of Nitte (DU)

<table>
<tr><td></td><td>Convocation: Degree will be awarded in person for the students who have graduated during the preceding academic year. Degrees will be awarded in absentia to such students who are unable to attend the Convocation. Students are required to apply for the Convocation along with the prescribed fees, after having satisfactorily completed all the Degree requirements within the specified date in order to arrange for the award of the Degree during convocation.</td></tr>
<tr><td>22NMT20.0</td><td>AWARD OF CLASS, PRIZES, MEDALS & RANKS:

Award of Class: Sometimes, it would be necessary to provide equivalence of SGPA and CGPA with the percentages and/or Class awarded as in the conventional system of declaring the results of University examinations. This can be done by prescribing certain specific thresholds in these averages for Distinction, First Class and Second Class as described below.

Percentage Equivalence of Grade Points (For a 10-Point Scale)
<table>
<tr><th>GPA</th><th>Percentage of Marks*</th><th>Class</th></tr>
<tr><td>≥ 7.00</td><td>≥ 70%</td><td>Distinction</td></tr>
<tr><td>≥ 6.00</td><td>≥ 60%</td><td>First Class</td></tr>
<tr><td>5.0 ≥ GPA <6.00</td><td>50≥ Percentage < 60%</td><td>Second Class</td></tr>
</table>
Percentage * = (GPA) x 10

For the award of Prizes, Medals and ranks: The conditions stipulated by the Donor may be considered as per the statutes framed by the University for such awards.
An attempt means the appearance/registration of a candidate for an examination in one or more courses either in part or failing a particular examination.
A candidate who fails/remaining absent (after submitting exam application) in the main examination and passes one or more subjects/courses or all subjects/courses in the supplementary/Make-up examination such candidates shall be considered as taken more than an attempt.
Merit Certificates and University Medals/ will be awarded on the basis of overall CGPA, governed by the specific selection criteria that may be formulated by the University for such Medals / Awards
</td></tr>
</table>

	○ Only those candidates who have completed the Program and fulfilled all the requirements in the minimum number of years prescribed (i.e., 2 years) and who have passed each semester in the first attempt are eligible for the award of Merit Certificates and /or Ranks and University Medals. Candidates who pass the subjects in the supplementary/make-up examinations are not eligible for the award of Ranks, Medal or Merit Certificate.
22NMT21.0	**CONDUCT AND DISCIPLINE:** 1. Students shall conduct themselves within and outside the premises of the Institute, in a manner befitting the students of an Institution of National Importance 2. **As per the order of Honorable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned, any form of ragging will be severely dealt with**. 3. The following acts of omission/ or commission shall constitute gross Violation of the code of conduct and are liable to invoke disciplinary measures: a) Ragging b) Lack of courtesy and decorum; indecent behavior anywhere within or outside the campus. c) Willful damage or stealthy removal of any property /belongings of the Institute /Hostel or of fellow students/ citizens d) Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs. e) Mutilation or unauthorized possession of Library books. f) Noisy and unseemly behavior, disturbing studies of fellow Students. g) Hacking in computer systems (such as entering into other Person's area without prior permission, manipulation and/or Damage of computer hardware and software or any other Cybercrime etc.,). h) Plagiarism of any nature. i) Any other act of gross indiscipline as decided by the University from time to time. j) Smoking in College Campus and supari chewing. k) Unauthorized fund raising and promoting sales

	4. Commensurate with the gravity of offense, the punishment may be: reprimand, expulsion from the hostel, debarment from an examination, disallowing the use of certain facilities of the College, rustication for a specified period or even outright expulsion from the College, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances. i) For an offence committed in a) A hostel b) A department or in a classroom c) Elsewhere, the Chief Warden, the Head of the Department and the Dean (Students Welfare), respectively, shall have the authority to reprimand or impose fine. ii) All cases involving punishment shall be reported to the Principal. 5. Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Controller of Examination. ○ **Note:** Students are required to be inside the examination hall 20 minutes before the commencement of examination. This is applicable for all examinations (Semester end/Supplementary/makeup) henceforth. Students will not be allowed inside the examination hall after the commencement, under any circumstances.

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NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Scheme & Syllabus for
M. Tech. (Structural Engineering)

DEPARTMENT OF CIVIL ENGINEERING

2022-24

NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Institution Vision

Pursuing Excellence, Empowering people, Partnering in Community Development.

Institution Mission

To develop NMAM Institute of Technology, Nitte, as Center of Excellence by imparting Quality Education to generate Competent, Skilled and Humane Manpower to face emerging Scientific, Technological, Managerial and Social Challenges with Credibility, Integrity, Ethics and Social Concern.

Department Vision

To uphold the Department as a leader in community development through innovation and excellence in diverse areas of Civil Engineering to meet the global challenges and market demands.

Department Mission

1. To provide the students a strong theoretical knowledge and practical skills to understand the basic concept and fundamentals of various Civil Engineering subjects.
2. To be competent and skilled enough to take the challenges in Research, Consultancy and Entrepreneurship.
3. To encourage the students in developing professional ethics through discipline and principles.

Program Educational Objectives (PEO)

PEO 1.	Equipped to pursue professional career in the constantly changing field of construction, Engineering, Technology and Management.
PEO 2.	Competent enough to contribute knowledge base through Learning and Research.
PEO 3.	Continue to practice and promote the needs and challenges of real-world problems and come up with sustainable solutions for social needs.

Program Outcomes (PO)

At the end of M.Tech in Structural Engineering Program Students will have

PO1.	An ability to independently carry out research /investigation and development work to solve practical problems
PO2.	An ability to write and present a substantial technical report/document
PO3.	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
PO4.	Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors
PO5.	Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
PO6.	Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

Program Specific Outcomes (PSO)

PSO 1.	Apply knowledge of various domains of Structural Engineering; conduct experiments, analyse, interpret data, and design.
PSO 2.	Competent with skills and knowledge for Research and Innovative practices

DEPARTMENT: CIVIL ENGINEERING

Sl. No	Name of Faculty	Qualification	Designation
1.	Dr. I. Ramesh Mithanthaya	Ph. D	Prof./ Vice Principal /Dean(Aca)
2.	Dr. A.N. Parameswaran	Ph. D	Professor/ Director (III)
3.	Dr. Arun Kumar Bhat	Ph. D	Professor/HOD
4.	Dr. Udayakumar G.	Ph. D	Professor
5.	Dr. Srinath Shetty K.	Ph. D	Professor
6.	Dr. Radhakrishnan K.	Ph. D	Professor
7.	Mr. Bhandage A R	M. Tech	Associate Professor
8.	Dr. Bhojaraja B E.	Ph. D	Associate Professor
9.	Dr. Ranjith A.	Ph. D	Associate Professor
10.	Dr. Shaik Kabeer Ahmed	Ph. D	Associate Professor
11.	Mr. J.K. Lokesh	M.Tech	Asst. Prof. Gd III
12.	Mr. Pushparaj A Naik	M.Tech (Ph.D.)	Asst. Prof. Gd III
13.	Dr. Mithun B.M.	Ph. D	Asst. Prof. Gd III
14.	Dr. Saranya P	Ph. D	Asst. Prof. Gd III
15.	Dr. Shriram P Marathe	Ph. D	Asst. Prof. Gd III
16.	Mr. Sundip Shenoy R.	M.Tech	Asst. Prof. Gd II
17.	Mr. Gururaj Acharya	M.Tech.	Asst. Prof. Gd II
18.	Mr. Rakshith Kumar Shetty	M.Tech.	Asst. Prof. Gd II
19.	Mr. Manjunath M.	M.Tech. (Ph. D)	Asst. Prof. Gd II
20.	Mr. Roshan Rai	M.Tech.	Asst. Prof. Gd II
21.	Mr. Janakaraj M	M.Tech.	Asst. Prof. Gd II
22.	Mr. Arjun K Punja	B. E., MBA.	Asst. Prof. Gd II
23.	Mr. Prashantha Kumar K.	M.Tech (Ph. D)	Asst. Prof. Gd I
24.	Mr. Prithviraj H.K.	M.Tech.	Asst. Prof. Gd I
25.	Mr. Thushar S. Shetty	M.Tech.	Asst. Prof. Gd I
26.	Mr. Pradeep Karanth	M.Tech.	Asst. Prof. Gd I
27.	Mr. Shanmukha Shetty	M.Tech, (Ph. D)	Asst. Prof. Gd I
28.	Mr. Sabyath P Shetty	M.Tech.	Asst. Prof. Gd I
29.	Ms. Thanushree Hegde	M.Tech.	Asst. Prof. Gd I
30.	Ms. Deekshitha M	M.Tech.	Asst. Prof. Gd I
31.	Mr. Ekanath P.	M. Tech.	Visiting Faculty
32.	Mr. Rajesh D. Maistry	M. Tech.	Visiting Faculty

CREDIT DISTRIBUTION

No.	Course Category	Suggested Credits
1.	Professional Courses (PCC) – core	16
2.	Professional Courses (PEC) – elective	18
3.	Research Methodology & IPR/RETP	04
4.	Labs	04
5.	Project Work (UCC) (Phase 1 & 2)	08+20
6.	Audit Courses (2 Nos)	--
7.	Seminar on Current Topic (UCC)	02
8.	Internship (UCC)	08
	Total Credits to be earned:	**80**

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M.Tech. (CST): Scheme of Teaching and Examinations 2022-24

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022 - 23)

1st Year Scheme

I SEMESTER

Sl. No	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Lecture	Tutorial	Practical	Duration Hrs	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	22CST101	Mechanics of Deformable Bodies	CV	4	0	0	3	50	50	100	4
2	PCC	22CST102	Structural Dynamics	CV	4	0	0	3	50	50	100	4
3	PEC	22CST11X	Elective – I	CV	3	0	0	3	50	50	100	3
4	PEC	22CST12X	Elective - II	CV	3	0	0	3	50	50	100	3
5	PEC	22CST13X	Elective - III	CV	3	0	0	3	50	50	100	3
6	RETP	22CST103	Research Experience Through Practice -I	CV	Four contact hours /week for carrying out Research and Interaction between the faculty and students			-	100	0	100	2
7	PCC	22CST104	Computer Aided Design in Structural Engineering-I	CV	0	0	2	3	50	50	100	1
8	PCC	22CST105	Structural Detailing Lab-I	CV	0	0	2	3	50	50	100	1
9	AUDIT	22CSTAU1	Audit Course-I	CV	2	-	-	-	-	-	-	-
				Total	**19**	**0**	**4**	**21**	**450**	**350**	**800**	**21**

II SEMESTER

Sl. No	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Lecture	Tutorial	Practical	Duration Hrs	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	22CST201	Advanced Design of Steel Structures	CV	4	0	0	3	50	50	100	4
2	PCC	22CST202	Finite Element Method of Analysis	CV	4	0	0	3	50	50	100	4
3	PEC	22CST21X	Elective – IV	CV	3	0	0	3	50	50	100	3
4	PEC	22CST22X	Elective – V	CV	3	0	0	3	50	50	100	3
5	PEC	22CST23X	Elective - VI	CV	3	0	0	3	50	50	100	3
6	RETP	22CST203	Research Experience Through Practice -II	CV	Four contact hours /week for carrying out Research and Interaction between the faculty and students			-	100	0	100	2
7	PCC	22CST204	Computer Aided Design In Structural Engineering-II	CV	0	0	2	3	50	50	100	1
8	PCC	22CST205	Structural Detailing Lab-II	CV	0	0	2	3	50	50	100	1
9	AUDIT	22CSTAU2	Audit Course-II	CV	2	-	-	-	-	-	-	-
				Total	**19**	**0**	**4**	**21**	**450**	**350**	**800**	**21**

Note: PCC: Professional Core Course, PEC: Professional Elective Course, AUDIT (AU): Non-credit Audit course, RETP: Research Experience Through Practice.

L –Lecture, T – Tutorial, P- Practical/ Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

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(Effective from the academic year 2022 - 23)

2nd Year Scheme

III SEMESTER

Sl. No	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Lecture	Tutorial	Practical	Duration Hrs	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	UCC	22CST301	Industry Internship/ Research Internship/Mini Project	CV	8 Weeks Full Time [40-45 Hrs/week]			3	100	0	100	8
2	UCC	22CST302	Seminar on Special Topic	CV	0	0	2	3	100	0	100	2
3	UCC	22CST303	Project Part -1	CV	12 Weeks Full Time [Min 30 Hrs/week]			3	200	0	200	8
				Total	**0**	**0**	**2**	**9**	**400**	**0**	**400**	**18**

Note: L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Internship: CIE Evaluation is for 100 Marks where 50 Marks is for Report and 50 Marks for the Presentation

Project Part-1: CIE Evaluation is for 200 Marks where 100 Marks is for Report and 100 Marks for the Presentation

IV SEMESTER

Sl. No	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Lecture	Tutorial	Practical	Duration Hrs	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	UCC	22CST401	Project Part -2	CV	22 Weeks Full Time [Min 36 Hrs/week]			3	200	200	400	20
				Total	**0**	**0**	**0**	**3**	**200**	**200**	**400**	**20**

Note: L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Project Part-2: CIE Evaluation is for 200 Marks having Project Progress Evaluation (PPE)-1 and PPE-2 each for 100 Marks.

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Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2022 - 23)

List of Domain Specific Skill Development Audit Course (AUDIT)	
Course Code	**Course Title**
22CSTAU1	National Building Code –Part I
22CSTAU2	National Building Code –Part II

List of Electives [PEC]			
Elective - I		**Elective - II**	
Code	**Course Title**	**Code**	**Course Title**
22CST111	Special Concrete	22CST121	Green Building Design
22CST112	Cold Formed Light Gauge Steel Structures	22CST122	AI and Expert System in Structural Engineering
22CST113	Advanced design of RCC structures	22CST123	Computational Structural Mechanics
Elective - III		**Elective - IV**	
Code	**Course Title**	**Code**	**Course Title**
22CST131	Repair and Restoration of Structures	22CST211	Design of Concrete Bridges
22CST132	Design of Tall Structures	22CST212	Reliability analysis of structures
22CST133	Optimization Techniques	22CST213	Design Concepts of Substructures
Elective - V		**Elective – VI**	
Code	**Course Title**	**Code**	**Course Title**
22CST221	Fracture Mechanics of concrete	22CST231*	Characterization of Construction Materials
22CST222	Stability Analysis of Structures	22CST232	Theory of plates and shells
22CST223	Design of Earthquake Resistant structures	22CST233**	Ground Improvement, Tunnelling & Precast Technique

* NPTEL course

** Industry offered course

Professional Core Courses

MECHANICS OF DEFORMABLE BODIES			
Course Code:	**22CST101**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**4:0:0:0**	**Credits**	**04**
Total Teaching Hours	**50**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Understand the concept of stress and strain at a point in Cartesian and polar coordinates
2.	Know the principal stresses and principal strains in an elastic body
3.	Discuss about plane stress, plane strain and axisymmetric problems
4.	Learn 3D elasticity problems
5.	Understand the concept of plasticity and failure theories

UNIT-I

Theory of Elasticity	**12 Hours**

Definition of stress and strain and strain at a point, components of stress and strain at a point of Cartesian and polar coordinates. Constitutive relations, equilibrium equations, compatibility equations and boundary conditions in 2-D and 3-D cases.

UNIT-II

Theory of Elasticity	**10 Hours**

Transformation of stress and strain at a point, Principal stresses and principal strains, invariants of stress and strain, hydrostatic and deviatric stress, spherical and deviatric strains, maximum shear strain.

UNIT-III

Theory of Elasticity	**10 Hours**

Plane stress and plane strain: Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams. Solution of axisymmetric problems, stress concentration due to the presence of a circular hole in plates.

UNIT-IV

Theory of Elasticity	**10 Hours**

Elementary problems of elasticity in three dimensions, stretching of a prismatic bar by its own weight, twist of circular shafts, torsion of non-circular sections, membrane analogy, Propagation of waves in solid media. Applications of finite difference equations in elasticity.

UNIT-V

Theory of Plasticity	**10 Hours**

Stress – strain diagram in simple tension, perfectly elastic, Rigid – Perfectly plastic, Linear work – hardening, Elastic Perfectly plastic, Elastic Linear work hardening materials, Failure theories, yield conditions, stress – space representation of yield criteria through Westergaard stress space, Tresca and Von-Mises criteria of yielding.

Practical Component:

Stress analysis of simple 1D, 2D and 3D elements using software.

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

1.	Analyse 2D and 3D problems of elasticity using equilibrium and compatibility equations
2.	Compute principal stresses and principal strains in an elastic body
3.	Solve plane stress, plane strain and axisymmetric problems
4.	Analyse problems on torsion, finite difference problems of elasticity
5.	Describe the concept of plasticity with various theories of failure

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**		
↓ Course Outcomes							1	2	
CST101-1.1	1	3	2	3	2	2	2	3	
CST101-1.2	1	3	2	3	2	2	2	3	
CST101-1.3	1	3	2	3	2	2	2	3	
CST101-1.4	1	3	2	3	2	2	2	3	
CST101-1.5	1	3	2	3	2	2	2	3	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Timoshenko & Goodier, "Theory of Elasticity", McGraw Hill.
2.	Srinath L.S., Advanced Mechanics of Solids, 10th print, Tata McGraw Hill Publishing company, New Delhi, 1994.
3.	Sadhu Singh, "Theory of Elasticity", Khanna Publishers.
4.	Verma P.D.S, "Theory of Elasticity", Vikas Publishing Pvt. Ltd.
5.	Chenn W.P and Hendry D.J, "Plasticity for Structural Engineers", Springer Verlag.
6.	Valliappan C, "Continuum Mechanics Fundamentals", Oxford IBH Publishing Co. Ltd.
7.	Sadhu Singh, "Applied Stress Analysis", Khanna Publishers.
8.	Xi Lu, "Theory of Elasticity", John Wiley.

STRUCTURAL DYNAMICS			
Course Code:	**22CST102**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**4:0:0:0**	**Credits**	**04**
Total Teaching Hours	**50**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	The objective of this course is to make students to learn principles of Structural Dynamics and its importance in structural engineering field.
2.	To implement structural dynamics principles through different methods and to apply the same for free and forced vibration of structures.
3.	To know the Importance of Natural frequency and mode shapes.
4.	To understand and implement the various methods of modal analysis.
5.	To evaluate the dynamic characteristics of the structures for better structural design in view of earthquake.

UNIT-I

Introduction	**10 Hours**

Introduction to Dynamical problems in Civil Engineering, Concept of degrees of freedom, D'Alembert's principle, principle of virtual displacement and energy principle

UNIT-II

Dynamics of Single-degree-of-freedom systems	**12 Hours**

Mathematical models of SDOF system, Free vibration response of damped and undamped systems, Response to harmonic loading, support motion, evaluation of damping, vibration isolation, transmissibility, response to periodic forces. Numerical methods applied to SDOF, Direct integration and Duhamel integral

UNIT-III

Dynamics of Multi-degree freedom systems	**10 Hours**

Mathematical models of MDOF systems, free vibration of undamped MDOF systems - Natural frequencies and mode shapes – orthogonality conditions, free vibration of damped MDOF systems.

UNIT-IV

Modal analysis & Approximate Methods	**10 Hours**

Free and forced vibration with and without damping. Rayleigh's method Dunkarley's method, Rayleigh-Ritz method.

UNIT-V

Dynamics of Continuous systems & Response of structures to earthquakes	**10 Hours**

Free longitudinal vibration of bars, flexural vibration of beams with different end conditions, Characterization Of earthquake ground motion. Principle of vibration-measuring instruments – seismometer and accelerometer.

Practical Component:

Dynamic Analysis of Structures Using Software's

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

1.	Understand the importance of structural dynamics in civil engineering and basic principles.
2.	Achieve knowledge on Single degree of freedom system in dynamics, mathematical equations and Vibration measuring instruments.

3.	Achieve knowledge on Multi-degree of freedom system in dynamics and Mode shapes.
4.	Know Modal analysis by various mathematical methods.
5.	Understand Dynamics of Continuous systems & Response of structures to earthquakes.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**		
↓ Course Outcomes							1	2	
CST102-1.1	1	3	2	3	2	2	2	3	
CST102-1.2	1	3	2	3	2	2	2	3	
CST102-1.3	1	3	2	3	2	2	2	3	
CST102-1.4	1	3	2	3	2	2	2	3	
CST102-1.5	1	3	2	3	2	2	2	3	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Mario Paz, "**Structural dynamics – Theory and Computation**", CBS Publishers
2.	Mukyopadhyaya, "**Vibration and Structural Dynamics**", Oxford&IH

REFERENCE BOOKS:

1.	Mario Paz, "**Structural dynamics – Theory and Computation**", CBS Publishers
2.	Biggs, "**Structural Dynamics**", McGraw Hil
3.	R.W. Clough & J. Penzien, "**Dynamics of Structures**", McGrawHill
4.	Anil K. Chopra, "**Dynamics of Structures**", Prentice Hall of India.
5.	Timoshenko, S., "**Vibration Problems in Engineering**", VanNostrand Co.
6.	Mukyopadhyaya, "**Vibration and Structural Dynamics**", Oxford&IH
7.	William Thompson, "**Theory of Vibration with Applications**".
8.	William Seto, "**Mechanical Vibrations**", McGraw Hill Pub., (Schaum Series).

E Books / MOOCs/ NPTEL

1.	https://archive.nptel.ac.in/courses/105/106/105106151/
2.	https://archive.nptel.ac.in/courses/105/101/105101209/
3.	https://archive.nptel.ac.in/courses/105/101/105101006/

COMPUTER AIDED DESIGN IN STRUCTURAL ENGINEERING-I			
Course Code:	**22CST103**	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P: S):	**0:0:2:0**	**Credits:**	**01**
Total Teaching Hours:	**30**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1.	**Understand** the analysis by software tool**.**
2.	**Design** the various civil Engineering structures using softwares

UNIT-I

Introduction	**10 Hours**

Introduction to Computer Aided Design, Creating design sheets using Microsoft Excel

UNIT-II

Analysis	**16 Hours**

Structural Analysis of 2D and 3D Trusses, Structural Analysis of Continuous Beams using for different types of loadings and support conditions. Analysing and designing one BHK building model

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

1.	**Make use of** Microsoft Excel; **Creating** Design Sheets.
2.	**Analysing and Designing** using ETABS/Midas or Open Source Software's.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**		
↓ Course Outcomes							1	2	
22CST103-1.1	1	3	2	3	2	2	2	3	
22CST103-1.2	1	3	2	3	2	2	2	3	

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Punmia B. C., Ashok Kumar Jain, Arun Kumar Jain, "Strength of Materials and Theory of Structures", Volume I & Volume II, Laxmi Publications (P) Ltd., 2019.
2.	Ramamrutham S., "Theory of Structures", Dhanpat Rai & Sons, New Delhi, 2018.
3.	N. Krishnaraju and R.N.Pranesh, Reinforced Concrete Design (IS456:2000)-Principles and Practice, New Age International Publishers, New Delhi, 2006.
4.	Dr. Ramchandra and Virendra Gehlot, Limit State Design of Concrete Structures (As per IS: 456-2000), Scientific Publishers (India), Jodhpur, 2010.
5.	Punmia B.C.(2017) "Soil Mechanics and Foundations" Laxmi Publishing Co
6.	IS: 456-2000 (to be supplied in the examination), SP16.
7.	Punmia B. C., Ashok Kumar Jain, Arun Kumar Jain, "Strength of Materials and Theory of Structures", Volume I & Volume II, Laxmi Publications (P) Ltd., 2019.
8.	Ramamrutham S., "Theory of Structures", Dhanpat Rai & Sons, New Delhi, 2018.

STRUCTURAL DETAILING-I

Course Code:	**22CST104**	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P: S):	**0:0:2:0**	**Credits:**	**01**
Total Teaching Hours:	**30**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1.	**Understand** the process and importance of structural detailing**.**
2.	**Creating** Detailed drawings analysed using 22CST103 Course.

UNIT-I

Introduction	**10 Hours**
Introduction to SP-34-1987, detailing of foundation, column members	

UNIT-II

Detailing	**16 Hours**
Detailing of beams, slab, staircase, and preparation of detailed drawings	

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

1.	**Make use of SP34 Code**; **Creating** Design Sheets.
2.	**Creating** detailed drawings using Auto Cad.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**		
↓ Course Outcomes							1	2	
22CST104-1.1	1	3	2	3	2	2	2	3	
22CST104-1.2	1	3	2	3	2	2	2	3	

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	D. Krishnamurthy (2015) –"Structural Design and Drawing", (Concrete Structures), CBS publishers, New Delhi.
2.	P. C. Varghese (2002)-Limit State Design of Reinforced Concrete, 2nd Edition by Prentice-Hall of India Pvt. Ltd., New Delhi.
3.	B.C. Punmia (2005)-"Reinforced Concrete Structures", Laxmi Publications.
4.	P. Dayaratnam (2004), Limit State Design of Reinforced Concrete Structures, CBS Publishers & Distributors Pvt Ltd New Delhi.
5.	Ashok K. Jain (2002), Reinforced Concrete Limit State Design, 6th Edition, Nem Chand & Bros, Roorkee.
6.	Ramamrutham S., "Theory of Structures", Dhanpat Rai & Sons, New Delhi, 2018.

E Resources

1.	https://nptel.ac.in/courses/105105104

ADVANCED DESIGN OF STEEL STRUCTURES			
Course Code:	**22CST201**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**4:0:0:0**	**Credits**	**04**
Total Teaching Hours	**50**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	The objectives are to provide students with advanced knowledge of steel structural design and confidence to apply the underlying principles to solve a wide range of structural steel problems.
2.	To understand the importance of plastic analysis in structural steel design.
3.	To have expertise in designing various components of structures using steel
4.	To understand design complexities with respect to members subjecting to various forces in case of steel design
5.	Understand the advanced principles of the design of hot-rolled and cold-formed steel structural members

UNIT-I

Plastic Analysis	**10 Hours**

Introduction, Ductility of steel, fully plastic moment of mild steel sections, plastic hinges and shape functions, basic theorems of plastic analysis, plastic analysis of continuous beams and portal frames (Single bay and Single storey only)

UNIT-II

Laterally Unrestrained Beams	**12 Hours**

Lateral buckling of beams, factors affecting lateral stability, IS 800 code provisions, and design approach. Lateral buckling strength of cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, mono- symmetric and non-uniform beams – Design Examples.

UNIT-III

Members Subjected to Combined Forces	**10 Hours**

Beam Columns in Frames: Behaviour of short and long beam-columns, effects of slenderness ratio and axial force on modes of failure, biaxial bending, strength of beam columns, effective length of columns-, and methods in IS 800 – Examples.

UNIT-IV

Steel Beams with Web Openings	**10 Hours**

Shape of the web openings, practical guide lines, and force distribution and failure patterns, analysis of beams with perforated thin and thick webs, design of castellated beams, Vierendeel girders

UNIT-V

Cold formed steel sections and Tubular sections	**10 Hours**

Techniques and properties, advantages, typical profiles, Stiffened and un-stiffened elements, Local buckling effects, effective section properties, IS 811 code provisions-numerical examples, beam design, column design.

Design principles of rounded tubular structures, permissible stresses, design of tension members, compression members and beams, connections.

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

1.	Understand the importance of steel design in structural engineering field.
2.	Achieve knowledge of plastic analysis and its importance in steel structures design.
3.	Achieve knowledge on design of structural members subjected to combined forces
4.	To know the expected failure patterns and various methods of design of beams with web openings
5.	To know the methods of design and design principles of cold formed and tubular sections design

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	**PSO↓** 1	2
CST201-1.1	1	3	2	3	2	2	2	3
CST201-1.2	1	3	2	3	2	2	2	3
CST201-1.3	1	3	2	3	2	2	2	3
CST201-1.4	1	3	2	3	2	2	2	3
CST201-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	N. Subramanian, "Design of Steel Structures", Oxford, IBH.
2.	Duggal .S.K., "Design of Steel structures". Tata McGraw-Hill Education, 2000.

E Books / MOOCs/ NPTEL

1.	Design of steel structures - Course (nptel.ac.in)

FINITE ELEMENT METHOD OF ANALYSIS

Course Code:	22CST202	Course Type	PCC
Teaching Hours/Week (L: T: P: S)	4:0:0:0	Credits	04
Total Teaching Hours	50	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	To provide basic knowledge of finite element analysis to solve problems in structural mechanics
2.	To highlight the various steps involved in analysing problems related to plane trusses, beams, plane stress, plane strain, axisymmetric, plates and shells using finite element method.
3.	To enlighten the concept of isoparametric elements and variation method

UNIT-I

Basic concepts of elasticity	**12 Hours**

Basic concepts of elasticity – Kinematic and Static variables for various types of structural problems – approximate method of structural analysis – Rayleigh – Ritz method , Finite difference method – Finite element method. Principles of finite element method – advantages & disadvantages – Finite element procedure. Finite elements used for one, two & three dimensional problems.

UNIT-II

Element aspect ratio	**10 Hours**

Element aspect ratio – mesh refinement vs. Higher order elements – Numbering of nodes to minimize band width, Nodal displacement parameters – Convergence criterion – Compatibility requirements – Geometric invariance – Shape function – Polynomial form of displacement function.

Generalized and Natural coordinates – Lagrangian interpolation function – shape functions for one, two & three dimensional elements

UNIT-III

Isoparametric elements	**10 Hours**

Isoparametric elements - Internal nodes and higher order elements – Serendipity and Lagrangian family of Finite Elements – Sub parametric and Super parametric elements – Condensation of internal nodes – Jacobian transformation Matrix. Development of strain – displacement matrix and stiffness matrix, consistent load vector, numerical integration.

UNIT-IV

Variation method and minimization of Energy approach of element formulation	**10 Hours**

Variation method and minimization of Energy approach of element formulation.

Application of Finite Element Method for the analysis of one & two dimensional problems - Analysis of simple beams and plane trusses.

UNIT-V

Application to plane stress	**10 Hours**

Application to plane stress / strain / axisymmetric problems using CST & Quadrilateral Elements. Application to Plates & Shells- Choice of displacement function

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

1.	Explain the steps of finite element analysis and various types of finite elements
2.	Derive shape functions in terms of natural coordinates and Cartesian coordinates
3.	Discuss the application of iso-parametric elements, Jacobian matrix and numerical integration techniques
4.	Analyse simple beams and plane truss problems by finite element method
5.	Apply the knowledge of finite element analysis in plane stress, plane strain, axi-symmetric, plates and shells problems

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**	
↓ Course Outcomes							1	2
CST202-1.1	1	3	2	3	2	2	2	3
CST202-1.2	1	3	2	3	2	2	2	3
CST202-1.3	1	3	2	3	2	2	2	3
CST202-1.4	1	3	2	3	2	2	2	3
CST202-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

1.	Zeinkeiwich, O.C. and Tayler, R.L., The Finite Element Method for Solid and Structural Mechanics, Butterworth-Heinemann,2013
2.	Krishnamoorthy, C.S., Finite Element Analysis: Theory and programming, Tata McGraw Hill Publishing Co. Ltd., 2017
3.	Desai, C., and Abel, J. F., Introduction to the Finite Element Method: A Numerical method for Engineering Analysis, East West Press Pvt. Ltd.,1972
4.	Cook, R.D., Malkas, D.S. and Plesha., M.E., Concepts and applications of Finite Element Analysis, John Wiley and Sons., 2007
5.	Reddy, J., An Introduction to Finite Element Methods, McGraw Hill Co., 2013
6.	Bathe K J, Finite Element Procedures in Engineering Analysis, Prentice Hall

7.	Shames,I.H. and Dym, C.J., Energy and Finite Element Methods in Structural Mechanics, McGraw Hill, New York,1985
E Books / MOOCs/ NPTEL	
1.	Basics Of Finite Element Analysis-I - Course (nptel.ac.in)
2.	NPTEL :: Civil Engineering - Finite Element Analysis

COMPUTER AIDED DESIGN IN STRUCTURAL ENGINEERING-II			
Course Code:	**22CST203**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**30**	**CIE + SEE Marks**	**50+0**

Teaching Department: Civil Engineering

Course Objectives:

1.	**Understand** the analysis by software tool for bridges**.**
2.	**Design** the various civil Engineering structures using softwares

UNIT-I

Bridge Analysis	**10 Hours**
Introduction to bridge design and analysis of simple slab and T-Beam Bridge	

UNIT-II

Retaining Wall and Water Tanks	**16 Hours**
Analysis and Design of Retaining wall, Analysis and Design of water tanks	

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

1.	**Make use of** Microsoft Excel; **Creating** Design Sheets.
2.	**Analysing and Designing** using ETABS/Midas or Open Source Software's.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**	
↓ Course Outcomes							1	2
CST203-1.1	1	3	2	3	2	2	2	3
CST203-1.2	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Punmia B. C., Ashok Kumar Jain, Arun Kumar Jain, "Strength of Materials and Theory of Structures", Volume I & Volume II, Laxmi Publications (P) Ltd., 2019.
2.	Ramamrutham S., "Theory of Structures", Dhanpat Rai & Sons, New Delhi, 2018
3.	N. Krishnaraju and R.N.Pranesh, Reinforced Concrete Design (IS456:2000)-Principles

	and Practice, New Age International Publishers, New Delhi, 2006
4.	Dr. Ramchandra and Virendra Gehlot, Limit State Design of Concrete Structures (As per IS: 456-2000), Scientific Publishers (India), Jodhpur, 2010
5.	Punmia B.C.(2017) "Soil Mechanics and Foundations" Laxmi Publishing Co
6.	IS: 456-2000 (to be supplied in the examination), SP16

STRUCTURAL DETAILING-II

Course Code:	**22CST204**	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P: S):	**0:0:2:0**	**Credits:**	**01**
Total Teaching Hours:	**30**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1.	**Understand** the process and importance of structural detailing**.**
2.	**Creating** Detailed drawings analysed using 22CST203 Course.

UNIT-I

Introduction — **10 Hours**

Introduction to SP-34-1987, IRC Codal provisions and detailing methodologies

UNIT-II

Detailing — **16 Hours**

Detailing of Simple slab bridge, T-Beam Bridge and preparation of detailed drawings as per Standard plans on Highway Bridges

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

1.	**Make use of SP34 Code**; **Creating** Design Sheets.
2.	**Creating** detailed drawings using Auto Cad.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	**PSO↓** 1	2
22CST204-1.1	1	3	2	3	2	2	2	3
22CST204-1.2	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	D.Krishnamurthy (2015) –"Structural Design and Drawing", (Concrete Structures), CBS publishers, New Delhi.

2.	P. C. Varghese (2002)-Limit State Design of Reinforced Concrete, 2nd Edition by Prentice-Hall of India Pvt. Ltd., New Delhi.
3.	B.C. Punmia (2005)-"Reinforced Concrete Structures", Laxmi Publications.
4.	P. Dayaratnam (2004), Limit State Design of Reinforced Concrete Structures, CBS Publishers & Distributors Pvt Ltd New Delhi.
5.	Ashok K. Jain (2002), Reinforced Concrete Limit State Design, 6th Edition, Nem Chand & Bros, Roorkee.
6.	Ramamrutham S., "Theory of Structures", Dhanpat Rai & Sons, New Delhi, 2018.
E Resources	
1.	https://nptel.ac.in/courses/105105104

Professional Elective Courses

SPECIAL CONCRETES

Course Code:	**22CST111**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Learn the principles of concrete mix design.
2.	To differentiate between the different types of concrete.
3.	To characterize the high performance concrete.

UNIT-I

Components of modern concrete — **10 Hours**

Components of modern concrete and developments in the process and constituent materials: Role of constituents, Development in cements and cement replacement materials, pozzolona, fly ash, silica fume, rice husk ash, recycled aggregates, chemical admixtures. Mix proportioning of Concrete: Principles and methods.

Light Weight concrete — **6 Hours**

Light Weight concrete: Introduction, classification, properties, strength and durability, mix proportioning and problems. High density concrete: Radiation shielding ability of concrete, materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods.

UNIT-II

Ferro cement — **10 Hours**

Ferro cement: Ferro cement materials, mechanical properties, cracking of Ferro cement, strength and behaviour in tension, compression and flexure, Design of Ferro cement in tension, Ferro cement constructions, durability, and applications.

Fibre reinforced concrete — **6 Hours**

Fibre reinforced concrete: Fibre materials, mix proportioning, distribution and orientation, interfacial bond, properties in fresh state, strength and behavior in tension, compression and flexure of steel fibre reinforced concrete, mechanical properties, crack arrest and toughening mechanism, applications.

UNIT-III

High Performance concrete — **8 Hours**

High Performance concrete: constituents, mix proportioning, properties in fresh and hardened states, applications and limitations. Ready Mixed Concrete, Self-Compacting Concrete, Reactive powder concrete, bacterial concrete

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

1.	Achieve knowledge of design and development of problem solving skills.

2.	Understand the principles of concrete mix design.
3.	Design and develop analytical skills.
4.	Summarize the light weight concrete, Ferro cement material and fibre reinforced concrete.
5.	Understand the concept of high performance concrete.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	**PSO↓** 1	2	
CST111-1.1	1	3	2	3	2	2	2	3	
CST111-1.2	1	3	2	3	2	2	2	3	
CST111-1.3	1	3	2	3	2	2	2	3	
CST111-1.4	1	3	2	3	2	2	2	3	
CST111-1.5	1	3	2	3	2	2	2	3	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Neville A.M, "**Properties of Concrete",** Pearson Education, Asis, 2000.
2.	P. Kumar Mehta, Paul J.N. Monterio, CONCRETE, "**Microstructure, Properties and Materials"**- Tata McGraw Hill

REFERENCE BOOKS:

1.	A.R. Santhakumar, (2007) "Concrete Technology"-Oxford University Press, New Delhi, 2007.
2.	Short A and Kinniburgh. W, "Light Weight Concrete"- Asia Publishing House, 1963
3.	Aitcin P.C. "High performance concrete"-E and FN, Spon London 1998
4.	Rixom.R. and Mailvaganam.N., "Chemical admixtures in concrete"- E and FN, Spon London 1999
5.	Rudnai.G., "Light Weight concrete"- Akademiaikiado, Budapest, 1963.
6.	IS: 10262: 2019 Concrete Mix Proportioning – Guidelines
7.	IS 456-2000 Plain and Reinforced Concrete - Code of Practice

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.nptel.ac.in/noc22_ce09

COLD FORMED LIGHT GAUGE STEEL STRUCTURES			
Course Code:	**22CST112**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**50**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	To understand the concept of local buckling and limiting width to thickness ratio.
2.	Design of structural elements in compression and tension using light gauge steel structures.
3.	Design of light gauge steel structures in flexure.

UNIT-I

Buckling — **10 Hours**

Concept of local buckling of thin elements. Limiting width to thickness ratio. Post buckling strength

Light Gauge sections — **6 Hours**

Forms of light gauge sections, Effective width computation of unstiffened, stiffened, multiple stiffened compression elements

UNIT-II

Compression and Tension Design — **10 Hours**

Design of compression and tension members.

Flexure Design — **6 Hours**

Design of flexural members (Laterally restrained / laterally unrestrained).

UNIT-III

Connection Design — **8 Hours**

Connections in structures composed of light gauge sections

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

1.	Design light gauge steel structural elements in compression.
2.	Design light gauge steel structural elements in tension.
3.	Design light gauge steel structural elements in flexure.
4.	Designing connections in structures composed of light gauge sections.
5.	Design light gauge steel structural elements in compression.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**		
↓ Course Outcomes							1	2	
CST112-1.1	1	3	2	3	2	2	2	3	
CST112-1.2	1	3	2	3	2	2	2	3	
CST112-1.3	1	3	2	3	2	2	2	3	
CST112-1.4	1	3	2	3	2	2	2	3	
CST112-1.5	1	3	2	3	2	2	2	3	

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1. Ramchandra and Virendra Gehlot " Design of Steel Structures " Vol 1 and Vol.2, Scientific Publishers, Jodhpur

2.	IS-801-1975, IS-800-2007, IS-875
3.	B.C. Punmia, A.K. Jain "Design of Steel Structures", Laxmi Publications, New Delhi.
E Books / MOOCs/ NPTEL	
1.	https://nptel.ac.in/courses/105105162

ADVANCED DESIGN OF RCC STRUCTURES			
Course Code:	**22CST113**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**50**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	To provide basic knowledge of mathematics, science and engineering in the areas of advanced RCC design using limit state design
2.	To give procedural knowledge to design a system, component or process as per needs and specifications of advanced RCC structures like silos, bunkers chimneys, grid floor, flat slabs and continuous beams subjected to various loading combination with different end
3.	To imbibe the culture of professional and ethical responsibilities by following codal provisions in the analysis, design and detailing of advanced structural elements for strength and durability.

UNIT-I

Yield Line Analysis and Flat slabs	**10 Hours**
Yield line method of design of slabs, flat slabs	
RCC Grid Floors	**6 Hours**
Design of grid floors	

UNIT-II

Storage Structures	**10 Hours**
Design of storage structures like silos, bunkers and chimneys	
Flexure Design	**6 Hours**
Design of continuous beams with redistribution of moments	

UNIT-III

Curved Beams	**8 Hours**
Design of curved beams	

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

1.	Analyze and design the slabs by yield line method and also capable of designing flat slabs.
2.	Design the grid floors for given practical condition

3.	Effectively design the storage structures like silos, bunkers and chimneys.
4.	Use the concept of redistribution of moments in design.
5.	Reproduce the best building detailing in earthquake prone area and detailing of expansion & contraction joints.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	**PSO↓** 1	2
CST113-1.1	1	3	2	3	2	2	2	3
CST113-1.2	1	3	2	3	2	2	2	3
CST113-1.3	1	3	2	3	2	2	2	3
CST113-1.4	1	3	2	3	2	2	2	3
CST113-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Raju N K "Advanced Reinforced Concrete Design", CBS Publisher
2.	Dr.B.C.Punmia et.al, "Reinforced Concrete Design",Vol – II, Lakshmi Publications

REFERENCE BOOKS:

1.	A Park and Paulay, **"Reinforced Reinforced and Prestressed Concrete"**
2.	Lin TY and Burns N H, "**Reinforced Concrete Design**".
3.	Kong KF and Evans T H "**Design of Prestressed Concrete Structures**
4.	P.C. Varghese, "**Advanced Reinforced Concrete Design**", Prentice-Hall of India, New Delhi, 2005.
5.	Dr.B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, **"Comprehensive RCC Design"**
6.	A Park and Paulay, **"Reinforced and Prestressed Concrete"**
7.	Lin TY and Burns N H, "**Reinforced Concrete Design**".

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/105106176

GREEN BUILDING DESIGN

Course Code:	**22CST121**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**50**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	To understand the concept of high-performance green building and sustainability.
2.	To study and understand the function of materials used for designing green buildings and generate substantial cost savings.
3.	Learn about the selection of mechanical and electrical lighting systems. And learn about green building water supply and waste water supply systems.

UNIT-I

Introduction	**10 Hours**

Introduction. Need for green building- Impact of building industry on energy resources, natural resources and environment. Green building-definition. Principles of green building. Concept of Embodied energy and calculation. Life cycle assessment. Consideration while selecting material and design for longevity

Building Envelope	**6 Hours**

Building envelope- Conventional materials and Use of low energy materials - Base materials for RCC and Steel systems. Alternatives to structural systems, masonry, mortar, plastering, roofing, ceiling, paving, flooring, doors, windows and wood work. Smart materials. Low energy construction- low energy material, locally sourced material and recycled material

UNIT-II

Sustainable siting of building	**10 Hours**

Sustainable siting of building. Orientation of the building. Use of natural light, solar heat and ventilation. Fenestration and shading. Effective cooling and heating systems-solar passive techniques of heating and cooling in a building design. Methods of minimizing load on Conventional systems-Landscaping, water bodies. Building form-surface to volume ratio

Thermal Comfort	**6 Hours**

Thermal Insulation for roof and walls. Glazing and shading systems. Building finishes. Effective electrical systems- photovoltaic systems. Efficient HVAC systems. Efficient lighting system- efficient bulbs, occupancy sensor systems and light sensors. Efficient motors. Energy auditing and Certification systems-GRIHA, LEED BREEAM and IGBC etc

UNIT-III

Water Conservation	**8 Hours**

Conserving water in building- Water efficient fixtures- flow restrictors, sensors, no water fixtures. Alternatives for secondary uses. Rain water harvesting, solar water heaters and solar cooking. Low flush toilets, grey water recycling. Onsite treatment. Eco-friendly toilets. Reducing irrigation water requirements. Vertical farming. Xeriscaping.

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

1.	Apply the concepts of embodied energy and their calculations and design for longevity.
2.	Application of alternative energy efficient materials for various building components.

3.	Orient and plan the building environment to suit to effectively utilize the natural light, solar energy and other sources to ensure effective control on the inside environment of a building.
4.	Understand the implementation of thermal insulation system, energy saving bulbs etc.,
5.	Understand the criteria involved in energy auditing and certification systems- GRIHA, LEED BREEAM and IGBC etc.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**	
↓ Course Outcomes							1	2
CST121-1.1	1	3	2	3	2	2	2	3
CST121-1.2	1	3	2	3	2	2	2	3
CST121-1.3	1	3	2	3	2	2	2	3
CST121-1.4	1	3	2	3	2	2	2	3
CST121-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Prof. Dr. Michael Bauer, Peter Mösle and Dr. Michael Schwarz (2010) "Green Building – Guidebook for Sustainable Architecture" Springer.
2.	Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison (2001) "Green Building Handbook" Volume 1-Spon Press. Editor:
3.	MiliMajumdar, (2002) "Energy-efficient buildings in India" Tata Energy Research Institute.
4.	TERI "Sustainable Building Design Manual- Volume I & II" Tata Energy Research Institute.
5.	Indian Green Building Council: www.igbc.inIGBC Green Homes Abridged Reference Guide
6.	IGBC Green Factory Building Abridged Reference Guide
7.	LEED India NC Reference Guide / LEED India CS Reference Guide
8.	Background material of green building training Program conducted by IGBC

E Books / MOOCs/ NPTEL

1.	Green Rating for Integrated Habitat Assessment: http://grihaindia.org/
2.	United States Green Building Council: http://www.usgbc.org/
3.	The Whole Building Design Guide: http://www.wbdg.org/Technical Manual

AI & EXPERT SYSTEM IN STRUCTURAL ENGINEERING			
Course Code:	**22CST122**	**Course Type**	**PCC**

Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	40	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	Use expert systems to achieve fairly high levels of performance in task areas which require a good deal of specialized knowledge and training.
2.	Develop expert systems to perform tasks which are physically difficult, tedious, or expensive to have a human perform
3.	To make students to learn the principles of software design process

UNIT-I

Software Engineering — **10 Hours**

Introduction of software engineering – Application areas – Software design process – various design – representation techniques. Top – down design, Bottom – up design – modular programming – structural programming – Conversion of non-structured programs – Software testing – Software reliability and availability.

Object Oriented Programming — **6 Hours**

Comparison between procedure – oriented programming and object oriented programming, Advantages of OOP objects, Classes, Data encapsulation, Inheritance, Polymorphism etc. Application of OOP in Analysis and design of RC, PSC and steel structural elements.

Artificial Intelligence: Artificial Intelligence, Introduction, AI – Application fields, defining the problems – state space representation – problem characteristics – production system – production system characteristics

UNIT-II

Design of storage structures — **10 Hours**

Design of storage structures like silos, bunkers and chimne Knowledge representation – Formal logic – predicate logic – logic programming – forward v/s backward reasoning – matching control knowledge. Search and control: Concepts – uniformed blind search: depth first search: depth first search – breadth first search – bi – directional search – informed search – heuristic graph search – generate and test – hill climbing – best first search AND Orgraph search. Non formal knowledge representation – semantic networks – frames – scripts – productions systems. Programming in LISP

Expert Systems — **6 Hours**

Their superiority over conventional software – components of an expert system – expert system life cycle – expert system developments process – nature of expert knowledge – techniques of soliciting and encoding expert knowledge. Inference: Forward chaining-backward chaining – rule value approach.

UNIT-III

	8 Hours

Uncertainty – symbolic reasoning under uncertainty: logic for non – monotonic reasoning. Statistical reasoning: Probability and Bayes theorem – certainty factor and rule based system – Bayesian network – Dempster – Shafer theory. Fuzzy reasoning. Features of rule based, networks based and frame based expert system – examples of expert systems in Construction Management and Structural Engg., Expert system shells. Neural Networks, An introduction – their possible applications in Civil Engg

Course Outcomes: At the Conserving end of the course student will be able to

1.	Achieve knowledge of design and development of problem solving skills.
2.	Understand the principles of object oriented programming.
3.	Design and develop analytical skills.
4.	Summarize the artificial intelligence and expert system.
5.	Understand the concept of knowledge representation.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**	
↓ Course Outcomes							1	2
CST122-1.1	1	3	2	3	2	2	2	3
CST122-1.2	1	3	2	3	2	2	2	3
CST122-1.3	1	3	2	3	2	2	2	3
CST122-1.4	1	3	2	3	2	2	2	3
CST122-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	M.L.Shooman, "**Software Engineering**"- McGraw Hill. Richard Fairly, "**Software Engineering Concepts**"- McGraw Hill.
2.	Timothy Budd, "**An Introduction to Object Oriented Programming in Turbo C++**"- Addison – Wesley Publications
3.	Rober Lafore, "**Object Oriented Programming in Turbo C++**"- Gelgotia Publishers
4.	Balaguruswamy, "**Object Oriented Programming with C++**" TMH Publishing Company Ltd
5.	Rolston, D.W **"Artificial Intelligence and Expert Systems"-** McGraw Hill, New York.
6.	Nilson, N.J., "**Principals of Artificial Intelligence"-** Narosa, New Delhi.
7.	Adeli, H., **"Expert Systems in Constructions and Structural Engg"-** Chapman & Hall, New York

8.	Elaine Rick and Keuin Knight, "**Artificial intelligence**"- Tata McGraw Hill Edition
9.	H.Adeli**, "Expert system in structural design and construction**" Chapman and Hall, 1988.

E Books / MOOCs/ NPTEL	
1.	https://nptel.ac.in/courses/106106140

COMPUTATIONAL STRUCTURAL MECHANICS			
Course Code:	**22CST123**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	To provide basic knowledge of mathematics and numerical techniques to solve problems in structural analysis.
2.	To highlight the various steps involved in analyzing problems related to plane trusses, plane frames and continuous beams using matrix methods, viz., flexibility and stiffness methods.
3.	To enlighten the concept of temperature effects and lack of fit in solving problems of structural analysis

UNIT-I

Brief history of Theory of structures	**10 Hours**

Static and Kinematic indeterminacy, Concepts of stiffness and flexibility. Energy concepts. Principle of minimum potential energy and minimum complementary energy.

Introduction to flexibility and stiffness methods: Development of element flexibility and element stiffness matrices for truss, beam and grid elements

Flexibility method	**6Hours**

Force-transformation matrix – Development of global flexibility matrix for continuous beams, plane trusses and rigid plane frames (having not more than six co-ordinates – 6x6 flexibility matrix), Analysis of continuous beams**,** plane trusses and rigid plane frames (having not more than 3 coordinates

UNIT-II

Stiffness Method	**10 Hours**

Displacement-transformation matrix – Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames (having not more than six co-ordinates – 6x6 stiffness matrix), Analysis of continuous beams, plane trusses and rigid plane frames by stiffness method (having not more than 3 coordinates).

Introduction, Analysis of regular trusses by element approach. Analysis of continuous beams and portal frames by element approach or system approach

Direct Stiffness Method	**6 Hours**

Analysis of continuous beams, plane trusses and rigid plane frames (having not more than 3 coordinates).

UNIT-III

Effects of temperature change and lack of fit	**8 Hours**

Effects of temperature change and lack of fit. Related numerical problems by flexibility and stiffness method as in Units 2 and 4. Solution techniques including numerical problems for simultaneous equations - Gauss elimination and Cholesky methods. Bandwidth consideration

Methods of solving linear simultaneous equations – Gauss elimination method, Cholesky method and Gauss-Siedal method.

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

1.	Develop flexibility and stiffness matrix for truss, beam and grid elements
2.	Analyze beams, frames and trusses by flexibility method
3.	Solve problems on beams, frames and trusses by stiffness method using element approach.
4.	Apply the knowledge of direct stiffness method to analyze problems on beams, frames and trusses.
5.	Use numerical techniques for solving simultaneous equations with the understanding of band width.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**	
↓ Course Outcomes							1	2
CST123-1.1	1	3	2	3	2	2	2	3
CST123-1.2	1	3	2	3	2	2	2	3
CST123-1.3	1	3	2	3	2	2	2	3
CST123-1.4	1	3	2	3	2	2	2	3
CST123-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1. S.Rajasekaran, "**Computational Structural Mechanics**", PHI, New Dehi 2001

2.	C.S.Reddy, "**Basic Structural Analysis**", TMH, New Delhi 2001
3.	F.W.Beaufait et al.,"**Computer methods of Structural Analysis"**, Prentice Hall, 1970.
4.	W.Weaver and J.H.Gere, "**Matrix Analysis of Framed Structures"**, Van Nastran, 1980
5.	H.Karde Stuncer, "**Elementary Matrix Analysis of Structures"**, McGraw Hill, 1974.
6.	A.K.Jain , "**Advanced Structural Analysis with Computer Application" ,** Nemichand and Brothers, Roorkee, India

REPAIR AND RESTORATION OF STRUCTURES			
Course Code:	**22CST131**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Learn the failures of structure due to deterioration of concrete.
2.	Gain the knowledge about difference between the repair and restoration of structures.
3.	Study about the repair materials and compatibility with the parental structure.
4.	Different types of retrofitting to strengthen the existing structures & Types of polymer concrete and epoxy grouting, shotcreting
5.	Damage assessment of reinforced concrete structure methodology and approach

UNIT-I

General	**10 Hours**

Introduction, Cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations, experimental investigations using NDT, load testing, corrosion mapping, core drilling and other instrumental methods. Quality assurance for concrete construction as built, concrete properties - strength, permeability, thermal properties and cracking.

Influence on Serviceability and Durability	**6 Hours**

Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels; cathodic protection.

UNIT-II

Maintenance and Repair Strategies	**10 Hours**

Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance, Importance of Maintenance, Preventive measures on various aspects of inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration - testing techniques.

Materials for Repair | **6 Hours**

Special concretes and mortar, concrete chemicals, Expansive cement, polymer concrete, Sulphur infiltrated concrete, Ferro cement, Fiber reinforced concrete.

Techniques for Repair: Rust eliminators and polymers coating for rebar during repair, foamed concrete, Mortar and Dry pack, Vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, Shoring and Underpinning.

UNIT-III

Strengthening of structures | **8 Hours**

Guide lines for retrofit of concrete structures, Jacketing of Columns – strengthening by interior and external reinforcing, Steel Plate jacketing, External Pre-stressing, Fiber wrapping,

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

1.	Explain the failure and Experimental investigations to be carried out on structures.
2.	Outline the difference between repair and restoration of structures.
3.	Explain the Repair materials compatibility with the Parent structures
4.	Suggest different retrofitting techniques for existing damaged structures.
5.	Explain the damage assessment technique to be followed for RC structures

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	**PSO↓** 1	2
CST131-1.1	1	3	2	3	2	2	2	3
CST131-1.2	1	3	2	3	2	2	2	3
CST131-1.3	1	3	2	3	2	2	2	3
CST131-1.4	1	3	2	3	2	2	2	3
CST131-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Walter F. Silva-Araya, Oladis T. de Rinc¢n, Luis Pumarada-O'Neill. "Repair and Rehabilitation of Reinforced Concrete Structures: The State of the Art.". ASCE Publications, 01-Jan-1998-Technology & Engineering
2.	Sidney., M. Johnson "**Deterioration Maintenance and Repair of Structures**"
3.	R.N. Raikar "**Rehabilitation of Structures**"- Edited by, Vol. 1, 2 and 3, Proc., Int. Symposium, Maharashtra Indian Chapter of ACI, Bombay

4.	Denison Campbell, Allen & Harold Roper, "**Concrete Structures – Materials, Maintenance and Repair**", Longman Scientific and Technical
5.	R.T.Allen and S.C. Edwards, "**Repair of Concrete Structures**", Blakie and Sons
6.	Raiker R.N. "**Learning for failure from Deficiencies in Design, Construction and Service**"- R&D Center (SDCPL)
7.	Santhakumar A.R. "**Training Course notes on Damage Assessment and Repair in Low Cost Housing**", Anna University
E Books / MOOCs/ NPTEL	
1.	Maintenance and Repair of Concrete Structures - Course (nptel.ac.in)
2.	Retrofitting and Rehabilitation of Civil Infrastructure - Course (nptel.ac.in)

DESIGN OF TALL STRUCTURES			
Course Code:	**22CST132**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	The objectives of this course is to make students to learn principles of stability of tall buildings
2.	To design the tall buildings for earthquake and wind resistance.
3.	To understand the behavior of various structural components in tall structures
4.	To analyze and design the various complicated structural components of tall structures
5.	To evaluate the performance of tall structures for strength and stability.

UNIT-I

Design Criteria, Loading and Movement	**10 Hours**
Design philosophy, loading, sequential loading, and materials – high performance concrete, fiber reinforced concrete, lightweight concrete, design mixes. Gravity loading Dead and live load, methods of live load reduction, Impact, Gravity loading, Construction loads	
Wind loading & Earthquake loading	**6 Hours**
Static and dynamic approach, Analytical and wind tunnel experimentation method. Equivalent lateral force, modal analysis, combinations of loading, working stress design, Limit state design, Plastic design	

UNIT-II

Behavior of Various Structural Systems	**10 Hours**
Factors affecting growth, Height and structural form; High rise behavior, Rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, outrigger – braced and hybrid mega system	

Analysis and Design	**6 Hours**

Modeling for approximate analysis, accurate analysis and reduction techniques, analysis of building as total structural system considering overall integrity and major subsystem interaction, analysis for member forces; drift and twist, computerized general three dimensional analyses. Sectional shapes, properties and resisting capacities, design, deflection, cracking, pre-stressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire

UNIT-III

Stability of Tall Buildings	**8 Hours**

Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first order and P-Delta analysis, Transnational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation

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

1.	Achieve Knowledge of design and development of problem solving skills.
2.	Understand the effect of earthquake and wind load on structures.
3.	Understand the behavior of various structural system
4.	Understand the principles of strength and stability Design and develop analytical skills.
5.	Summarize the behavior of various structural systems. Understand the concepts of P-Delta analysis.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	**PSO↓** 1	2
CST132-1.1	1	3	2	3	2	2	2	3
CST132-1.2	1	3	2	3	2	2	2	3
CST132-1.3	1	3	2	3	2	2	2	3
CST132-1.4	1	3	2	3	2	2	2	3
CST132-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Taranath B.S, "**Structural Analysis and Design of Tall Buildings** McGraw Hill
2.	Wilf gang Schuller, "**High rise building structures**"- John Wiley
3.	Bryan Stafford Smith & Alexcoull, "**Tall building structures Analysis and Design**"- John Wiley
4.	T.Y Lin & D.Stotes Burry, "**Structural concepts and system for Architects and Engineers"-** John Wiley

5.	Lynn S.Beedle, "**Advances in Tall Buildings**"- CBS Publishers and Distributors.
6.	Dr. Y.P. Gupta – Editor, "**Proceedings National Seminar on High Rise Structures- Design and Construction practices for middle level cities"-** New Age International Limited.

OPTIMIZATION TECHNIQUES			
Course Code:	**22CST133**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Understand the need and concepts of design optimization
2.	To use conventional and modern optimization methods in structural applications.
3.	To make students to learn the concepts of linear, non-linear, geometric and dynamic optimization techniques

UNIT-I

Introduction	**10 Hours**

Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems. Optimization Techniques: Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms constrained optimization solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques

linear programming	**6 Hours**

Linear programming, standard form of linear programming, geometry of linear programming problems, solution of a system of linear simultaneous equations, pivotal production of general systems of equations, simplex algorithms, revised simpler methods, duality in linear programming

UNIT-II

Non-linear programming	**10 Hours**

Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, Unconstrained optimization methods, direct search methods, random search methods, descent methods

Constrained optimization technique	**6 Hours**

Constrained optimization techniques such as direct methods, the complex methods, cutting plane method, exterior penalty function methods for structural engineering

problems. Formulation and solution of structural optimization problems by different techniques.

UNIT-III

Geometric programming	**8 Hours**

Geometric programming, conversion of NLP as a sequence of LP/ geometric programming. **Dynamic programming:** Dynamic programming conversion of NLP as a sequence of LP/ Dynamic programming

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

1.	Achieve the knowledge of design and development of problem solving skills.
2.	Understand the principles of optimization.
3.	Summarize the linear, non-linear and geometric programming.
4.	Implement the concept of dynamic programming.
5.	Develop analytical ability to implement optimization techniques to structural problems.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**	
↓ Course Outcomes							1	2
CST133-1.1	1	3	2	3	2	2	2	3
CST133-1.2	1	3	2	3	2	2	2	3
CST133-1.3	1	3	2	3	2	2	2	3
CST133-1.4	1	3	2	3	2	2	2	3
CST133-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Spunt, "**Optimum Structural Design**"- Prentice Hall
2.	S.S. Rao, "**Optimization – Theory and Practice**"- Wiley Eastern Ltd.
3.	Uri Krisch, "**Optimum Structural Design**"- McGraw Hill
4.	Richard Bronson, "**Operation Research**"- Schaum's Outline Series
5.	Bhavikatti S.S.- "**Structural optimization using sequential linear programming"-** Vikas publishing house

DESIGN OF CONCRETE BRIDGES			
Course Code:	**22CST211**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	The objectives of this course is to make students to learn principles and design of Concrete Bridges
2.	To design the Concrete Bridges for various loading conditions as per IRC Standards.
3.	To understand the various design procedures and feasibility for concrete bridges.
4.	To understand the design complications of various types of bridges for various classes of vehicle loading
5.	To learn the structural detailing of Concrete bridges.

UNIT-I

Introduction Bridges and Bridge substructures: Historical Developments, Site Selection for Bridges, Classification of Bridges Forces on Bridges**.** Abutments, piers and wing walls.

Box Culvert: Different Loading Cases IRC Class AA Tracked, Wheeled and Class A Loading, working out the worst combination of loading, Moment Distribution, Calculation of BM & SF, Structural Design of Slab Culvert, with Reinforcement Details.	**10 Hours**

UNIT-II

T Beam Bridge Slab Design: Proportioning of Components Analysis of interior Slab & Cantilever Slab Using IRC Class AA Tracked, Wheeled Class A Loading, Structural Design of Slab, with Reinforcement Detail. T Beam Bridge Cross Girder Design: Analysis of Cross Girder for Dead Load & Live Load Using IRC Class AA Tracked, Wheeled Class A Loading A Loads, Structural Design of Beam, with Reinforcement Detail. T Beam Bridge Main Girder Design: Analysis of Main Girder for Dead Load & Live Load Using IRC Class AA Tracked, Wheeled Class A Loading Using COURBON'S Method, Analysis of Main Girder Using HENDRY-JAEGER and MORICE-LITTLE Method for IRC Class AA Tracked vehicle only, BM & SF for different loads, Structural Design of Main Girder With Reinforcement Details **PSC Bridges:** Introduction to Pre and Post Tensioning, Proportioning of Components, Analysis and Structural Design of Slab, Analysis of Main Girder using COURBON's Method for IRC Class AA tracked vehicle, Calculation of pre-stressing force, cable profile and calculation of stresses, Design of End block and detailing of main girder	**10 Hours**

UNIT-III

Balanced Cantilever Bridge:	**8 Hours**
Introduction and proportioning of components, Design of simply supported portion and design of cantilever portion, design of articulation	

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

1.	Achieve Knowledge on history of bridges and various components of bridges
2.	Learn the design of Box and Slab culvert and its structural detailing.
3.	Learn the design of T-Beam bridge Slab, cross girder and main girder and its structural detailing

4.	Understand the principles PSC Bridge design and structural detailing
5.	Achieve Knowledge on design of Balance cantilever Bridge.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	PSO↓ 1	PSO↓ 2
CST211-1.1	1	3	2	3	2	2	2	3
CST211-1.2	1	3	2	3	2	2	2	3
CST211-1.3	1	3	2	3	2	2	2	3
CST211-1.4	1	3	2	3	2	2	2	3
CST211-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	**"Essentials of Bridge Engineering"**- D Johnson Victor, Oxford & IBH Publishing Co New Delhi
2.	**"Design of Bridges"-** N Krishna Raju, Oxford & IBH Publishing Co New Delhi
3.	**"Principles and Practice of Bridge Engineering"-** S P Bindra Dhanpat Rai & Sons New Delhi
4.	IRC 6 – 1966 "**Standard Specifications And Code Of Practice For Road Bridges"-** Section II Loads and Stresses, The Indian Road Congress New Delhi
5.	IRC 21 – 1966 "**Standard Specifications And Code Of Practice For Road Bridges"-**Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi
6.	IS 456 – 2000 "**Indian Standard Plain and Reinforced Concrete Code of Practice"-** (Fourth Revision) BIS New Delhi
7.	IS 1343 – "**Indian Standard Prestressed Concrete Code of Practice"-** BIS New Delhi
8.	Raina V.K., "**Concrete Bridge Practice**"- Tata McGraw Hill
9.	Bakht B & Jaeggar, "**Bridge Analysis Simplified**"- McGraw Hill
10.	Ponnuswamy . S, "**Bridge Engineering**"- Tata McGraw Hill.
11.	Derrick Beckett, "**An Introduction to Structural Design of Concrete**

RELIABILITY ANALYSIS OF STRUCTURES

Course Code:	**22CST212**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Understand the concepts and techniques of reliability and probability

	distributions
2.	Define safety format or failure surface for a given actions and response along with their statistics.
3.	Arrive at mean value of a dominant design parameter for the target reliability index

UNIT-I

Preliminary Data Analysis — **10 Hours**

Preliminary Data Analysis: Graphical representation- Histogram, frequency polygon, Measures of central tendency- grouped and ungrouped data, measures of dispersion, and measures of asymmetry.

Curve fitting and Correlation: Fitting a straight line, curve of the form $y= ab^{x}$ and parabola, Coefficient of correlation

Concepts of Structural Safety — **6 Hours**

Concepts of Structural Safety

Basics of statistics and Probability- Statistical parameters and their significance, Histograms, frequency polygon, measures of central tendency- grouped and un grouped data,

Curve fitting and correlation: Fitting a straight line and parabolic variation, curve of the form $y=ab^{x}$ and $y= a^{x}b$, coefficient of correlation

UNIT-II

Random variables and Probability distributions — **10 Hours**

Random variables and Probability distributions: Random variables, Description of common probability distributions. Hypothesis tests- acceptance and rejection testing - Chi square test, KS test. Probability mass function, probability density function, Mathematical expectation, Chebyshev's theorem. Discrete distributions- Binomial and poison distributions, Continuous distributions- Normal, Log normal distributions.

Statistical Quality Control in Civil Engineering — **6 Hours**

Characteristic strength and Characteristic load, Probability modeling of strength, Geometrical dimensions material properties and loading. Application problems

UNIT-III

Balanced Cantilever Bridge — **8 Hours**

Introduction and proportioning of components, Design of simply supported portion and design of cantilever portion, design of articulation

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

1.	Achieve Knowledge on history of bridges and various components of bridges
2.	Learn the design of Box and Slab culvert and its structural detailing
3.	Learn the design of Box and Slab culvert and its structural detailing
4.	Understand the principles PSC Bridge design and structural detailing
5.	Achieve Knowledge on design of Balance cantilever Bridge.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**

↓ Course Outcomes							1	2
CST212-1.1	1	3	2	3	2	2	2	3
CST212-1.2	1	3	2	3	2	2	2	3
CST212-1.3	1	3	2	3	2	2	2	3
CST212-1.4	1	3	2	3	2	2	2	3
CST212-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Ranganathan, R. (1999). **"Structural Reliability Analysis and design"-** Jaico publishing house, Mumbai, India.
2.	Ang, A. H. S., and Tang, W. H. (1984). **"Probability concepts in engineering planning and design"-** Volume –I, John Wiley and sons, Inc, New York.
3.	Ang, A. H. S., and Tang, W. H. (1984). **"Probability concepts in engineering planning and design"-**Volume –II, John Wiley and Sons, Inc., New York.
4.	Thoft- Christensen, P., and Baker, M. J., **"Structural reliability theory and its applications",** Springer-Verlag, Berlin, New York. 1982.
5.	Haldar A., and Mahadevan S.,(2000). **"Probability, reliability and statistical methods in engineering design"**. John Wiley and Sons, New York.
6.	Robert E. Melchers (2002) , **"Structural reliability analysis and prediction",** 2nd edition, John Wiley & Sons, Inc, New York.

E Books / MOOCs/ NPTEL

1.	Structural Reliability - Course (nptel.ac.in)

DESIGN CONCEPTS OF SUBSTRUCTURES

Course Code:	**22CST213**	**Course Type**	**PCC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Study the preliminary exposure to soil exploration and fundamental requirements of foundation design and requirement.
2.	Design and analysis of various foundations.
3.	Study of deep foundation, design, analysis and the stability checks.
4.	Study of preliminary analysis and design aspects of pile groups.
5.	Study the different types of well foundations and carry out the analysis.

UNIT-I

Shallow Foundation	**16 Hours**

Introduction, Site investigation, In-situ testing of soils, Subsoil exploration, Classification of foundations systems. General requirement of foundations, Selection of foundations, Computations of Loads, Design concepts. Shallow foundations in clay, Shallow foundation in sand & C-Φ soils.

Design concepts of Combined footings (rectangular & trapezoidal), strap footings & wall footings, Types of rafts, bearing capacity & settlements of raft foundation, Rigid methods, Flexible methods, soil-structure interaction, different methods of modeling the soil. Raft – superstructure interaction effects & general concepts of structural design.

UNIT-II

Deep Foundation	**16 Hours**

Introduction to deep foundations, Load Transfer in Deep Foundations, Types of Deep Foundations, Ultimate bearing capacity of different types of piles in different soil conditions, Laterally loaded piles, tension piles & batter piles, under reamed piles.

Pile groups: Bearing capacity, Efficiency of pile groups, settlement, uplift capacity, load distribution between piles, Negative skin friction of single piles and pile groups –Settlement of pile groups in clays, Equivalent raft approach – Settlement of pile groups in sands, Proportioning and design concepts of piles. Pile load tests.

UNIT-III

Well Foundations	**08 Hours**

Components of a well foundation, Types, Analysis of well foundations, Design principles, Well construction and sinking. Problems encountered in well sinking–Tilts and Shifts– Causes – Permissible tilts and shifts - Methods to rectify tilts and shifts – Forces acting on a well foundation –Allowable bearing pressure – Lateral stability of well foundations

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

1.	Explain the basic requirements for foundations and design foundations
2.	Analyze and design the various types of foundations and also to check their stability
3.	Analyze and design of pile foundations.
4.	Analyze and design pile group and estimate the efficiency of a Pile Group
5.	Describe the types of well foundations

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓** 1	2
22CST213.1	1	1											1	3
22CST213.2	2	2	3										2	3
22CST213.3	1	2	3										2	3
22CST213.4	3	2	2										2	3
22CST213.5	1	2	2										2	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Swami Saran – **"Analysis & Design of Substructures"-** Oxford & IBH Pub. Co. Pvt. Ltd., 1998.
2.	Gopal Ranjan and Rao A.S.R., **"Basic and Applied Soil Mechanics",** New Age International Pvt Ltd, Publishers (2016)

REFERENCE BOOKS:	
1.	Murthy V.N.S.,(2018), **"Principles of Soil Mechanics and Foundation Engineering",** UBS Publishers Distributors Pvt. Ltd.
2.	B. M. Das, and Nagaratnam (2019)**, "Principles of Foundation Engineering**, Ninth Edition, SI Edition.
3.	Venkatramaiah C (2006), **"Geotechnical Engineering",** Universities Press (India) Ltd.
4.	Relevant codes of Bureau of Indian Standards.
E Books / MOOCs/ NPTEL	
1.	https://onlinecourses.nptel.ac.in/noc21_ce76
2.	Rock Mechanics and Tunneling - Course (nptel.ac.in)

FRACTURE MECHANICS OF CONCRETE			
Course Code:	**22CST221**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Understand concepts of fracture mechanics of concrete.
2.	Explain the stress function, strain energy, and relationship between stress intensity factor.
3.	Explain the crack propagation in linear materials and principles of nonlinear fracture mechanics.
4.	Examine Structure and fracture process of concrete and microstructure of concrete.
5.	Explain nonlinear fracture mechanics, energy dissipation and Comments on Effective-Elastic Crack Approach

UNIT-I

Failure of structure	**10 Hours**

Failure of Structures Structural Failure Based on Material Performance, Concepts of Linear Elastic Fracture Mechanics, Fracture Mechanics of Concrete and Rock, Structural Design in Terms of Failure Process: Serviceability Slate Strength State.

Principles of Linear Elastic Fracture Mechanics	**6 Hours**

Principles of Linear Elastic Fracture Mechanics: Airy Stress Functions for Plane Problems in Elasticity, Complex Stress Function, Elastic Stress and Displacement Fields at Crack Tip, Stress Intensity Factors and Crack Opening displacements for Some Useful Geometries: Uniaxial Tensile Plate with Center Crack and Uniaxial Tensile Plate with Double-Edge crack, Uniaxial Tensile Plate with Single-Edge crack, Three point bend beams, center crack plate subjected to wedge forces, single edge crack plate subjected to wedge forces. Super position of stress intensity factors, plastic zone at crack tip, griffith fracture theory, strain energy release rate for crack propagation, relationship between stress intensity factor and strain energy release rate, measurement of Kt for metallic materials, design based on linear elastic fracture mechanics.

UNIT-II

Principles of non linear fracture mechanics	**10 Hours**

Principles of non linear fracture mechanics. Energy principles for crack propagation in linear materials, J-Integral for non linear elastic materials, fracture resistance (R curve), crack tip opening displacement, measurements of J-R curves and CTOD for metallic materials

Fracture behavior	**6 Hours**

Structure and fracture process of concrete Constituents and microstructure of concrete, fracture behavior and strain localization of concrete, Fracture Process Zone and Toughening mechanisms. Experimental Determination of Fracture Process Zone: Laser Holographic Interferometry, Acoustic Emission, Dye Penetration. Influence of Fracture Process Zone on Fracture Behavior of Concrete

UNIT-III

Nonlinear Fracture Mechanics	**8 Hours**

Nonlinear Fracture Mechanics for Mode I Quasi-Brittle Fracture General Description of Quasi-Brittle Fracture, Fictitious Crack Approach: Energy Dissipation for Fictitious Crack, Fictitious Crack Model by Hillerborg, Crack Band Model by Bazant and Oh, Determination and Influence of σ(w) Relationship, Comments on Fictitious Crack Approach. Effective-Elastic Crack Approach: Energy dissipation for effective-elastic crack, Two-Parameter Fracture Model by Jenq and Shah. Size Effect Model by Bazunt and Kazemi, Effective Crack Model by Karihaloo and Nallathambi, Effective Crack Model by Refai and Swartz, Comments on Effective-Elastic Crack Approach

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

1.	Brief the concepts of fracture mechanics of concrete
2.	Derive the stress function, strain energy, and relationship between stress intensity factor
3.	Brief the crack propagation in linear materials and principles of non linear fracture mechanics
4.	Brief the structure and fracture process of concrete and microstructure of concrete.
5.	Analyse the energy dissipation and comments on effective elastic crack approach.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	**PSO↓** 1	2
CST221-1.1	1	3	2	3	2	2	2	3
CST221-1.2	1	3	2	3	2	2	2	3
CST221-1.3	1	3	2	3	2	2	2	3
CST221-1.4	1	3	2	3	2	2	2	3
CST221-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1. B. L. Karihaloo, "Fracture Mechanics and Structural Concrete", Concrete design and

	construction series, Pearson Education Limited , Harlow, United Kingdom, 1995.
2.	Surendra p Shah, Stuart E Swartz and Chengsheng Ouyang, "Fracture Mechanics of Concrete: Applications of Fracture Mechanics to Concrete, Rock and Other Quasi-Brittle Materials", John Wiley & Sons INC.2002.w
E Books / MOOCs/ NPTEL	
1.	Engineering Fracture Mechanics - Course (nptel.ac.in)

STABILITY ANALYSIS OF STRUCTURES			
Course Code:	**22CST222**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Learn the principles of stability of structures.
2.	To analyze the structural elements for stability.
3.	To evaluate the use of strain energy in the plate bending and stability.

UNIT-I

Beam – column	**10 Hours**

Differential equation. Beam column subjected to (i) lateral concentrated load, (ii) several concentrated loads, (iii) continuous lateral load. Application of trigonometric series, Euler's formulation using fourth order differential equation for pined – pined, fixed – fixed, fixed – free and fixed – pinned column

Buckling of frames and continuous beams.	**6 Hours**

Elastica74. Energy method – Approximate calculation of critical loads for a cantilever. Exact critical load for hinged – hinged column using energy approach. Buckling of bar on elastic foundation. Buckling of cantilever column under distributed loads. Determination of critical loads by successive approximation. Bars with varying cross section Effect of shear force on critical load. Column subjected to non –conservative follower and pulsating forces

UNIT-II

Stability analysis by finite element approach	**10 Hours**

deviation of shape function for a two nodded Bernoulli – Euler beam element (lateral and translation of) – element stiffness and element geometric stiffness matrices – assembled stiffness and geometric stiffness matrices for a discretised column with different boundary condition – calculation of critical loads for a discretised (two elements) column (both ends built in). Buckling of pin jointed frames (maximum of two active dof) – symmetrical single bay portal frame

Lateral buckling of beams	**6 Hours**

differential equation – pure bending – cantilever beam with tip load – simply supported beam of I section subjected to central concentrated load. Pure Torsion of thin – walled bars of open cross section. Non – uniform Torsion of thin – walled bars of open cross section

UNIT-III	
Buckling of simply supported rectangular plate	**8 Hours**

Expression for strain energy in plate bending with in plate forces (linear and non – linear). Buckling of simply supported rectangular plate – uniaxial load and biaxial load. Buckling of uniformly compressed rectangular plate simply supported along two opposite sides perpendicular to the direction of compression and having various edge condition along the other two sides.

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

1.	Achieve knowledge of design and development of problem solving skills
2.	Understand the principles of strength and stability
3.	Design and develop analytical skills
4.	Appraise the stability analysis by finite element approach
5.	Understand the concept of lateral buckling of beams.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**	
↓ Course Outcomes							1	2
CST222-1.1	1	3	2	3	2	2	2	3
CST222-1.2	1	3	2	3	2	2	2	3
CST222-1.3	1	3	2	3	2	2	2	3
CST222-1.4	1	3	2	3	2	2	2	3
CST222-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Stephen P.Timoshenko, James M Gere, "Theory of Elastic Stability"-2nd Edition, McGraw – Hill, New Delhi
2.	S.Rajashekar, "Computations and Structural Mechanics"- Prentice – Hall, India
3.	Ray W Clough and J Penzien, "Dynamics of Structures" - 2nd Edition, McGraw Hill, New Delhi
4.	H.Zeiglar, "Principles of Structural Stability"-Blaisdall Publications.

E Books / MOOCs/ NPTEL

1.	Elastic Stability of Structures - Course (nptel.ac.in)

DESIGN OF EARHQUAKE RESISTANT STRUCTURES			
Course Code:	**22CST223**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	To give preliminary exposure to design of earthquake engineering
2.	To outline Seismic response of building and response history behaviors for

	different time period.
3.	Improve analytical skill and problem solving abilities
4.	Design some earthquake resistant structures
5.	Explain the earthquake resistant of masonry structures

UNIT-I

Introduction to engineering seismology	**10 Hours**

Introduction to engineering seismology, Seismic Waves, Characteristics of Earthquake and its quantification, Magnitude and Intensity, Seismic Instruments, Strong Ground Motions, Characteristics of Earthquakes, Attenuation of the Ground motion, History of Major Earthquakes in India

Seismic response of buildings	**6 Hours**

Seismic response of buildings, Study of response of buildings and structures due to past earthquakes, Complexity of Earthquake Ground Motion.
Response Spectrum- elastic and elasto-plastic spectra, tripartite plot, use of response spectrum in earthquake resistant design

UNIT-II

Earthquake analysis of multi-storied RC structure	**10 Hours**

Earthquake analysis of multi-storied RC structure, discussion of IS code provisions of Earthquake resistant design of buildings. Analysis and design of RCC multistoried buildings by limit state method using static and dynamic method

Structural configuration for earthquake resistant design frames	**6 Hours**

Structural configuration for earthquake resistant design frames, shear walls and dual systems, Seismic Resistant Structural Systems Ductility and energy absorption in buildings, details of providing ductility in structures, lessons from structural damage during past earthquakes. Art of detailing earthquake resistant structures, expansion and contraction joints in buildings

UNIT-III

Concepts for Earthquake resistant masonry	**6 Hours**

Concepts for Earthquake resistant masonry: lateral load analysis of masonry building, basis of flexibility of diaphragm, strength and material properties of masonry, Causes to failure of masonry structures and remedial measures taken to retrofit the structures, causes of damage in masonry building, poor performance of masonry building, Behavior of unreinforced and reinforced masonry wall, preparation of earthquake resistance of earthen building, in plane stiffness of wall with openings, Seismic behavior of masonry buildings during past earthquake, earthquake resistant design of masonry building- IS codal provisions.

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

1.	Explain the basic principles and history of earthquake engineering
2.	Analyze Seismic response of building and response history behaviors for different earthquake data for different time period
3.	Ability to deal with practical problems in earthquake engineering in static and

	dynamic loading
4.	Suggest earthquake resistant design methods of shear wall, dual system and important of ductility in structures
5.	Understand the concept of earthquake resistant of masonry structures.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	PSO↓ 1	PSO↓ 2
CST223-1.1	1	3	2	3	2	2	2	3
CST223-1.2	1	3	2	3	2	2	2	3
CST223-1.3	1	3	2	3	2	2	2	3
CST223-1.4	1	3	2	3	2	2	2	3
CST223-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Minoru Wakabayashi, "**Design of Earthquake Resistant Buildings**", McGraw Hill Pub
2.	Anil K Chopra, "**Dynamics of Structures – Theory and Application to Earthquake Engineering**", 2nd ed., Pearson Education pub.
3.	Anderson, R .A., "**Fundamentals of Vibrations**", Mc Millan
4.	IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993
5.	Timoshenkeo, S., "**Vibration and Structural Dynamics**", Van Nostrand Co.
6.	Clough and Penzien, "**Dynamics of Structures"**. McGraw Hill
7.	Mukyopadhyaya, "**Vibration and Structural Dynamics**", Oxford & IBH
8.	James Ambrose and Dimitry Vergun, **"Design for Earthquakes".**
9.U963.	David Key, "**Earthquake Design Practice for Buildings**", Thomas Telford
E Books / MOOCs/ NPTEL	
1.	Earthquake Resistant Design of Foundations - Course (nptel.ac.in)
2.	NPTEL :: Civil Engineering - NOC:Earthquake Resistant Design of Foundations

CHARACTERIZATION OF CONSTRUCTION MATERIALS [NPTEL COURSE]

Course Code:	**22CCT231***	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Prof. Manu Santhanam, Prof. Piyush Chaunsali | IIT Madras

Course Objectives:

1.	To introduce students to the characterization of construction materials and their behaviour, with a view of developing their understanding of the mechanisms that govern the performance of these materials.

2.	To focus primarily on cement and concrete, and include the following techniques; the physics of the techniques and their application to cement science.

COURSE LAYOUT

Week 1:	Introduction to course; Structure of Construction Materials – An Overview
Week 2:	Calorimetry
Week 3:	X-ray diffraction
Week 4:	X-ray diffraction
Week 5:	Thermal analysis
Week 6:	Surface area measurement
Week 7:	Optical microscopy
Week 8:	Scanning electron microscopy
Week 9:	Image analysis
Week 10:	Spectroscopic techniques
Week 11:	Mercury intrusion porosimetry
Week 12:	Impedance analysis and ultrasonic methods

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

1.	Describe the characterization of construction materials and their behaviour, mechanisms that govern the performance of these materials.
2.	Explain cement and concrete physics and their application to cement science.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	PSO↓ 1	PSO↓ 2
22CCT231-1.1	2	2	2				2	
22CCT231-1.2		1	2	2			2	

1: Low 2: Medium 3: High

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
Exam score = 75% of the proctored certification exam score out of 100
Final score = Average assignment score + Exam score

NOTE

- You will be eligible for a certificate only if average assignment score >=10/25 and exam score >= 30/75. If one of the 2 criteria are not met, you will not get the certificate even if the Final score >= 40/100.
- Certificate will have your name, photograph and the score in the final exam with the breakup.
- It will have the logos of NPTEL and IIT Guwahati.
- It will be e-verifiable at nptel.ac.in/noc.

REFERENCE BOOKS:

1.	Karen Scrivener, Ruben Snellings, Barbara Lothenbach, A Practical Guide to Microstructural Analysis of Cementitious Materials, CRC Press, 2015.

2.	V. S. Ramachandran and James J. Beaudoin, Eds., Handbook of Analytical Techniques in Concrete Science and Technology, William Andrew Publishing, New York, 2001.
3.	D A St. John, A. W. Poole, and I. Sims, Concrete Petrography – A Handbook of Investigative Techniques, Arnold Publishing. London, 1998.
4.	William D. Callister, Materials Science and Engineering: An Introduction, Sixth Edition, John Wiley and Sons, 2003.
5.	J. M. Illston and P. L. J. Domone, Construction Materials – Their Nature and Behaviour, Third Edition, Spon Press, 2001.
6.	Jan Skalny, Editor, Materials Science of Concrete, Volumes I – VII, American Ceramic Society, 1989 – 2005.
7.	J.F. Young, S. Mindess, R.J. Gray and A. Bentur, The Science and Technology of Civil Engineering Materials, Prentice Hall, 1998.

THEORY OF PLATES AND SHELLS

Course Code:	**22CST232**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Understand the theory of thin plates with the possible solution related to small deflection
2.	Know the types of shells along with membrane theory
3.	Learn the design concepts and detailing of folded plates and simple shells

UNIT-I

Introduction to plate theory — **10 Hours**

Introduction to plate theory, Small deflection of laterally loaded thin rectangular plates for pure bending. Navier's and Levy's solution for various lateral loading and boundary conditions (No derivation), Numerical examples.

Energy methods — **6 Hours**

Energy methods for rectangular and circular plates with clamped edges subjected to symmetric loadings.

UNIT-II

Introduction to curved surfaces — **10 Hours**

Introduction to curved surfaces and classification of shells, Membrane theory of spherical shells, cylindrical shells, hyperbolic paraboloids, elliptic paraboloid and conoids

Spherical shells — **6 Hours**

Axially symmetric bending of shells of revolution, Closed cylindrical shells, water tanks, spherical shells and Geckler's approximation. Bending theory of doubly curved shallow shells.

UNIT-III

Design of folded plates — **8 Hours**

Design and detailing of folded plates with numerical examples, Design and Detailing of simple shell problems – spherical domes, water tanks, barrel vaults and hyperbolic paraboloid roofs

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

1.	Analyse laterally loaded thin plate problems with small deflections
2.	Discuss energy methods of symmetrical loaded rectangular and circular plates with clamped edges
3.	Analyse different types of shells using membrane theory
4.	Analyse symmetric bending of shells of revolution
5.	Design and detail folded plates and simple shells

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	**PSO↓** 1	2
CST232-1.1	1	3	2	3	2	2	2	3
CST232-1.2	1	3	2	3	2	2	2	3
CST232-1.3	1	3	2	3	2	2	2	3
CST232-1.4	1	3	2	3	2	2	2	3
CST232-1.5	1	3	2	3	2	2	2	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Timoshenko, S. and Woinowsky-Krieger, W., "Theory of Plates and Shells" 2nd Edition, McGraw-Hill Co., New York, 1959
2.	Ramaswamy G.S. – "Design and Constructions of Concrete Shell Roofs" – CBS Publishers and Distributors – New Delhi – 1986.
3.	Ugural, A. C. "Stresses in Plates and Shells", 2nd edition, McGraw-Hill, 1999.
4.	R. Szilard, "Theory and analysis of plates - classical and numerical methods", Prentice Hall,1994.
5.	Chatterjee.B.K. – "Theory and Design of Concrete Shell", – Chapman & Hall, New York-third Edition, 1988.

E Books / MOOCs/ NPTEL

1.	https://archive.nptel.ac.in/courses/105/103/105103209/
2.	Plates and Shells - Course (nptel.ac.in)

GROUND IMPROVEMENT, TUNNELLING & PRECAST TECHNIQUE (Industry Offered Course)

Course Code:	**22CCT233****	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1.	Develop ability to analyze weak and compressible soil and provide proper treatment to improve its characteristics.
2.	Understand the underlying principle in dynamic consolidation. Select proper method for anchors, grouting and vacuum consolidation.
3.	Study of preliminary analysis of and requirements of different types of Tunnels
4.	Excavation and Construction of various Tunnels.
5.	Understand the advances in pre-cast constructions.

UNIT-I

Ground Improvement Techniques — **16 Hours**

Engineering properties of soft & weak and compressible deposits; principles of treatment; Methods of soil improvement-lime stabilization and injection; thermal, electrical and chemical methods. Dynamic consolidation; vibroflotation; compaction by blasting; pre-consolidation with vertical drains; Granular piles; soil nailing. Anchors; Grouting; Electro-osmosis; Soil freezing; Vacuum consolidation; Case histories Soil confinement

UNIT-II

Tunnelling — **08 Hours**

Scope and application, art of tunnelling, future tunnelling considerations, size, shape, purpose, geological aspects, Types and purpose of tunnels; factors affecting choice of excavation technique; Methods: soft ground tunnelling, hard rock tunnelling, shallow tunnelling, deep tunnelling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures

Excavation of large and deep tunnels — **08 Hours**

Introduction; purpose and use; excavation issues; excavation methods- unit operations, different equipment, types of rock pressure and methods to deal, roof and wall supports, case studies from hydel, road and rail tunnels, ground treatment for adverse conditions.
Introduction and advantages of shield tunneling; classification; different types of shield tunneling techniques-Conventional shields, EPBS, segmental lining, cost calculations Tunneling by Road headers and Impact Hammers: Cutting principles, method of excavation, selection, performance, limitations and problems. Tunneling by Tunnel Boring Machines: Boring principles, method of excavation, selection, performance, limitations and problems; TBM applications.

UNIT-III

Precast Constructions — **08 Hours**

Ecowall, elements, Benefits and Application

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

1.	Propose proper treatment method for soft, weak and compressible soil strata.
2.	Planning and design of suitable method of advanced soil stabilization for a site.
3.	Describe the tunnelling procedures for various conditions.
4.	Explain the operations and functioning of Tunnel boring machine.
5.	Interpret the advances in pre-cast technology in construction sector.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	PSO↓ 1	PSO↓ 2
22CCT233-1.1	3			1	1	3	1	3
22CCT233-1.2	2	3	2	2	2	2	2	1
22CCT233-1.3	3	2	2	1	1	3	1	2
22CCT233-1.4	2	3	2	2	2	2	2	1
22CCT233-1.5	3	2		1	1	3	1	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Purushotham Raj, "Ground Improvement Techniques".
2.	Design and construction of tunnels by Pietro Lunardi, Springer-Verlag Berlin Heidelberg 2008

REFERENCE BOOKS:

1.	Manfredd RH, "Engineering Principles of Ground Modification", Mc Graw Hill
2.	R. Srinivasan, "Harbour, Dock and Tunnel Engineering", Charotar Publishing House Pvt. Ltd., Anand (Gujarat), 27th Revised edition, 2015.
3.	C Venkatramaiah, "Transportation Engineering", Volume II: Railways, Airports, Docks and Harbours, Bridges and Tunnels, Oxford University Press, New Delhi, 1st edition 2016.
4.	Kim S. Elliott, "Precast Concrete Structures" 2nd edition, CRC Press, 2019.

Audit Courses

NBC 2016 PART I

Course Code:	22CSTAU1	Course Type	AU
Teaching Hours/Week (L: T: P: S)	2:0:0:0	Credits	02
Total Teaching Hours	30	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	To APPLY PROVISIONS OF THE NBC
2.	The Fire and Life Safety in Solving Engineering Problems.
3.	The Building Services in Solving Engineering Problems.
4.	The Plumbing Services in Solving Engineering Problems.

UNIT-I

Prerequisite for Applying Provisions of the Code, Organization and Enforcement Development Control Rules and General Building Requirements Fire and Life Safety	**15 Hours**

UNIT-II

Building Services Lighting and Ventilation Electrical and Allied Installations Air Conditioning, Heating and Mechanical Ventilation Acoustics, Sound Insulation and Noise Control Installation of Lifts and Escalators	**15 Hours**

UNIT-III

Water Supply, Drainage and Sanitation, Solid Waste Management, Gas Supply	**10 Hours**

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

1.	Use and Apply the NBC to Civil Engineering
2.	Solve Engineering Problems

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	PSO↓		
↓ Course Outcomes							1	2	3
22CSTAU1-1.1	3	2	2	1	2	2	1	3	
22CSTAU1-1.2	2	3	1	1	2	2	2	1	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	National Building Code of India 2016 Volume I, Bureau of Indian Standards

NBC 2016 PART II

Course Code:	22CSTAU2	Course Type	AU
Teaching Hours/Week (L: T: P: S)	2:0:0:0	Credits	02

Total Teaching Hours	30	CIE + SEE Marks	50+50

Teaching Department: Civil Engineering

Course Objectives:

1.	The use of Landscape planning and development in civil engineering.
2.	The sustainability approach in solving engineering problems.
3.	The Asset and Facility Management
4.	The prefabrication and composite construction for advanced construction.
5.	

UNIT-I

Landscape Development, Signs and Outdoor Display Structures: Landscape Planning, Design and Development, Signs and Outdoor Display Structures.	**15 Hours**

UNIT-II

Approach to Sustainability, Asset and Facility Management	**15 Hours**

UNIT-III

Prefabrication, Systems Building, Mixed/Composite Construction	**10 Hours**

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

1.	Use and Apply the NBC to Civil Engineering
2.	Apply in solving engineering problems

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**		
↓ Course Outcomes							1	2	
22CSTAU2-1.1	3	2	2	1	2	2	1	3	
22CSTAU2-1.2	2	3	1	1	2	2	2	1	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	National Building Code of India 2016 Volume II, Bureau of Indian Standards

Research Experience Through Practice

RESEARCH EXPERIENCE THROUGH PRACTICE -1

Course Code:	**22CST105**	**Course Type**	**RETP**
Teaching Hours/Week (L: T: P)	**0:0:4**	**Credits**	**2**
Total Teaching Hours	**0+0+52**	**CIE**	**100**

Teaching Department: Any

Course Objectives: The research purposes are

1. To foresee future problems through pursuit of truth as a "global centre of excellence for intellectual creativity".
2. To respond to current social demands, and to contribute to the creation and development of scientific technologies with the aim of realizing an affluent society and natural environment for humanity.
3. At the same time, the course aims to create excellent educational resources and an excellent educational environment through frontline researches
4. To Understand professional writing and communication contexts and genres, analyzing quantifiable data discovered by researching, and constructing finished professional workplace documents.

Individual PG Students are to be allotted to the individual faculty members based on student's area of research interest, specialization of faculty members in the beginning of the first semester.

MODULE -1

Defining the research problem – Selecting the problem – Necessity of defining the problem - Techniques involved in defining the problem – Importance of literature review in defining a problem – Survey of literature – Primary and secondary sources – Reviews, treatise, monographs patents – web as a source – searching the web – Identifying gap areas from literature review – Development of working hypothesis, systematic way of conducting research, write a review / research paper, research proposal, preparation of research report.

MODULE-2

- Introduction various simulation tools related to Structural Engineering
- Use of software tools (STAAD.Pro, ETABS, MIDAS Lab, MATLAB-Simulink)
- Introduction to typesetting tool (Latex).
- At the end of the course students should submit a research proposal and should present the idea.

The Research proposal report prepared based on the work carried out by the PG Student is evaluated for 50 marks and 20 minutes presentation on the research work carried out will be evaluated for 50 marks jointly by the examiners.

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

1.	Identify and define the problem statement based on the literature reviewed.
2.	Formulate the objectives specific to the defined problem statement.
3.	Develop the methodology for achieving the objectives.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**	
↓ Course Outcomes							1	2
22CST105-1.1	2	2	2	1	2	2	1	2

22CST105-1.2	2	2	2	1	2	2	1	2
22CST105-1.3	2	2	2	1	2	2	1	2

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Gina Wisker, "The Undergraduate Research Hand book", 2018.

E Books / MOOCs/ NPTEL

1.	https://www.classcentral.com/course/swayam-research-methodology-17760

RESEARCH EXPERIENCE THROUGH PRACTICE -2

Course Code:	**22CST205**	**Course Type**	**RETP**
Teaching Hours/Week (L: T: P)	**0:0:4**	**Credits**	**2**
Total Teaching Hours	**0+0+52**	**CIE**	**100**

Teaching Department: Civil Engineering

Course Objectives: The research purposes are

1. To foresee future problems through pursuit of truth as a "global centre of excellence for intellectual creativity".
2. To respond to current social demands, and to contribute to the creation and development of scientific technologies with the aim of realizing an affluent society and natural environment for humanity.
3. At the same time, the course aims to create excellent educational resources and an excellent educational environment through frontline researches.
4. To Understand professional writing and communication contexts and genres, analyzing quantifiable data discovered by researching, and constructing finished professional workplace documents.

The students are expected to carry out Mathematical Modelling/Design calculations/computer simulations/Preliminary experimentation/testing of the research problems identified during Research Experience through Practice-I carried out in the first semester.

At the end of the second semester, students are expected to submit a full research paper based on the Mathematical modelling/ Design calculations/computer simulations/Preliminary experimentation/testing carried out during second semester.

The research paper prepared based on the work carried out by the PG Student is evaluated for 50 marks and 20 minutes presentation on the research work carried out will be evaluated for 50marks jointly by the examiners.

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

1.	Create a model/prototype through fabrication, simulation, data analysis, Experimentation for the proposed problem.
2.	Analyse and validate the results obtained.
3.	Compose a technical paper as per the given format.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	**PSO↓**	
↓ Course Outcomes							1	2
22CST205-1.1	2	2	2	1	2	2	1	2

22CST205-1.2	2	2	2	1	2	2	1	2
22CST205-1.3	2	2	2	1	2	2	1	2

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Gina Wisker, "The Undergraduate Research Hand book", 2018.

E Resource

1.	https://www.coursera.org/learn/academic-writing-capstone