Techno India NJR Institute of Technology

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Course File

STRENGTH OF MATERIALS (4CE4-05)

Semester: IV, Year: II (2023-24)

Name of faculty: Nishit Jain

Email ID: nishit.jain@technonjr.org

Total Number of Lectures: 42

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VISSION & MISSION OF INSTITUTE

Vision

Empowering student with recent and emerging technologies to create innovative technical leaders capable of contributing to industrial and societal needs for betterment of mankind across the globe.

Mission

M1: To provide dynamic learning environment to students by providing constant exposure to latest technologies by linking closely with the industries.

M2: To establish effective interface with industry to obtain live problems to enhance critical thinking and problem solving skills among students and consultancy projects for faculty.

M3: To provide avenues and opportunities to faculty for domain specific trainings and qualification upgradation.

M4: To develop ethical leaders with strong communication skills.

VISION & MISSION OF DEPARTMENT

Department Vision

To increase students learning of fundamentals for designing and planning of buildings and latest technologies through industry-aligned project-based learning which will help in transforming students to be good civil engineering professionals leading to innovation and incubation of new ideas.

Department Mission

M1: To create experimental learning through solving problems of Government, Society, Smart Cities, Industry and other entities.

M2: To teach the latest technologies to the students as beyond the syllabus activity so that they are updated and industry ready.

M3: To enable engineering students understand industry-aligned technologies and learn to find solutions from their early engineering days and this is the only way to produce globally relevant engineers solving real-life problems applying current technologies.

M4: To enable students to generate projects through problem faced by and requirement of Smart cities, industry, Government and other entities whereby those outlined problem statements are to be studied deeply by a group of faculty members to convert them into real-time project format.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs 1: To provide an in-depth understanding of the fundamentals of Civil Engineering and create a foundation for lifelong learning to facilitate a progressive career in the construction Industry, as an entrepreneur and in pursuit of higher studies.

PEOs 2: To equip the students with technical and analytical skills to develop innovative solutions to complex real-life problems using existing and novel technologies. To equip the students with good communication and interpersonal skills, inter-disciplinary teamwork and leadership skills to enable them to fulfill professional responsibilities.

PEOs 3: To expose them to various contemporary issues which will enable them to become ethical and responsible towards themselves, co-workers, Society and the Nation.

PEOs 4: To make the student's industry ready by imparting education related to the latest technologies so that they can grab future industry jobs.

PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO1: To be aware of and initiate some-work on future technologies and new developments which may impact the future Industry 4.0.

PSO2: Hands on training on upcoming technologies and project-based learning.

PSO3: Get exposure to BIM (Building Information Modeling).

PROGRAMME OUTCOMES (POs)

A student will develop:

PO01. ENGINEERING KNOWLEDGE: An ability to apply knowledge of Mathematics, Science and Engineering Fundamentals in Electronics and Communication Engineering.

PO02. PROBLEM ANALYSIS: Ability to analyze and interpret data by designing and conducting experiments. Develop the knowledge of developing algorithms, designing, implementation and testing applications in electronics and communication related areas.

PO03. DESIGN/ DEVELOPMENT OF SOLUTION: An ability to Design a system Component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

PO04. CONDUCTION OF INVESTIGATION OF COMPLEX PROBLEMS: Ability to Identify, formulate and solve engineering problems.

PO05. MODERN TOOL USAGE: An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

PO06. THE ENGINEERING AND SOCIETY: Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.

PO07. ENVIRONMENT & SUSTAINABILITY: Understand the impact of professional engineering solution in societal and environmental contexts, and demonstrate the knowledge of, and need of sustainable development.

PO08. ETHICS: An ability to understand the professional, social and ethical responsibility.

PO09. INDIVIDUAL AND TEAM WORK: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. COMMUNICATION: An ability to Communicate effectively in order to succeed in their profession such as, being able to write effective reports and design documentation, make effective presentations.

PO11. PROJECT MANAGEMENT & FINANCE: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in team, to manage projects and in multidisciplinary environment.

PO12. LIFE-LONG LEARNING: Recognize the need and an ability to engage in life-long learning.

Course Overview:

The Strength of Materials course, also known as Mechanics of Materials, provides an in-depth understanding of the internal effects induced by external forces on structural elements. This course covers key concepts such as stress, strain, deformation, deflection, torsion, flexure, shear diagrams, and moment diagrams, which are fundamental for students in Civil and Mechanical Engineering. The primary objectives are to analyze the strength and behavior of materials and structural components under various forces and thermal loads, investigate the response of materials to different force types and temperature variations, and emphasize real-world conditions to assess their impact on the integrity and performance of engineering structures.

Course Outcome:

4CE4-05	Cognitive Level	
4CE4-05.1	Understand	Analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
4CE4-05.2	Apply	Execute the use of appropriate materials in design considering engineering properties, sustainability, cost and weight.
4CE4-05.3	Apply	Implement the skills for engineering work in accordance with ethical and economic constraints related to the design of structures.
4CE4-05.4	Apply	Understand the concept of torsion and columns.
4CE4-05.5	Apply	Determine deflection of beam by using various method

Prerequisites:

1. Student will be able to Analyze and design structural members
2. Student will be able to Utilize appropriate materials in design.
3. Students will be able to Perform engineering work.
4. Students will be able to provide students with exposure to the systematic methods for solving engineering problems in solid mechanics.
5. Students will be able to build the necessary theoretical background for further structural analysi

Mapping COs, POs and PSOs:

STRENGTH OF MATERIALS															
Course Outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO24405.1	2	2	2	2	0	0	0	0	0	0	0	1	1	1	1
CO24405.2	2	2	2	2	0	0	0	0	0	0	0	0	1	1	1
CO24405.3	2	2	2	1	0	0	0	0	0	0	0	1	1	1	1
CO24405.4	3	3	3	3	0	0	0	0	0	0	0	1	2	2	1
CO24405.5	3	2	3	2	0	0	0	0	0	0	0	1	2	2	1

UNIVERSITY ACADEMIC CALENDAR

Academic Calendar for Even Semester for Session

Course: Bachelor of Technology (B.TECH.)				
Course: Bachelor of Technology (B.TECH.)				
Semester	II	IV	VI	VIII
Commencement of Classes	26.02.2024	15.02.2024	15.02.2024	02.01.2024
First Mid Term	02.04.2024	20.03.2024	20.03.2024	15.02.2024
Second Mid Term	03.06.2024	06.05.2024	06.05.2024	21.03.2024
Last Working Day	10.06.2024	31.05.2024	31.05.2024	20.04.2024
Commencement of Practical Exams	01.07.2024	03.06.2024	03.06.2024	22.04.2024
Commencement of Theory Exams	19.06.2024	14.06.2024	15.06.2024	02.05.2024
Project (VIII)				
Practical Training (After II Sem.)	15.07.2024 To 31.07.2024			
Practical Training (After IV Sem.)	01.07.2024 To 17.08.2024			
Practical Training (After VI Sem.)	01.07.2024 To 17.08.2024			

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Evaluation Scheme

FACULTY DETAILS:

Name of the Faculty : Mr. Nishit Jain

Designation : Assistant Professor

Department : Civil Engineering

1. TARGET

a) Percentage Pass : 100 %
b) Percentage I class: 70 %

2. METHOD OF EVALUATION

2.1. Continuous Assessment Examinations (Mid-Term 1 & 2)

2.2. Assignments / Seminars

2.3. Mini Projects

2.4. Quiz

2.5. Semester Examination

Others_____

3. List out any new topic(s) or any innovation you would like to introduce in teaching the subject in this Semester.

1. Take the help of creative tools to stimulate creativity. Include slide presentations, demonstration or forms of visual exercises that will excite the young minds and capture their interest.

Signature of Faculty: **Signature of HOD**

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

II Year-IV Semester: B.Tech. (Civil Engineering)

4CE4-05: STRENGTH OF MATERIALS

Credit: 3 **Max. Marks: 100 (IA:30, ETE:70)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hrs.
1	**Introduction:** to objective, scope and outcome of the subject	1
2	**Simple Stresses and Strains in different members:** Stresses in prismatic & non prismatic members and in composite members; Thermal stresses; Stresses in composite members, Compatibility condition.	5
3	**Compound Stress:** Two dimensional stress system: stress resultant, principal planes and principal stresses, state of pure shear maximum shear stress, Mohr's circle &its application. Introduction to theories of failures.	6
4	**Bending of Beams:** Bending moment, Shear force and Axial thrust diagrams for statically determinate beams subjected to various types of loads and moments, Point of Contra-flexure, relation between load, SF and BM.	8
5	**Theory of simple bending**: Distribution of bending and shear stresses for simple and composite sections, Combined direct and bending stress,	6
6	**Torsion:** Elementary concepts of torsion, shear stress in solid and hollow circular shafts, angle of twist, power transmitted by a shaft, combined bending and torsion;	4
7	**Columns:**Short and long columns, slenderness ratio, crushing and buckling of column, short column subjected to axial and eccentric loads; Euler's theory and its limitation, concept of effective length of columns; Rankine & Secant formulae, middle third rule, core of a section.	5
8	**Deflection of Beams:** Differential relation between load, shear force, bending moment, slope deflection. Slope & deflection in determinate beams using double integration method, Macaulay's method, area moment method and conjugate beam method and their application to statically determinate prismatic beams.	7
	TOTAL	42

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

TEXT/REFERENCEBOOKS

1. Mechanics of Structures Vol. I & II by S.B Junarkar, Charotar Publishing House, Anand.
2. Strength of Materials & Mechanics of Structures: Vol. I, II by Dr. B.C. PunmiaLaxmi Publications (p) Ltd.
3. Strength of Material by Singer and Pytel, Harper Collins Publishers.
4. Elements of Strength of Materials by Timoshenko & Young, Mc Graw HillBook Co.

WEEKLY TIME TABLE OF THE TEACHER

Day	1	2	3	4	5	6	7
Monday		SOM					
Tuesday		SOM					
Wednesday		SOM					
Thursday							
Friday				SOM			
Saturday							

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COURSE-PLAN

Lecture No	Unit	Topic	Teaching Methods/ Teaching Aids
1	1	INTRODUCTION: To Objective, Scope And Outcome Of The Subject	White Board
2	2	Student should be able to understand SIMPLE STRESSES AND STRAINS IN DIFFERENT MEMBERS: Stresses In Prismatic & Non Prismatic Members	White Board
3	2	Student should be able to understand (Contd.) Simple Stresses And Strains InDifferent Members	White Board
4	2	Student should be able to understand Simple Stresses And Strains In DifferentMembers In Composite Members.	White Board
5	2	Student should be able to understand Thermal Stresses	White Board
6	2	Student should be able to understand Stresses In Composite Members,Compatibility Condition	White Board
7	2	Student should be able to understand Stresses In Composite Members, Compatibility Condition	White Board
8	3	Student should be able to understand COMPOUND STRESS: Two Dimensional Stress System	White Board
9	3	Student should be able to understand Stress Resultant, Principal Planes And Principal Stresses	White Board
10	3	Student should be able to understand Stress Resultant, Principal Planes And Principal Stresses	White Board
11	3	Student should be able to understand State Of Pure Shear Maximum Shear Stress	White Board
12	3	Student should be able to understand Mohr's Circle &Its Application	White Board

13	3	Student should be able to Introduce To Theories Of Failures	White Board
14	4	Student should be able to understand BENDING OF BEAMS: Bending Moment	White Board
15	4	Student should be able to understand Shear Force And Axial Thrust Diagrams For Statically Determinate	White Board
16	4	Student should be able to understand Shear Force And Axial Thrust Diagrams For Statically Determinate	White Board
17	4	Student should be able to understand Point Of Contra-Flexure, Relation Between Load	White Board
18	4	Student should be able to solve problem based on SF And BM.	White Board
19	4	Student should be able to solve problem based on SF And BM.	White Board
20	4	Student should be able to solve problem based on SF And BM.	White Board
21	4	Student should be able to solve problem based on SF And BM.	White Board
22	4	Student should be able to solve problem based on SF And BM.	White Board
23	5	Student should be able to understand THEORY OF SIMPLE BENDING	White Board
24	5	Student should be able to understand Distribution Of Bending And Shear Stresses	White Board
25	5	Student should be able to understand (Contd.) Distribution Of Bending And Shear Stresses	White Board
26	5	Student should be able to understand Distribution Of Bending And Shear Stresses	White Board
27	5	Student should be able to understand Distribution Of Bending And Shear Stresses	White Board
28	5	Student should be able to understand Combined Direct And Bending Stress	White Board
29	5	Student should be able to understand Combined Direct And Bending Stress	White Board

30	6	Student should be able to understand TORSION: Elementary Concepts Of Torsion	White Board
31	6	Student should be able to understand Shear Stress In Solid And Hollow Circular Shafts	White Board
32	6	Student should be able to understand Angle Of Twist, Power Transmitted By A Shaft	White Board
33	6	Student should be able to understand Bending And Torsion	White Board
34	7	Student should be able to understand COLUMNS: Short And Long Columns	White Board
35	7	Student should be able to understand Slenderness Ratio, Crushing And Buckling Of Column	White Board
36	7	Student should be able to understand Short Column Subjected To Axial And Eccentric Loads	White Board
37	7	Student should be able to understand Euler's Theory And Its Limitation, Concept Of Effective Length Of	White Board
38	7	Student should be able to understand Rankine & Secant Formulae, Middle Third Rule, Core Of A	White Board
39	8	Student should be able to understand DEFLECTION OF BEAMS: Differential	White Board
		Relation Between Load	White Board
40	8	Student should be able to understand Shear Force, Bending Moment, Slope	White Board
		Deflection.	White Board
41	8	Student should be able to understand Slope & Deflection In Determinate	White Board
42	8	Student should be able to understand Double Integration Method	White Board

Signature of Faculty: **Signature of HOD**

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Assignment Sheet

ASSIGNMENT NO. 1

1	. What is stress A. Define Hooke's law. B. Define Modulus of Elasticity and Shear Modulus.
2	. Define Resilience, Proof Resilience & Modulus of Resilience. Give expression for Stress due to gradually applied load & suddenly applied load. A. Explain the classification of Columns. c. B. Derive the Torsion Equation C. List the assumptions made in theory of simple bending
3	. What must be the length of a 5m diameter aluminum wire be so that it can be so twisted through one complete revolution without exceeding a shearing stress of 42 N/mm2 . Let G=2.7X104 N/mm2. A. Define the following. a) Slenderness ratio b) Buckling. B. Find the safe compressive load on a hollow C.I. column, one end rigidly fixed and other hinged, of 150mm external diameter and 100mm internal diameter and 10m in length. Use Euler's formula with F.O.S. of 5 and E= 95KN/mm2
4	. A hollow shaft is to transmit is to 400 KW power at 90 r.p.m. If fs = 74 N/mm2 and internal diameter is 0.6 times the external diameter, then find both the diamers assuming the following relations Tmax= 1.35 Tmean. d. A. A laminated spring 600mm long is made up of plates each being 60mm wide and 8mm thick. Fing the number of plates required to enable the spring to carry a central point load of 4000N if the permissible bending stress is 120N/mm2 . Also find deflection if E=200KN/mm2 .
5	. A closed coil helical spring is to carry a load of 500 N. The mean coil diameter is 10 times that of wire diameter. Calculate the diameters of spring and coil if the maximum shear stress in the material of the spring is 80 N/mm2 . A. Define any five mechanical properties of a material. h. B. Describe the functions of a spring. Write the formulas for calculating stiffness for springs connected in parallel and series..

SAMPLE QUIZ QUESTIONS

Q1: What is the primary objective of studying Strength of Materials in civil engineering?
a) To design electrical systems
b) To understand the behavior of materials under different loads
c) To analyze fluid dynamics
d) To measure the temperature of materials
Answer: b) To understand the behavior of materials under different loads

Q2: Which of the following best describes stress in a material?
a) The change in length of the material
b) The internal resistance offered by a material to an external force
c) The weight of the material
d) The mass per unit volume
Answer: b) The internal resistance offered by a material to an external force

Q3: What type of stress is experienced by a prismatic member subjected to axial loading?
a) Shear stress
b) Tensile or compressive stress
c) Bending stress
d) Torsional stress
Answer: b) Tensile or compressive stress

Q4: The relationship between stress and strain in a material that follows Hooke's Law is:
a) Linear
b) Quadratic
c) Exponential
d) Inverse
Answer: a) Linear

Q5: What is the term used to describe the ratio of lateral strain to longitudinal strain in a material?
a) Young's modulus
b) Modulus of rigidity
c) Poisson's ratio
d) Bulk modulus
Answer: c) Poisson's ratio

3. Compound Stress
Q6: What is Mohr's circle used for in material science?
a) To determine the shear force in a beam
b) To represent the state of stress at a point
c) To calculate the moment of inertia
d) To measure the tensile strength of a material

Answer: b) To represent the state of stress at a point

Q7: Principal stresses are:
a) The maximum and minimum normal stresses at a point
b) Always equal in magnitude
c) The average of the shear stresses at a point
d) Only present in brittle materials
Answer: a) The maximum and minimum normal stresses at a point

Q8: Which of the following represents pure shear stress?
a) When the principal stresses are equal
b) When the normal stress is zero and only shear stress acts on the plane
c) When the material is under uniform compression
d) When there is no shear stress present
Answer: b) When the normal stress is zero and only shear stress acts on the plane

4. Bending of Beams
Q9: The bending moment at a point in a beam is defined as:
a) The product of force and distance from the point to the force's line of action
b) The change in length due to bending
c) The internal moment that causes the beam to bend
d) The shear force acting along the beam
Answer: c) The internal moment that causes the beam to bend

Q10: Which of the following diagrams represent the variation of bending moment along the length of a beam?
a) Load diagram
b) Shear force diagram
c) Bending moment diagram
d) Stress-strain curve
Answer: c) Bending moment diagram

Q11: The point of contra-flexure in a beam is where:
a) Shear force is zero
b) Bending moment changes sign
c) The beam experiences maximum deflection
d) The beam is subjected to pure shear
Answer: b) Bending moment changes sign

Q13: In simple bending theory, the section that remains plane and normal to the longitudinal axis of a beam before bending:
a) Distorts after bending
b) Remains plane and normal

c) Warps due to bending stress
d) Experiences uniform compression
Answer: b) Remains plane and normal

6. Torsion
Q14: Torsional stress is directly proportional to:
a) The square of the radius of the shaft
b) The applied torque
c) The length of the shaft
d) The moment of inertia of the shaft's cross-section
Answer: b) The applied torque

Q15: The angle of twist in a shaft subjected to torsion depends on:
a) The material's modulus of rigidity
b) The length of the shaft
c) The applied torque
d) All of the above
Answer: d) All of the above

Q16: Slenderness ratio is a measure of:
a) The length of a column
b) The buckling strength of a column
c) The ratio of the length to the radius of gyration
d) The load-carrying capacity of a column
Answer: c) The ratio of the length to the radius of gyration

Q17: Euler’s formula for buckling load is valid for:
a) Short columns
b) Long columns with small deflection
c) Columns with large initial imperfections
d) Columns with variable cross-section
Answer: b) Long columns with small deflection

Q18: The deflection of a simply supported beam with a uniformly distributed load can be calculated using:
a) Shear force equation
b) Bending moment equation
c) Double integration method
d) Euler’s buckling formula
Answer: c) Double integration method

Q19: Which method is used to determine the slope and deflection in beams using the principle of virtual work?

a) Moment area method
b) Conjugate beam method
c) Macaulay's method
d) Strain energy method
Answer: b) Conjugate beam method

Q20: The slope of the deflection curve at a point on a beam is a measure of:
a) The maximum bending moment
b) The shear force at that point
c) The angle of rotation at that point
d) The deflection of the beam
Answer: c) The angle of rotation at that point

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MID-TERM PAPERS

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR **B. TECH 2ND – YEAR (IV SEM.) CIVIL ENGINEERING – MT-I (April 2024)** **4CE4-05: STRENGTH OF MATERIALS** Time: 3 Hr Max. Marks: 70		
Note: 1) The paper is divided into 2 parts: Part-A and Part-B. 2) Part-A contains 10 questions and carries 2 marks each. 3) Part-B contains 5 questions. Each question has two options and carries 10 marks each.		
PART A		
a	Explain the Hook's Law.	CO1
b	Explain the shear stress.	CO1
c	Explain strain.	CO1
d	Define: Thermal Stresses.	CO1
e	Define: Ductility.	CO2
f	Define:Poisson's ratio.	CO2
g	What do you understand by principal of super position?	CO2
h	What do you understand by prismatic & non-prismatic members?	CO2
i	What is Mohr's circle?	CO3
j	Define brittleness.	CO3
PART B		
1	Draw and explain, stress-strain diagram for tensile test. **OR** A member ABC is formed by connecting a steel bar of 20 mm diameter to an aluminum bar of 30 mm diameter, and is subjected to forces as shown in Fig 1 Determine the total deformation of the bar, taking E for aluminum as 0.7 x l0^5 N/mm2 and that for steel as 2xl0^5 N/mm2.	CO1
2	Derive hooke's law for uniformly tapering circular bars. **OR** If a tension test bar is found to taper from (D + a) diameter to (D — a) diameter, prove the error involved in using the mean diameter to calculate the Young's (10a/D)^2 percent.	CO1
3	Derive relation b/w E & K **OR** Derive relation b/w E, N, K, & m.	CO2

4	A steel rod of cross-sectional area 2000 mm2 and two brass each of cross-sectional area of 1200 mm2 together support a load Of 60 kN, as shown in fig 2 Find the stresses in the Take E for steel= 2xl0^5 N/mm2and E for brass = 1 x l0^5 N/mm2	CO2
	OR	
	A mild steel of 25 mm diameter and 400 mm long is encased centrally inside a hollow copper tube of ertemal diameter 35 mm and inside diameter 30 mm. The ends of the and tube are rigidly attached, and the composite bar is subjected to an arial pull of 40 kN. If E for steel and copper is 200 GN/m2 and 100 GN/m2 respectively, find the stress developed in the and the tube. Find also the extension of the rod	
5	Derive expression for elongation of bar of uniform section due to self weight.	CO3
	OR	
	A steel wire of 10 mm diameter and length 150 m is used to lift a weight of 2.5 kN at its lowest end. Calculate the total elongation of the wire if the unit mass (or mass density) of the wire is 7.95 kg/m3 and E = 2.04 x l0^5 N/mm2	

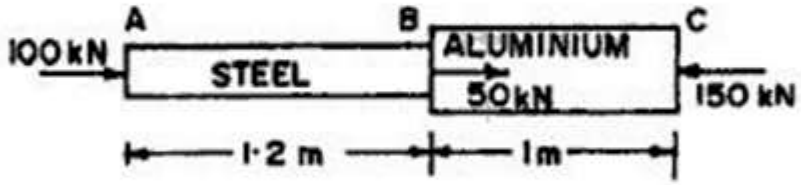

FIG 1

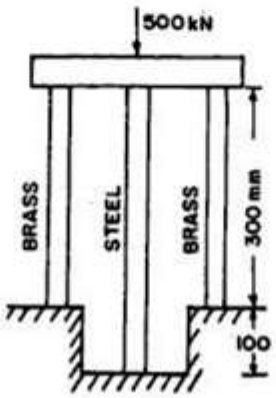

FIG 2

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Marks and Gap Analysis of Mid-Term 1

S.No.	University Roll No.	Name of Student	Mid-Term 1 MM-70	Remark (Remedial Class need or not – Y/N)
1.	22ETCCE001	ANKIT KUMAR	54	N
2.	22ETCCE002	ARMAAN CHAUHAN	38	N
3.	22ETCCE003	AYUSH SINGH JHALA	41	N
4.	22ETCCE004	PARIDHI NINAMA	61	N
5.	22ETCCE005	PRAVEEN DANGI	45	N
6.	22ETCCE006	ROSHNI TABIYAR	63	N

*(Y, if obtained marks are <50%)

Signature of Faculty: **Signature of HOD**

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Remedial Action Taken to Remove the Gaps (After Mid- Term 1)

S.no.	University Roll no.	Name of Student	Topics to be discussed in Remedial Class	Schedule Date of Remedial Class	Outcome Achieved
1.	NIL				
2.					

Signature of Faculty: **Signature of HOD**

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR
B. TECH II YEAR (IV SEM.) – MT-II (JUN'24)
STRENGTH OF MATERIALS (4CE4-05)

Time: 3 Hr **Max. Marks:** 70

Note:

1. The paper is divided into 2 parts: Part-A and, Part-B.
2. Part-A contains 10 questions and carries 2 mark each.
3. Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

	PART A (Word limit 25)	
a	Draw a neat diagram of a fixed support beam. What types of reactions are available at the fixed support?	CO1
b	What is the slenderness ratio?	CO1
c	State hook's law	CO2
d	Define thermal stress.	CO2
e	What is the poisons ratio?	CO3
f	Define the point of contra flexure.	CO3
g	What is the principle of superposition?	CO4
h	Explain the neutral axis.	CO4
i	Define shear force	CO5
j	Define bending moment.	CO5

PART B

Q1 [CO1] A rectangular beam 200m wide and 300mm deep, carries a UDL of 10kN/ over a simply supported span of 6m, Determine the radius of curvature for the section where bending is maximum if E= 200Gpa.

Or

What are the assumptions of simple bending, for the relation:

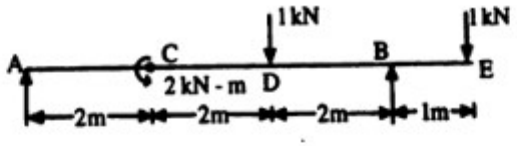
$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

Q2. [CO2] What do you understand by principal stresses and principal planes? Derive the expression to obtain principal stresses under the action of two perpendicular direct stresses with state of simple shear applied to an elastic material at a certain point.

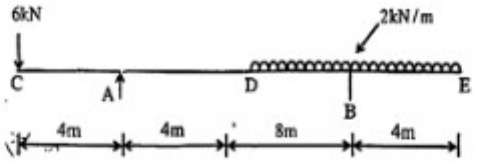
Or

Explain various theories of failure?

Q3 [CO3] Construct SFD & BMD for the given beam.



Or



Q4. [CO4] Find the Euler's crushing load for a hollow cylinder cast iron column, 150mm external dia, 20 mm thick, 6m long and hinged at both ends.

Take E = 80kN/mm², σ = 567 N/mm², a = $\frac{1}{1600}$

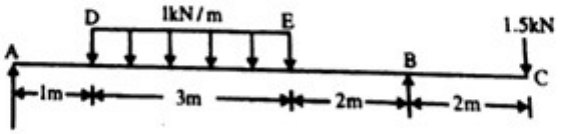
Or

Determine the maximum value of slenderness ratio of mild steel column for with Euler's formula is valid.

Take σ = 330 N/mm2, E = 210kN/mm2

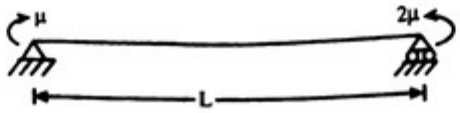
Q5 [CO5] An over hung beam ABC, supported at A & B is loaded as shown. Determine by double integration method, Deflection at free end c.

Take E = 2 10^5 N/mm² and I = 450 cm⁴



Or

Simply supported beam AB is acted upon by couple's μ and 2μ at the ends as shown, Using area moment method find the Slopes at A & B.



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Marks and Gap Analysis of Mid-Term II

Sr. No.	University Roll No.	Name of Student	Mid-Term 2 MM-70	Remark (Remedial Class need or not – Y/N)
1.	22ETCCE001	ANKIT KUMAR	53	N
2.	22ETCCE002	ARMAAN CHAUHAN	37	N
3.	22ETCCE003	AYUSH SINGH JHALA	40	N
4.	22ETCCE004	PARIDHI NINAMA	60	N
5.	22ETCCE005	PRAVEEN DANGI	44	N
6.	22ETCCE006	ROSHNI TABIYAR	62	N

*(Y, if obtained marks are <50%)

Signature of Faculty: **Signature of HOD**

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Remedial Action Taken to Remove the Gaps (After Mid- Term II)

Sr. No.	University Roll no.	Name of Student	Topics to be discussed in Remedial Class	Schedule Date of Remedial Class	Course Outcome
1.	NIL				

Signature of Faculty: **Signature of HOD**

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PREVIOUS YEAR PAPERS

Roll No. _____ Total No. of Pages.: 03

410305/

410305 /

B.Tech. IV Sem Back Exam Aug. 2023 Acad. Session 2022-23

Civil Engineering

(4CE4-05) - Strength of Materials

Time :3Hours **Maximum Marks:120**

Min. Passing Marks:

Instructions to Candidates:

Part – A: Short answer questions (up to 25 words) 10 * 2 marks = 20 marks. All ten questions are compulsory.

Part – B: Analytical/Problem Solving questions 5 * 8 marks = 40 marks. Candidates have to answer 5 questions out of 7.

Part – C: Descriptive/Analytical/Problem Solving questions 4 * 15 marks = 60 marks. Candidates have to answer 4 questions out of 5.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting materials is permitted during examination. (Mentioned in form No. 205)

1_NIL_____ 2__NIL_____

PART-A

Q.1. Explain the Hook's Law.

Q.2 Explain the principle stresses and principal plane.

Q.3. What is the slenderness ratio?

Q.4. Explain the neutral axis.

Q.5. What is the section modulus?

Q.6. Explain the trunk modulus.

P.T.O.

Q.7. Explain the torsional rigidity.

Q.8. Explain the shear force and bending moment.

Q.9. What is the thermal stress?

Q.10. Explain the shear stress and strain.

PART-B

(Answer 4 questions out of 6)

Q.1. Determine the relation between B.M(M), SF(S) and load intensity (W) and show that

$$\frac{dM}{dx} = -S \text{ and } \frac{dS}{dx} = -W$$

Q.2. Discuss Macaulay's method for deflection. How do we use singularity functions for deflection calculations.

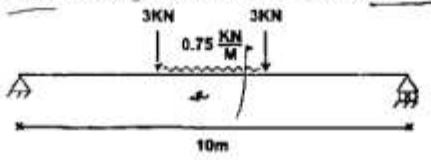
Q.3. Derive the Euler's formula for crippling load and discuss its limitations.

Q.4. Explain the various theories of failure.

Q.5. A beam AB of span L simply supported at the ends carries a point load W at a distance a from the left end. Determine the maximum deflection and slope at the supports.

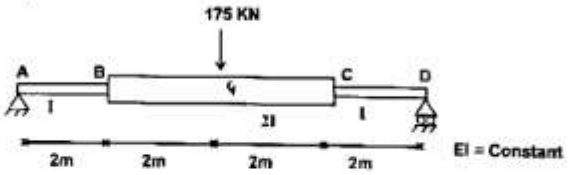
Q.6. Draw the shear force and bending moment diagrams for the beam shown in the figure below:

PART-B Q.6



Q.7. Using conjugate beam method, find the slope at support and deflection at mid span for beam shown in figure below:

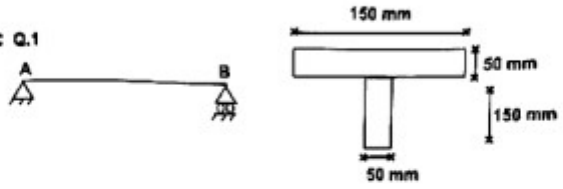
PART-B Q.7



PART- C

Q.1. A beam of T-section, shown in figure below, is subjected to udl of 5 KN/m and span is 8m. Determine the stresses at the extreme fibres of the section and also calculate the total tensile force on the section.

PART-C Q.1



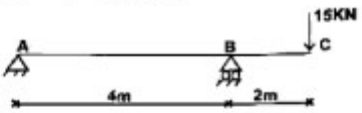
Q.2. Find the Euler's crushing load for a hollow cylindrical cast iron column, 150 mm external dia, 20 mm thick, 6m long and hinged at both ends. Compare this load with the crushing load given Rankine's formula. For what length of column would these two formula. For what length of column would these two formula give the same crushing load. E = 80000 N/mm^2

$\sigma_c = 567 N/mm^2$ $a = \frac{1}{1600}$

Q.3. A Beam shown in figure below. Determine the deflection at C and the maximum deflection between A and B.

E = 200000 N/mm^2 I = 24*10^{-6}m^4

PART-C Q.3



Q.4. Determine the maximum value of the slenderness ratio of mild steel column for which fuler's formula's is valid.

Take $\sigma_c = 330 N/mm^2$ $E = 210000 N/mm^2$

Q.5. Draw Mohr's circle for

(a) Pure shear

(b) Pure biaxial tension

(c) Pure uniaxial compression

(d) Pure uniaxial tension in a two dimensional stress system.

****

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4E1315

Roll No. _____ Total No. of Pages: 4

4E1315

B. Tech. IV - Sem. (Main) Exam., - 2022

Civil Engineering

4CE4-05 Strength of Materials

Time: 3 Hours **Maximum Marks: 70**

Instructions to Candidates:

Attempt all ten questions from Part A. Five questions out of seven questions from Part B and three questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[10×2=20]**

All questions are compulsory

Q.1 Draw a neat diagram of fixed support. What type of support reactions are available at a fixed support?

Q.2 Write short notes on 'Slenderness Ratio'.

Q.3 State Hooke's law. Write down different types of stresses and strains.

Q.4 Why a hollow shaft is preferred over a solid shaft?

Q.5 Define the following terms: Thermal Stresses, Thermal Strains and Poisson's ratio.

Q.6 Define 'point of contraflexure'.

Q.7 Define principal planes and principal stresses and explain their uses.

Q.8 What do you understand by principal of super position?

Q.9 Define angle of twist, twisting moment and torsional rigidity.

Q.10 Which is the effective method for finding out the deflection & why?

PART – B

(Analytical/Problem solving questions) **[5×4=20]**

Attempt any five questions (Word limit 100)

Q.1 A rectangular beam 200 m wide and 300 mm deep carries an UDL of 10 kN/m over a simply supported span of 6 m. Determine:

(i) The maximum stress in the beam due to bending

(ii) The radius of curvature for the section where bending is maximum, if E= 200 GPa

Q.2 Write the assumption of theory of simple bending and prove this relation.

$$\frac{M}{I}=\frac{\sigma}{y}=\frac{E}{R}$$

Q.3 Derive the relation between load, shear force and bending moment.

Q.4 Find the maximum torque that can be safely applied to a shaft of 200 mm dia, if permissible angle of twist is 1^0 in a length of 5 m and the permissible shear stress is 45 N/mm². Take modulus of rigidity (G) = 0.8×10^5 N/mm².

Q.5 Derive an expression of the Euler's crippling load for a long column, when -

(i) It has both ends hinged and

(ii) Both the hands are fixed

Q.6 Draw the typical shape of shear stress distribution for the following sections shown in Fig. 1:

Fig 1

Q.7 An aluminum rod 22 mm diameter passes through a steel tube of 25 mm internal diameter and 3 mm thick. The rod and tube are fixed at a temperature 180° C. Find the stress in the rod and tube, when the temperature falls to 60° C.

Take $E_s = 200$ kN/mm^2; $E_A = 70$ kN/mm^2; $\alpha_s = 12 \times 10^{-6}$ /° C; $\alpha_A = 12 \times 10^{-6}$ /° C

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) **[3×10=30]**

Attempt any three questions

Q.1 A simply supported beam of rectangular cross section of dimension 150×300 mm is having span of 4.5 m. It is loaded with u.d.l. of 8 KN-m compute:

(i) Shear stress developed on a layer 60 mm above the natural axis of a section located at 1.5 m from the left support.

(ii) Maximum shear stress on the support at neutral axis.

Q.2 What do you understand by principal stresses and principal planes? Derive the expression to obtain principle stresses under the action of two perpendicular direct stresses with state of simple shear applied to an elastic material at a certain point.

Q.3 A steel bar of rectangular cross section 30 x 40 mm pinned at each end is subjected to an axial compressive load. The bar is 1.75 m long. Determine the buckling load and corresponding stress using Euler's formula. Take E= 200 GPa.

Q.4 Draw the bending moment and shear force distribution diagrams for the beam shown in fig. 2. Indicate the values of S.F. and B.M at all critical locations. Also give the value of maximum shear force and maximum +Ve and -Ve bending moments and their locations. Determine the points of contraflexure.

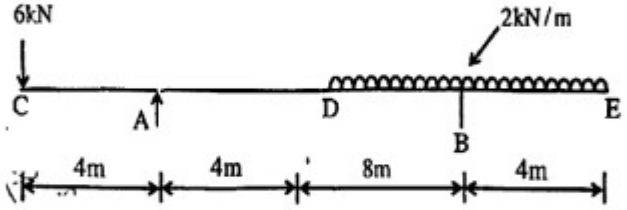

Fig.2

Q.5 A beam AB of 9 m span is simply supported at the ends and is loaded as shown in fig. 3. Determine-

(i) Deflection at C

(ii) Maximum deflection and

(iii) Slope at end A

Take E= 2x 10^5 N/mm^2 and I= 2x 10^7 mm^4.

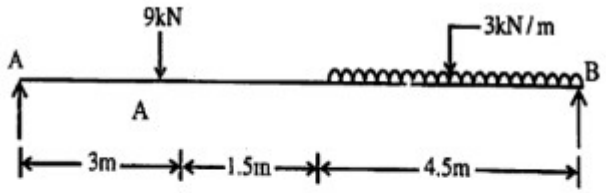

Fig.3

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STUDENT PERFORMANCE REPORT

Roll No.	Name of Student	I Mid-Term	II Mid-Term	Average
22ETCCE001	ANKIT KUMAR	54	53	53.5
22ETCCE002	ARMAAN CHAUHAN	38	37	37.5
22ETCCE003	AYUSH SINGH JHALA	41	40	40.5
22ETCCE004	PARIDHI NINAMA	61	60	60.5
22ETCCE005	PRAVEEN DANGI	45	44	44.5
22ETCCE006	ROSHNI TABIYAR	63	62	62.5

Signature of Faculty: **Signature of HOD**

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RESULT ANALYSIS

S.NO.	RTU ROLL NUMBER	NAME OF STUDENT	END TERM MARKS	SESSIONAL MARKS	TOTAL
		MAX MARKS	**70**	**30**	**100**
1.	22ETCCE001	ANKIT KUMAR		24	
2.	22ETCCE002	ARMAAN CHAUHAN		17	
3.	22ETCCE003	AYUSH SINGH JHALA		18	
4.	22ETCCE004	PARIDHI NINAMA		27	
5.	22ETCCE005	PRAVEEN DANGI		20	
6.	22ETCCE006	ROSHNI TABIYAR		28	

TOTAL	PASS	FAIL	ABSENT	PASS %
6				

Indirect Assessment:

Overall Teacher Self-Assessment (at the completion of course) in terms of course objective and outcomes

Course Objectives:

The Strength of Materials course, also known as Mechanics of Materials, provides an in-depth understanding of the internal effects induced by external forces on structural elements. This course covers key concepts such as stress, strain, deformation, deflection, torsion, flexure, shear diagrams, and moment diagrams, which are fundamental for students in Civil and Mechanical Engineering. The primary objectives are to analyze the strength and behavior of materials and structural components under various forces and thermal loads, investigate the response of materials to different force types and temperature variations, and emphasize real-world conditions to assess their impact on the integrity and performance of engineering structures.

Course Outcomes:

CO1:Analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials..

CO2: Execute the use of appropriate materials in design considering engineering properties, sustainability, cost and weight

CO3 Implement the skills for engineering work in accordance with ethical and economic constraints related to the design of structures

CO4: Understand the concept of torsion and columns.

CO5:. Determine deflection of beam by using various method

Methodology to identify bright student

Considered a range of criteria, including academic performance, creativity, critical thinking, problem-solving skills, and enthusiasm for learning. Bright students often excel in multiple areas. Observed how students perform in the classroom. In terms of active participation, engagement in discussions, leadership, and the ability to grasp complex concepts.

Efforts to keep students engaged

1. Active Learning:
   - Incorporate active learning strategies, such as group discussions, problem-solving activities, and hands-on projects. Active participation keeps students engaged and encourages critical thinking.
2. Varied Teaching Methods:
   - Use a variety of teaching methods, including lectures, group work, multimedia presentations, and interactive activities to cater to different learning preferences.
3. Technology Integration:
   - Leverage technology, such as online platforms, educational apps, and interactive software, to make lessons more engaging and interactive.

Methodology to identify weak student

Considered a range of criteria, including classroom observation, formative assessment, summative assessment, assignment review e.t.c. Weak students are struggling students with sensitivity and a desire to support their learning. Some measures, such as additional tutoring, personalized assignments, or alternative assessment methods, to help students succeed.

Targeted inventions for weak student

1. Additional Resources

Offer supplementary learning materials, such as textbooks, online resources, or multimedia content, to provide alternative explanations and reinforce key concepts.

2. Remedial classes

Establish a tutoring program where students can receive extra help from teachers.

3. Flipped classroom

Students are assigned pre-class learning materials, often in the form of videos, readings, or online modules, to cover the foundational concepts before coming to class.