MECHANICS OF SOLIDS (ME302PC)
COURSE PLANNER

I. COURSE OBJECTIVE AND RELEVANCE:

The objectives of Mechanics of Solids is to ensure that the structure or the member which is designed should be strong enough to resist the forces which it is subjected this is called strength requirements, its deformations should not be excessive i.e. should be in the stipulated limits. This is called serviceability requirements.

II. COURSE PURPOSE:

The course purpose is to study the strength of materials which will determine whether the properties of materials used is acceptable to make sure that the design structure will remain serviceable and will not fail under applied loads with a suitable factor of safety. It also teaches us how to make effective and economical use of engineering materials.

III. COURSE OBJECTIVES

S.NO	COURSE OBJECTIVES
1	To understand the theory of elasticity including stress, strain / displacement and Hooke's law and strain energy relationships.
2	To understand the shear force and bending moment diagrams of symmetrical beams.
3	To determine bending and shear stresses developed in beams of various sections. Understand the advantages and limitations of various measuring instruments
4	To understand various theories of failure, Mohr's circle of stresses, principle stresses and strains.
5	To determine stresses in a shaft under torsion and in thin cylindrical shells.

IV. COURSE OUTCOME:

S.No	Description	Bloom's Taxonomy Level
1	Able to analyze the given designed member is enough to resist the forces which it is subjected.	Analyze (Level 4)
2	Able to identify the serviceability requirements of designed structure member.	Knowledge(Level 1)
3	Able to determine the properties of given materials is acceptable to make sure that the design structure will remain serviceable and will not fail under applied loads with a suitable factor of safety.	Knowledge, Understand (Level 1, Level 2)
4	It also teaches us how to make effective and economical use of engineering materials.	Apply (Level 3)

V. HOW PROGRAM OUTCOMES ARE ASSESSED:

	Program Outcomes	Level	Proficiency assessed by
PO1:	**Engineering knowledge:** Graduates will demonstrate the ability to use basic knowledge in mathematics, science and engineering and apply them to solve problems specific to mechanical engineering.	**3**	Assignments and Exams
PO2:	**Problem analysis:** Graduates will demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results.	**2**	Assignments and Exams
PO3:	**PO3Design/development of solutions:** Graduates will demonstrate the ability to design any mechanical system or thermal that meets desired specifications and requirements.	**2**	Assignments and Exams
PO4:	**Conduct investigations of complex problems:** Graduates will demonstrate the ability to identify, formulate and solve mechanical engineering problems of a complex kind.	**1**	Assignments and Exams
PO5:	**Modern tool usage:** Graduates will be familiar with applying software methods and modern computer tools to analyze mechanical engineering problems.	**--**	--
PO6:	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	**--**	--
PO7:	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	**--**	--
PO8:	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	**--**	--
PO9:	**Individual and teamwork:** Graduates will demonstrate the ability to function as a coherent unit in multidisciplinary design teams, and deliver results through collaborative research	**3**	Assignments and Exams
PO10:	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	**1**	Assignments and Exams
PO11:	**Project management and finance:** Graduate will be able to design a system to meet desired needs within environmental, economic, political, ethical health and safety, manufacturability and management knowledge and techniques to estimate time, resources to complete project.	**--**	--
PO12:	**Life-long learning:** Graduates should be capable of self-education and clearly understand the value of life-long learning.	**2**	Assignments and Exams

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO 1:	The student will be able to apply the knowledge of Mathematics, Sciences and engineering fundamentals to formulate, analyse and provide solutions the problems related to Mechanical engineering and communicate them effectively to the concerned.	**3**	Lectures, Assignments
PSO 2:	Design mechanical systems in various fields such as machine elements, thermal, manufacturing, industrial and inter-disciplinary fields by using various engineering/technological tools to meet the mercurial needs of the industry and society at large.	**2**	Projects
PSO 3:	The ability to grasp the latest development, methodologies of mechanical engineering and posses competent knowledge of design process,practicalprofecencies,skills and knowledge of programme and developing ideas towards research	**1**	Guest Lectures

PRE REQUISITES:

Studying Mechanics of solids requires knowledge of Engineering Mechanics. One should have sufficient knowledge about Moments, Forces, System of forces, Centroids, Moment of Inertia, Stress and strain.

VII. SYLLABUS:

UNIT-I

SIMPLE STRESSES AND SRAINS:

Elasticity and plasticity- Types of stresses and strains- Hookes's law- Stress-strain diagram for mild steel- Working stress- Factor of safety- Lateral strain, Poisson's ratio and volumetric strain, Elastic moduli and the relationship between them- Bars of varying section- Composite bars- Temperature stresses, Strain energy- Resilience- Gradual, sudden, impact and shock loadings.

UNIT-II

SHEAR FORCE AND BENDING MOMENT: Definition of beam- Types of beams- Concept of shear force and bending moment- S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads- Point of contra flexure- Relation between S.F , B.M and rate of loading at a section of a beam.

UNIT-III

FLEXURAL STRESSES:

Theory of simple bending – Assumptions- Derivation of bending equation: M/I= f/y =E/R Neutral axis- Determination bending stresses- section modulus of rectangular and circular sections (Solid and Hollow), I,T Angle and Channel sections- Design of simple beam sections.

SHEAR STRESSES:

Derivation of formula- Shear stress distribution across various beams section like rectangular, circular, triangular, I, T angle sections.

UNIT-IV

PRINCIPAL STRESSES AND STRAINS:

Introduction-Stresses on an inclined section of a bar under axial loading-Compound stresses-Normal and tangential stresses on an inclined plane for biaxial stresses-Two perpendicular normal stresses accompanied by a state of simple shear-Mohr's circle of stresses-Principal stresses and strains- Analytical and graphical solutions.

THEORIES OF FAILURE:

Introduction-Various theories of failure-Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theoty (Von Mises Theory).

UNIT-V

TORSION OF CIRCULAR SHAFTS:

Theory of pure torsion-Derivation of Torsion equations: $T/J=q/r=N\theta/L$ –Assumptions made in the theory of pure torsion- Torsional moment of resistance-Polar section modulus-Power transmitted by shafts-Combined bending and torsion and end thrust-Design of shafts according to theories of failure.

THIN CYLINDERS

Thin seamless cylindrical shells -Derivation of formula for longitudinal and circumferential stresses- Hoop. Longitudinal and volumetric strains- changes in diameter and volume of thin cylinders-Thin spherical shells.

SUGGESTED BOOKS:

TEXT BOOKS:

1. Solid Mechanics by Popov.
2. Strength of Materials by Ryder. G.H, Macmillan Long Man Pub.
3. Strength of Materials by W.A.Nash, TMH
4. Strength of Materials by Dr.R.K.Bansal
5. Strength of materials – R.S. Kurmi and Gupta.

REFERENCES:

6. Strength of Materials by Jindal, Umesh Publications.
7. Analysis of structures by Vazirani and Ratwani.
8. Mechanics of Structures Vol-I by H.J.Shah and S.B.Junnarkar, Charortar Publishing House Pvt.Ltd.
9. Strength of materials by D.S.Prakash Rao, Universities Press Pvt. Ltd..

10. Strength of materials by S.S.Rattan, Tata McGraw Hill Education Pvt..Ltd.
11. Fundamentals of Solid Mechanics by M.L.Gambhir, PHI Learning Pvt. Ltd.
12. Strength of materials by R.K.Rajput, S.Chand & Company Ltd.

NPTEL WEB COURSE:

http://nptel.ac.in/courses/112107147/
http://nptel.ac.in/courses/112107147/1
http://nptel.ac.in/courses/112107147/2
http://nptel.ac.in/courses/112107147/3
http://nptel.ac.in/courses/112107147/5
http://nptel.ac.in/courses/112107147/6

NPTEL VIDEO COURSE:

https://youtu.be/IpMZNpWjsk4
https://youtu.be/A1SWKe6ZwVc
https://youtu.be/51iDIC9ZgOk
https://youtu.be/acTLYnLmv4o

VIII. COURSE PLAN (WEEK-WISE):

Lecture No	Topics to be covered	Content to be covered under each topic	Link for PPT	Link for PDF	Link for Small Projects/ Numericals(if any)	Teaching Methodology	REFERENCES
1	Introduction to Simple Stresses and Strains	• Introduction, • Stress, • Importance, Areas of Influence Strains	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

2	Elasticity and plasticity-	• Types of stresses • Types of Strain • Practical Examples	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
3	Hookes's law- Stress-strain diagram for mild steel.	• Mechanical Properties • UTM Test • Sample preparation • Elongated Length	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
4	Working stress- Factor of safety	• FOS importance • Usage • Impact of FOS • Real time examples Discussion	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

5	Lateral strain, Poisson's ratio and volumetric strain	• Concept of lateral strain • Poission Ratio discussion • Poission ratio importance • Volumetric strain • Concept learning as search	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
6	Elastic moduli and the relationship between them	• Elastic Modulus • Bulk Modulus • Modulus of Rigidity • Relationship between all modulus	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
7	Bars of varying section	• Calculation of stresses • Calculation of deformation of varying section of bar • Numerical problems	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

8	Composite bars	• Composite bar-Definition • Thermal Effect on Composite bar • Coefficient of expansion • Numerical Problems	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
9	Thermal stresses	• Thermal stress : Definition • Effect of thermal stress • Numerical problems	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
10	Strain energy-Resilience, Types of Loading Gradual, sudden loading, Impact and shock loadings	• Strain Energy-Definition • How to measure strain energy • Impact of strain energy • Numerical problems • Types of Loading • Calculation of stress	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

11	Introduction to Shear force and Bending Moment:	• Introduction, • Types of Beam • Concept of shearing force and bending moment diagram	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
12	S.F and B.M diagrams for cantilever beam subjected to point loads, uniformly distributed load	• Relationship of cantilever beam subjected to u.d.l. • How to draw S.F and B.M. • Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
13	S.F and B.M diagrams for cantilever beam subjected to uniformly varying load	• Relationship of cantilever beam subjected to U.V.L. • How to draw S.F and B.M. • Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

14	S.F and B.M diagrams for cantilever beam subjected to uniformly varying load combination of point load,	• Relationship of cantilever beam subjected to U.V.L and Point Load. • How to draw S.F and B.M. • Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
15	S.F and B.M diagrams for simply supported beam subjected to point loads, uniformly distributed load.	• Relationship of cantilever beam subjected to U.V.L and Point Load. • How to draw S.F and B.M. • Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
16	S.F and B.M diagrams for simply supported beam subjected to point loads, uniformly varying load.	• Relationship of simply supported beam subjected to U.V.L and Point Load. • How to draw S.F and B.M. • Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

17	S.F and B.M diagrams for simply supported beam subjected to combination of point load, UDL,UVL	• Relationship of simply supported beam subjected to U.V.L and Point Load. • How to draw S.F and B.M. • Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
18	S.F and B.M diagrams for overhanging beam subjected to point loads UDL&UVL and combination of these loads.	• Relationship of cantilever beam subjected to U.V.L and Point Load. • How to draw S.F and B.M. • Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
19	Point of contra flexure- Relation between S.F , B.M and rate of loading at a section of a beam	• Definition – Contraflexure • Relationship derivation • Numerical Problem	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

20	Competitive Exam Question	• Discussion on the questions asked from this chapter in competitive exam	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
21	Degrees of freedom (Beyond the syllabus)	• Introduction, • Basic Knowledge of simple bending • DOF					
22	Introduction to Flexural Stresses, Theory of simple bending	• Flexural stresses • Thery of simple bending • Assumptions • Derivation of bending stress equation	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
23	Introduction to Flexural Stresses, Theory of simple bending	• Numerical Problems	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
24	Section modulus of rectangular section (solid &hollow)	• Definition • Section modulus for different section • Numerical problems					

25	I,T Angle and Channel sections	• Derivation • Numerical Problems	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
26	Design of simple beam sections	• Derivation • Numerical Problems	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
27	Introduction to Shear stresses-Derivation of formula	• Shear stresses • Definition • Derivation of relationship	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

28	Shear stress distribution across rectangular section, circular section	• Shear Stress distribution • Rectangular section • Circular section • Derivation of formula • Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
29	Shear stress distribution across triangular section	• Shear Stress distribution • Derivation of formula • Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
30	Numerical	• Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing		
31	Introduction to Principal Stresses and Strains.	• Definition • Principal stress • Principal strain				Chalk and Talk	T1

32	4	• Stress calculation • Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
33	Compound stresses	• Compound stress • Introduction • Numerical	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
34	Normal and tangential stresses on an inclined plane for biaxial stresses.	• Normal and Tangential stress • Numericals	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

35	Two perpendicular normal stresses accompanied by a state of simple shear.	• Principal stress relationship • Normal Stress • Shear stress • Numerical	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
36	Mohr's circle of stresses	• Concept • How to draw • Determination of principal stress	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
37	Principal stresses and strain- Analytical and graphical solutions						T1
38	Introduction to Theories of Failure	• Definition • Different types of theories • Applications	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	

39	Maximum Principal Stress Theory, Maximum strain theory	• Derivation • Numerical	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
40	Strain Energy and Shear Strain Energy Theory (Von Mises Theory)	• Derivation • Numerical	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
41	Introduction to Torsion of Circular Shafts- Theory of pure torsion.	• Introduction • Definitions of torsion • Assumptions • Derivation of relationship	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

42	Derivation of Torsion equation: T/J=q/r=Nθ/L, Assumptions made in the theory of pure torsion.	• Derivation • Assumptions • Numerical	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
43	Torsional moment of resistance	• Concept • Torsion moment resistance definition • Derivation of relationship	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
44	Polar section modulus, Power transmitted by shafts	• Definition • Relationship for section modulus • Determination of section modulus for different section	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

45	Combined bending and torsion and end thrust	• Concept • Derivation of relationship • Numerical problem	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
46	Design of shafts according to theories of failure.	• Types of Theories • Application in real-time problem	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
47	Introduction to Thin Cylinders-Thin seamless cylindrical shells-Derivation of formula for longitudinal and circumferential stresses.	• Thin cylinder definition • Circumferential and longitudinal stress • Derivation of relationship • Numerical	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

48	Derivation of formula for Hoop, Longitudinal and volumetric strains	• Derivation • Numerical	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1
49	Changes in diameter and volume of thin cylinders. Thin spherical shells.	• Derivation • Numerical	https://drive.google.com/drive/folders/1jVAv-gheSah2d3gee9zYQnL9vyYcIZMJ?usp=sharing	https://drive.google.com/drive/folders/1TkXnPIa3Jc4ZBvQSp80SthfFf9CbX3Yo?usp=sharing	https://drive.google.com/drive/folders/1ibmg1xxRUOD6z1rSdQh2ZXzw1h3Ut37F?usp=sharing	Chalk and Talk	T1

TEXT BOOK:

T1. Strength of materials – R.S. Kurmi and Gupta, S Chand Publications
T2. Solid Mechanics, by Popov
T3. Strength of Materials – Ryder. G.H.; Macmillan Long Man Pub.
T4. Strength of Materials – W.A. Nash, TMH

REFERENCE BOOK:

R1. Strength of Materials -By Jindal, Umesh Publications.
R2. Analysis of structures by Vazirani and Ratwani.
R3. Mechanics of Structures Vol –I by H.J.Shah and S.B.Junnarkar, Charotar Publishing House Pvt. Ltd.
R4. Strength of Materials by S. Ramamrutam, R. Narayan, Dhanpat Rai Publishing Company R5. Strength of Materials by R. K. Rajput, S Chand Publications.

IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CO's	Program Outcomes (PO's)												Program Specific Outcomes (PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	2	--	--	--	--	--	2	1	--	2	3	2	1
CO2.	3	2	2	--	--	--	--	--	3	1	--	2	3	2	1
CO3.	3	2	2	1	--	--	--	--	3	1	--	2	3	2	1
CO4.	3	2	2	1	--	--	--	--	3	1	--	2	3	2	1
	3	2	2	1	--	--	--	--	3	1	--	2	3	2	1
Avg	**3**	**2**	**2**	**1**	**--**	**--**	**--**	**--**	**3**	**1**	**--**	**2**	**3**	**2**	**1**

X. QUESTION BANK:

UNIT-I

Short Answer Questions:

Q. No	Questions	Blooms Taxonomy Level	Course Outcome
	Unit-I		
1	Define Longitudinal strain and lateral strain.	Knowledge	1
2	State Hooke's law	Knowledge	2
3	Define Modular ratio, Poisson's ratio	Knowledge	4
4	What is modulus of elasticity?	Understand	1
5	Explain lateral strain with a neat sketch	Understand	1
6	Write the relationship between bulk modulus, rigidity modulus and Poisson's Ratio	Create	2
7	Draw the stress-strain diagram for mild steel, brittle material and a ductile material and indicate the sailent points	Apply	2
8	What is Principle of Superposition?	Understand	2
9	What is the procedure for finding the thermal stresses in a composite bar?	Understand	2
10	Define Factor of Safety, working stress and allowable stress.	Knowledge	3

Unit-II			
1	Explain shear force in a beam with neat sketches	Understand	1
2	What are the different types of beams? Differentiate between a point load and a uniformly distributed load.	Knowledge	2
3	What is the maximum bending moment for a simply supported beam subjected to uniformly distributed load and where it occurs?	Knowledge	2
4	Write the relation between bending moment, shear force and the applied load.	Create	2
5	Define point of contra flexure.	Knowledge	1
6	Define moment of resistance of a beam	Knowledge	3
7	What do you mean by thrust Diagram?	Understand	4
8	How many points of Contraflexure you will have for a simply supported beam overhanging at one end only?	Knowledge	4
9	What are the sign conventions for shear force and bending moment in general?	Understand	2
UNIT-III			
1	Define the terms: bending stress, neutral axis	Knowledge	2
2	What do you mean by simple bending	understand	3
3	What do you mean by pure bending	Understand	1
4	What is the meaning of strength of section	Understand	1
5	Define the terms : modular ratio, equivalent section	Knowledge	1
6	Define the terms: section modulus, flitched beams.	knowledge	1
UNIT-IV			
1	Define terms of principle plane and principle Stress	knowledge	2
2	Define the term obliquity and how it is determined	knowledge	2
3	Write a note on mohr's circle of stress	create	2
4	Derive the expression for the stresses on an oblique plane of a rectangular body When the body is subjected to to simple shear stress	Evaluate	2
5	Discuss about about theories of failure	understand	3
UNIT-V			
1	Define the term thin cylinders	understand	1
2	Name the stresses set up in thin cylinders subjected to internal fluid pressure	Knowledg	2
3	Write the expressions for circumferential stress and longitudinal stress for a	Create	2
4	Write an expression for change in volume of athin cylindrical shell subjected to	Create	2
5	Define the term efficiency of a joint and write the equation	Understan	4
6	What is hoop stress and explain why hoop stress is required.	understand	2
7	Define the terms torsion, torsional rigidity and polar moment of inertia.	understand	3
8	Derive an expression for shear stress produced in circular shaft which is subjected to torsion. What are assumptions made in derivation?	evaluate	3

Long Answer Questions:

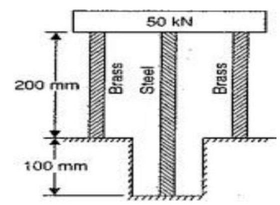
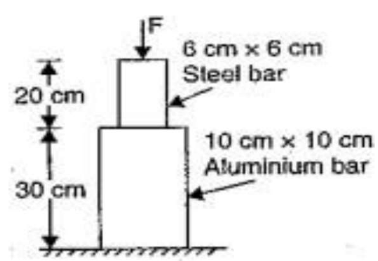
Q. No	Questions	Blooms Taxonomy Level	Course Outcome
	UNIT – I		
1	Three sections of a bar are having different lengths and different diameters. The bar is subjected to an axial load P. Determine the total change in length of the bar. Take Young's modulus of different sections as same.	Knowledge	1
2	Prove that the total extension of a uniformly tapering rod of diameters D_1 & D_2, when the rod is subjected to an axial load P is given by dL= $4PL/(\pi E\, D_1\, D_2)$ where L is total Length of the rod.	Knowledge	2
3	Find an expression for the total elongation of a bar due to its own weight, when the bar is fixed at its upper end and hanging freely at the lower end.	Knowledge	2
4	Find an expression for the total elongation of a uniformly tapering rectangular bar when it is subjected to an axial load P.	Understand	2
5	Derive the relation between three elastic modulii.	Understand	2
6	Define Volumetric Strain. Prove that the volumetric strain for a rectangular bar subjected to an axial load P in the direction of its length is given by $\varepsilon_V = (\delta l/l)(1-2\mu)$ where μ= Poisson's Ratio and $\delta l/l$ = longitudinal strain.	Knowledge	2
7	Derive an expression between modulus of elasticity and modulus of rigidity.	Understand	2
8	Prove that the stress induced in the body when the load is applied with the impact is given by, $\sigma = \frac{P}{A}\left(1+\sqrt{1+\frac{2AEh}{P.L}}\right)$ A=cross-section area of the body H=height through which load falls E= modulus of rigidity L=length of the body	Understand	2
9	Prove that the maximum stress induced in a body due to suddenly applied load is twice the stress induced when the same load is applied gradually.	Understand	2

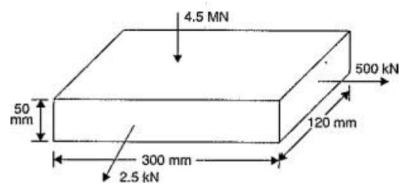
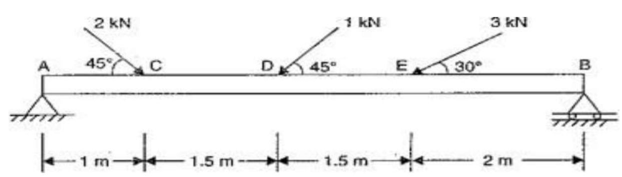
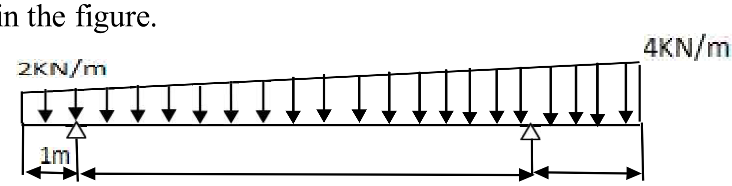
10	If the extension produced in a rod due to impact load is very small in comparison with the height through which the load falls, then the maximum stress induced in the body is given by $$\sigma = \sqrt{\frac{2E.P.h}{A.L}}$$	Knowledge	3
	UNIT – II		
1	Draw the shear force and bending moment diagrams for a cantilever of length L carrying a point load W at Free end.	Knowledge	8
2	Draw the shear force and bending moment diagrams for a simply supported beam of length L carrying a point load W at its middle point.	Knowledge	8
3	Draw the shear force and bending moment diagrams for a simply supported beam of length L which is subjected to a clockwise couple at the centre of the beam.	Apply	2
4	Draw the shear force and bending moment diagrams for a cantilever of length L carrying a uniformly distributed load w per unit length over its entire length. Also calculate maximum bending moment.	Apply	2
5	Draw the shear force and bending moment diagrams for a simply supported beam of length L carrying a uniformly distributed load w per unit length over its entire length.	Apply	2
6	Derive the relation between Load, shear force and bending moment.	Apply	3
7	Draw the shear force and bending moment diagrams for a cantilever of length L carrying a uniformly varying load zero at free end to w per unit length at the fixed end.	Apply	3
8	Draw the shear force and bending moment diagrams for a simply supported beam of length L carrying a uniformly varying load zero at each end to w per unit length at the centre.	Apply	2
9	How will you draw the S.F and B.M diagrams for a beam which is subjected to inclined loads?	Apply	1
	UNIT – III		
1	Derive an expression for bending stress	Knowledge	3
2	Show that for a rectangular section the max shear stress is 1.5 times the average	Knowledge	4
3	The shear stress is not maximum at the neutral axis in case of a triangular	Knowledge	2
4	A rectangular beam 100mm wideand 150mm deep is subjected to a shear force of	Apply	1
5	Derive bending equation M/I=f/y=E/R.	Knowledge	2
6	Discuss the assumptions involved in the theory of simple bending	Knowledge	3
7	Draw and explain shear stress distribution across I section	Knowledge	2
8	Draw and explain shear stress distribution acrossTsection.	Knowledge	2
9	Draw and explain shear stress distribution across Circular section.	Knowledge	2
	UNIT – IV		
2	**Derive** equations of static equilibrium for a three dimensional elastic body.	Knowledge	3

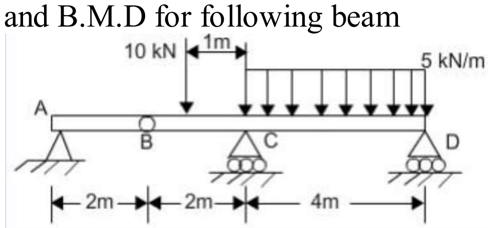
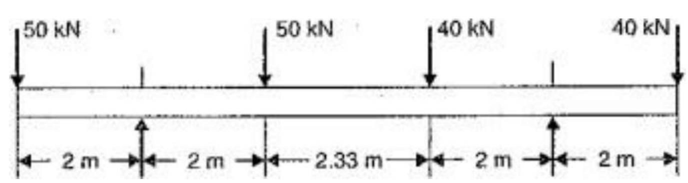
3	**Derive** the equations for stresses acting on inclined planes and deduce stress equations for principal planes.	Knowledge	4
4	**Determine** graphically state of stress on inclined plane for a deformable body.	Knowledge	1
5	**Derive** the strain equations for three mutually perpendicular line elements in terms	Knowledge	2
6	**Derive** equations for stains on inclined planes and deduce strain for principal planes.	Knowledge	2
7	**Draw** the Mohr's Circle to determine stains on inclined plane.	Knowledge	1
	UNIT – V		
1	Prove that the torque transmitted by the solid shaft when subjected to torsion is given by $$T = \frac{\pi}{16}\tau D^3$$	Apply	1
2	Derive the relation for a circular shaft when subjected to torsion as given below $$\frac{T}{J} = \frac{\tau}{R} = \frac{C\theta}{L}$$	Apply	2
3	Find the expression for strain energy stored in a body due to torsion.	Apply	2
4	A hollow shaft of external diameter D and internal diameter d is subjected to torsion. Prove that the strain energy stored is given by $$U = \frac{\tau^2}{4CD^2}(D^2 + d^2) \times V$$	Apply	2

Long Answer Questions: (Critical Thinking)

Q. No	Questions	Blooms Taxonomy Level	Course Outcome
	UNIT – I		
1	Find the minimum diameter of a steel wire with which a load of 3500N can be raised so that the stress in the wire may not exceed 130N/mm^2. For the size and the length of the middle portion if the stress there is 140N/mm^2 and the total extension of the bar is 0.14mm. take E= 2×10^5 N/mm^2.	Analyze	3
2	A copper rod 5mm in diameter when subjected to a pull of 750 N extends by 0.125mm over a gauge length of 327mm. find the Young's Modulus for copper.	Analyze	2

3	A steel punch can operate at a maximum compressive stress of 75N/mm^2. Find the minimum diameter of the hole which can be punched through a 10mm thick steel plate. Take the ultimate shearing strength as 375N/mm^2	Analyze	2
4	A steel rod of cross-sectional area 1600mm^2 and two brass rods each of cross- sectional area of 1000mm^2 together support a load of 50KN as shown in figure. Find the stresses in the rods. Take E for steel 2× 10^5 N/mm^2 and E for brass 1×10^5 N/mm^2 	Analyze	2
5	A steel rod 5 cm diameter and 6 m long is connected to two grips and the rod is maintained at a temperature of 100^{0}C. determine the stress and pull exerted when the temperature falls to 20^{0}C if (i) The ends do not yield (ii) The ends yield by 0.15cm Take E = 2 ×10^5 N/mm^2 and α=12×10^{-6}/ºC	Analyze	1
6	The extension in a rectangular steel bar of length 800mm and of thickness 20mm is found to be 0.21mm. The bar tapers uniformly in width from 80mm to 40mm. if E for the bar is 2×10^5 N/mm^2. Determine the axial tensile load on the bar.	Analyze	3
7	A member formed by connecting a steel bar and an aluminium bar is shown in the figure. Assuming that the bars are prevented from buckling sideways, calculate the magnitude of force P, that will cause the total length of the member to decrease 0.30mm. the values of elastic modulus for steel and aluminium are 2×10^5 N/mm^2 and 6.5×10^4 N/mm^2 	Explain	1

8	A metallic bar 300mm×120mm×50mm is loaded as shown in figure. Find the change in volume. Take $E=2\times10^5$ N/mm^2. And poisson's ratio =0.25 	Explain	1
9	The shear stress in a material at a point is given as 45N/mm^2. Determine the local strain energy per unit volume stored in the material due to shear stress. Take C= 8×10^4 N/mm^2	Analyze	1
10	A vertical compound tie member fixed rigidly at its upper end, consists of a steel rod 3m long and 20mm diameter, placed within an equally long brass tube 20mm internal diameter and 20 mm external diameter. The rod and the tube are fixed together at the ends. The compound member is then suddenly loaded in the tesion by a weight of 1200 Kgf falling through a height of 5mm on to a flange fixed to its lower end. Calculate the maximum in steel and brass.	Analyze	1
UNIT-II			
1	A beam is loaded as shown in following figure. Find the reactions at A and B, also draw the S.F, B.M and thrust Diagrams. 	Analyze	2
2	A simply supported beam of length 5m, carries a uniformly distributed load of 100N/m extending from the left end to a point 2m away. There is also a clockwise couple of 1500Nm applied at the centre of the beam. Draw the S.F and B.M diagrams for the beam and find the maximum bending moment.	Analyze	2
3	Draw the S.F and B.M diagrams for the beam carrying the loading shown in the figure. 	Analyze	4

4	A beam of length L is simply supported on two intermediate supports, movable along the length, with equal overhangs on either side. The supports are so adjusted that the maximum B.M is the minimum possible. Determine the position of the supports and draw the B.M and S.F diagrams for this position. The beam carries a uniformly distributed load of w per unit length over the entire length.	Analyze	2
5	A beam of uniform section 10m long carries a udl of 10KN/m over the whole length and a concentrated load of 10KN at the right end. If the beam is freely supported at the left end, find the position of the second support so that maximum bending moment for the beam shall be as small as possible. Find also the maximum bending moment for this case. Draw also SF and BM diagrams.	Analyze	3
6	Draw the S.F.D and B.M.D for following beam 	Analyze	2
7	A beam 10m long and simply supported at each end, has a uniformly distributed load of 1000N/m extending from the left end upto the centre of the beam. There is also an anti-clockwise couple of 15kN/m at a distance of 2.5m from the right end. Draw the S.F and B.M diagrams.	Analyze	2
8	A simply supported beam of length 8m rests on supports 6m apart, the right hand end is overhanging by 2m. The beam carries a udl of 1500N/m over the entire length. Draw S.F.D and B.M.D	Analyze	2
9	A cantilever of length 2m carries a udl of 2KN/m run over the length of 1m from the free end. It also carries a point load of 4KN at a distance of 0.5m from the free end. Draw the S.F.D and B.M.D.	Analyze	1
10	A beam is loaded as shown in the figure. Draw S.F.D and B.M.D and find a) Maximum Shear Force b) Maximum Bending Moment c) Point of inflexion 	Analyze	1
UNIT – III			

1	A steel plate of width 60mm and thickness 10mm is bent into a circular arc of radius 10m. Determine the max stress induced and the bending moment which will produce the max stress. Take E= $2x10^5$ N/mm^2.	Analyze	1
2	Calculate the max stress induced in a cast iron pipe of external diameter 40mm of internal diameter 20mm and of length 4m when the pipe is supported at its ends and carries a point load of 80N at the center.	Analyze	4
3	Derive an expression for bending stress	Analyze	3
4	Show that for a rectangular section the max shear stress is 1.5 times the average	Analyz e	3
5	The shear stress is not maximum at the neutral axis in case of a triangular section. Prove this statement.	Analyz e	3
6	A rectangular beam 100mm wide and 150mm deep is subjected to a shear force of 30kN. Determine the average stress, max shear stress	Analyz e	2
	UNIT – IV		
1	A structural member supports loads which produce, at a particular point, a direct tensile stress of $80N/mm^2$ and a shear stress of $45N/mm^2$ on the same plane .calculate the values and directions Of the principal stresses at the point and also the maximum stress, stating on which planes this will act.	Analyze	3
2	A solid shaft of circular cross-section supports a torque of 50KNm and a bending moment of 25KNm. If the diameter of the shaft is 150mm calculate the values of the principal stresses and their directions at a point on the surface of the shaft?	Analyze	3
3	A shear stress τ_{xy} acts in a two-dimensional field in which the maximum allowable shear stress is denoted by τ_{max} and the major principal stress by $\sigma 1$. Derive using the geometry of Mohr's circle of stress, expressions for the maximum values of direct stress which may be applied to the x and y planes in terms of three parameters given above.	Analyze	3
	UNIT-V		
1	A solid shaft of 20cm diameter is used to transmit torque. Find the maximum shaft transmitted by the torque if the maximum shear stresses induced in the shaft is $50N/mm^2$	Analyze	2
2	The shearing stress in a solid shaft is not to exceed $45N/mm^2$ when the torque transmitted 40000N-m. Determine the minimum diameter of the shaft.	Analyze	2
3	Two shafts of same material and of same lengths are subjected to the same torque if the first shaft is of a solid circular section and the second shaft is of hollow circular section whose internal diameter is 0.7 times the outside diameter and the maximum shear stress developed in each shaft is same compare the weights of the shafts.	Analyze	1

4	Find the maximum shear stress induced in a solid circular shaft of diameter 20cm when shaft transmit 187.5KW at 2000 r.p.m.	Analyze	2
5	A solid shaft has to transmit 12.5KW at 250 r.p.m taking allowable shear stress as $70N/mm^2$. Find suitable diameter for the shaft if maximum torque transmitted at each revolution exceeds the main by 20%.	Analyze	1
6	A cylindrical pipe of diameter 2m and thickness 2cm is subjected to an internal fluid pressure of $1.5N/mm^2$. Determine longitudinal stress and circumferential stress developed in the pipe material.	Analyze	2
7	A cylinder of internal diameter 0.60m contains air at a pressure of $7.5N/mm^2$ (gauge). If the maximum permissible stress induced in the material is $75N/mm^2$ find the thickness of the material.	Analyze	2

OBJECTIVE QUESTIONS:

JNTUH:

Unit-I

1. The ratio of ultimate stress to the working stress is known as
   (a) Poissions ratio (b) bulk modulus (c) factor of safety (d) working limit
2. Deformation of the body due to the force acting on it if P =Load L=length, A= Cross section area, E= Young's modulus.
   (a) PE /AL (b) PA/LE (c) PL/AE (d) AE/PL
3. Poission's ratio is maximum for
   (a) Steel (b) copper (c) aluminum (d) rubber
4. Hooks law holds good up to
   (a) Yield point (b) elastic limit (c) plastic limit (d) breaking point.
5. The ratio of Lateral Strain to longitudinal strain is called
   (a)Bulk Modulus (c) Modulus of Elasticity
   (b)Poisson's Ratio (d) Modulus of Rigidity
6. The thermal stress is given by
   (a) TEα (b) αET (c) TEα (d) TEαl
7. The total Strain energy stored in a body is known as
   (a)Impact Energy (c) Modulus of Resilience
   (b)Proof Resilience (d) Resilience
8. A rod is enclosed centrally in a tube and the assembly is tightened by rigid washers. If the assembly is subjected to compressive load, then
   (a) Rod is subjected to a compressive load
   (b) Tube is subjected to a compressive load
   (c) Both are subjected to a compressive load
   (d) None of the above

9. Poisson's ratio is maximum for
   (a) Steel (c) Aluminum
   (b) Copper (d) Rubber
10. The property of certain material of returning back to original position after removing external force is called
    (a) Plasticity (c) Ductility
    (b) Elasticity (d) Brittle

Unit-II

1. Point of contra flecture is the point where
   (a) Stress is maximum (c) Bending moment is maximum
   (b) Deflection changes sign (d) Bending Moment change its sign.
2. When a cantilever beam is loaded with concentrated loads the bending moment diagram will be
   (a) Horizontal straight line (c) Inclined Straight line
   (b) Vertical straight line (d) Parabolic
3. The bending moment on a section is Maximum where shearing force is
   (a) Minimum (c) Change in Sign
   (b) Maximum (d) Equal
4. A Cantilever beam of length (L) carries a point load (W) at the free end. The Shear Force diagram will be
   (a) Two equal and opposite rectangles (c) a triangle
   (b) Two equal and opposite triangles (d) a rectangle
5. At section of a beam sudden change in Bending Moment indicates the action of
   (a) Point load (b)B) couple (c) Point load or couple (d) UDL
6. If SFD between two sections varies linearly, BM between these sections varies
   (a) Linearly (b) Parabolically (c) Constant (d) None of these
7. Rate of change of shear force is equal to
   (a) Bending moment (c) Maximum deflection
   (b) Intensity of loading (d) Slope
8. The total internal Moment in the beam is called
   (a) Moment of resistance (c) Total Moment
   (b) Bending moment (d) None of the Above
9. A Cantilever beam 10 m long carries a point load of 10 KN at its free end and 15 KN as its middle. The bending moment at the middle of cantilever is
   (a) 50 KN-m (b) 25 KN-m (c) 100 KN-m (d) 200 KN-m
10. Bending moment diagram for a simply supported beam carrying central point load is a
    (a) Triangle (c) Circle
    (b) Rectangle (d) Square

Unit-III

1. Section modulus of a rectangular beam is
   (a) $bh^2/6$ (b) $bh^3/6$ (c) $bh^4/10$ (d) $bh^3/10$
2. When a load on the free end of a cantilever beam is increased, failure will occur
   (a) At the free ends (c) In the middle of the beam
   (b) At the fixed ends (d) At a distance 2L/3 from free end.
3. In theory of simple bending the bending stress in beam section varies
   (a) Linearly (b) Parabolically (c) Elliptically (d) None of above.
4. If 'b' is the width of the beam and'd' is depth of beam then Section modulus of rectangular section is given by
   (a) $db^2/12$ (b) $bd^2/12$ (c)$db^2/6$ (d)$bd^2/6$
5. In Theory of Simple bending the bending stress in beam section varies
   (a) Linearly (b) Parabolically (c) Elliptically (d) None of above.
6. Neutral axis of a beam is the axis at which
   (a) The shear force is zero (c)The bending stress is maximum
   (b) The section modulus is zero (d) The bending stress is zero
7. The bending stress at the Neutral axis is
   (a) Negative (b) Positive (c) zero (d) None of this
8. The layer which is unchanged due to bending
   (a) Boundary layer (b) Upper layer (c) Lower layer (d) Neutral layer
9. A section of beam is said to be pure bending, if it is subjected to
   (a) Constant bending moment and constant shear force
   (b) Constant shear force and zero bending moment
   (c) Constant bending moment and zero shear force
   (d) None of the above.
10. In a circular section, the maximum shear stress (maxτ) is given by
    (a) $avg\tau\times21$ (b) $avg\tau\times34$ (c) $avg\tau\times32$ (d) none of the above.
11. Shear stress diagram of the rectangular section
    (a) Straight line (b) Involutes (c) Hyperbola (d) Parabola
12. In rectangular beam, the ratio of maximum shear stress to average shear stress
    (a) 1 (b) 1.5 (c) 2 (d) 2.5
13. _______ helps us in obtaining the values of shear stress at any section along the depth of the beam
    (a) Shear stress distribution diagram
    (b) Bending moment diagram
    (c) Shear force diagram
    (d) Stress strain diagram

Unit-IV

1. The failure of a material is usually classified into
   (a) Brittle failure (fracture) (b) ductile failure (yield) (c) none of the above
2. Failure criteria are functions in stress or strain space which separate "_______" states from "________" states.
   (a) Failed, unfiled (b) un failed, failed (c) none of the above
3. The fracture toughness and the critical strain energy release rate for plane stress are related by
   (a) $G_{\mathrm{Ic}} = \frac{1}{E} K_{\mathrm{Ic}}^2$ (c) $\sigma = \sqrt{\frac{2E\gamma}{\pi a}}$
   (b) $G_I := \frac{P}{2t} \frac{du}{da}$ (d) None of the above.
4. On two perpendicular planes stresses are σ_1 = 120 MPa, σ_2 = 60 MPa and τ = ±40 MPa, what is the maximum shear stress at the point?
   (a) 60 MPa (b)50 MPa (c)0 MPa (d)None of these
5. At a point two principal stresses are +120 MPa and −80 MPa. What is the shear stress on a plane inclined 45° to the plane of major principal stress?
   (a)100 MPa (b) 50 MPa (c)20 MPa (d)None of these
6. Major principal stress at a point is 220 MPa. The radius of Mohr's stress circle is 70 MPa. What is the minor principal stress at the point?
   (a) 100 MPa (b) 150 MPa (c) 80 MPa (d) None of these
7. On an element, on two perpendicular planes, the shear stresses are ±50MPa. There is no normal stress on these planes. What is the maximum principal stress at the point?
   (a) 100 MPa (b) 50 MPa (c) 25 MPa (d) None of these
8. The plane across which shear stress is zero is
   (a) Principal plane (c) Tangential Plane
   (b) Oblique plane (d) None of the above
9. When a body is subjected to direct stresses in two mutually perpendicular directions (both tensile) then major principal stress is
   (a) σ 1 (b) σ 2 (c) σ 3 (d) σ 1+ σ 2
10. The angle at which principal plane develops is called
    (a) Principal strain (c) Principal stress
    (b) Lateral strain (d) Longitudinal strain

Unit-V

1. Circumferential and longitudinal strains in cylinder boiler under internal steam pressure, and ε_1 and ε_2 respectively. Change in volume of the boiler cylinder per unit volume will be

   (a) $\varepsilon_1 + 2\varepsilon_2$ (b) $\varepsilon_1 \varepsilon_2^2$ (c) $2\varepsilon_1 + \varepsilon_2$ (d) $\varepsilon_1^2 \varepsilon_2$
2. From design point of view, spherical pressure vessels are preferred over cylindrical pressure vesels because they
   (a) Are cost effective in fabrication
   (b) Have uniform higher circumferential stress
   (c) Uniform lower circumferential stress
   (d) Have a larger volume for the same quantity of material used
3. A cylindrical shell is said to be thin if the ratio of its internal diameter to the wall thickness is
   (a) Less than 20 (b) equal to 20 (c) More than 20 (d) None of above
4. The hoop or circumferential stress in a thin cylindrical shell of a diameter (D) Length (L) and thickness (t), when subjected to an internal pressure (p) is equal to
   (a) Pd/2t (b) Pd/4t (c) Pd/8t (d) Pd/16t
5. The design of a thin cylindrical shell is based on
   (a) Internal Pressure (c) Diameter of shell
   (b) Longitudinal stress (d) All of the above
6. In a thin cylinder, the hoop stress is given by
   (a) Pd/4t (b) Pd/t (c) Pd/2t (d) 2Pd/t
7. Maximum shear stress occurs at
   (a) Outermost surface of the shaft (c) At the center of the shaft
   (b) Innermost surface of the shaft (d) None of the above
8. Shear stress varies _________ in between center of the shaft to the outermost surface
   (a) Parabolically (c) Elliptically
   (b) Linearly (d) None of the above
9. Polar moment of inertia for a solid circular shaft is
   (a) $\Pi d^2/16$ (b) $\Pi d^4/64$ (c) $\Pi d^2/32$ (d) $\Pi d^4/32$
10. Polar modulus for a solid circular shaft is
    (a) $\Pi d^3/16$ (b) $\Pi d^4/16$ (c) $\Pi d^3/32$ (d) $\Pi d^4/32$

<u>GATE</u>:

1. Two identical circular rods of same diameter and same length are subjected to same magnitude of axial tensile force. One of the rods is made out of mild steel having the modulus of elasticity of 206GPa. The other rod os made out of cast iron having the modulus of elasticity of 100GPa. Assume both the materials to be homogeneous and isotropic and the axial force causes the same amount of uniform stress in both the rods.

The stresses developed are within the proportionality limit of the respective materials. Which of the following observations is correct?

(a) Both rods elongate by the same amount

(b) Mild steel rod elongates more than the cast iron rod

(c) Cast iron elongates more than the mild steel rod

(d) As the stresses are equal strains are also equal in both the rods.

2. A steel bar of 40mm x 40mm square cross section is subjected to an axial compressive load of 200KN. If the length of the bar is 2m and E=200GPa the elongation of the bar will be

(a) 1.25mm (b) 2.70mm (c) 4.05mm (d) 5.40mm

3. The ultimate tensile strength of a material is 400MPa and the elongation up to maximum load is 35%. If the material obeys power law of hardening, then the true stress- true strain relation (stress in MPa) in the plastic deformation range is :

(a) $0.30\sigma=540e$ (b) $0.30\sigma=775e$ (c) $0.35\sigma=540e$ (d) $0.3\ \sigma=775e$

4. An axial residual compressive stress due to manufacturing process present on the outer surface of a rotating shaft subjected to bending. Under a given bending load, the fatigue life of the shaft in the presence of the residual compressive stress is:

(a) Decreased

(b) Increased or decreased depending on the external bending load

(c) Neither decreased nor increased

(d) Increased

5. A static load is mounted at the centre of a shaft rotating at uniform angular velocity. This shaft will be designed for

(a) The maximum compressive stress (static)

(b) The maximum tensile stress (static)

(c) The maximum bending moment (static)

(d)) Fatigue loading

6. Fatigue strength of a rod subjected to cyclic axial force is less than that of a rotating beam of the same dimensions subjected to steady lateral force because

(a) Axial stiffness is less than bending stiffness

(b) Of absence of centrifugal effects in the rod

(c) The number of discontinuities vulnerable to fatigue are more in the rod

(d) At a particular time the rod has only one type of stress whereas the beam has both the tensile and compressive stresses.

7. A rod of length L and diameter D is subjected to a tensile load P. Which of the following is sufficient to calculate the resulting change in diameter?

(a) Young's modulus (c) Poisson's ratio

(b) Shear modulus (d) Both Young's modulus and shear modulus

8. In terms of Poisson's ratio (μ) the ratio of Young's Modulus (E) to Shear Modulus (G) of elastic materials is:

9. The relationship between Young's modulus (E), Bulk modulus (K) and Poisson's ratio (μ) is given by:
10. In a bolted joint two members are connected with an axial tightening force of 2200 N. If the bolt used has metric threads of 4 mm pitch, then torque required for achieving the tightening force is
   (a) 0.7Nm (b) 1.0 Nm (c) 1.4Nm (d) 2.8Nm
11. The figure below shows a steel rod of 25 mm2 cross sectional area. It is loaded at four points, K, L, M and N. Assume Esteel = 200 GPa. The total change in length of the rod due to loading is:
   (a) 1 μm (b) -10 μm (c) 16 μm (d) -20 μm
12. A bar having a cross-sectional area of 700mm2 is subjected to axial loads at the positions indicated. The value of stress in the segment QR is: P Q R S
   (a) 40 MPa (b) 50 MPa (c) 70 MPa (d) 120 MPa
13. An ejector mechanism consists of a helical compression spring having a spring constant of K = 981 × 103 N/m. It is pre-compressed by 100 mm from its free state. If it is used to eject a mass of 100 kg held on it, the mass will move up through a distance of
   (a) 100 mm (b) 500 mm (c) 981 mm (d) 1000 mm
14. The figure below shows a steel rod of 25 mm2 cross sectional area. It is loaded at four points, K, L, M and N. Assume Esteel = 200 GPa. The total change in length of the rod due to loading is:
   (a) 1 μm (b) -10 μm (c) 16 μm (d) -20 μm
15. An ejector mechanism consists of a helical compression spring having a spring constant of K = 981 × 103 N/m. It is pre-compressed by 100 mm from its free state. If it is used to eject a mass of 100 kg held on it, the mass will move up through a distance of
   (a) 100mm (b)500mm (c)981mm (d)1000mm

IES:

1. A solid uniform metal bar of diameter D and length L is hanging vertically from its upper end. The elongation of the bar due to self weight is:
   (a) Proportional to L and inversely proportional to D^2
   (b) Proportional to L^2 and inversely proportional to D^2
   (c) Proportional of L but independent of D
   (d) Proportional of L^2 but independent of D
2. The deformation of a bar under its own weight as compared to that when subjected to a direct axial load equal to its own weight will be:
   (a) The same (b) One-fourth (c) Half (d) Double
3. A rigid beam of negligible weight is supported in a horizontal position by two rods of steel and aluminum, 2 m and 1 m long having values of cross - sectional areas 1 cm2 and 2 cm^2 and E of 200 GPa and 100 GPa respectively. A load P is applied as shown in the figure If the rigid beam is to remain horizontal then
   (a) The forces on both sides should be equal

(b) The force on aluminum rod should be twice the force on steel
(c) The force on the steel rod should be twice the force on aluminum
(d) The force P must be applied at the centre of the beam

4. Which one of the following statements is correct? A beam is said to be of uniform strength if
   (a) The bending moment is the same throughout the beam
   (b) The shear stress is the same throughout the beam
   (c) The deflection is the same throughout the beam
   (d) The bending stress is the same at every section along its longitudinal axis
5. Which one of the following statements is correct? Beams of uniform strength vary in section such that
   (a) Bending moment remains constant (c) Maximum bending stress remains constant
   (b) Shear force remains constant (d) Deflection remains constant
6. For bolts of uniform strength, the shank diameter is made equal to
   (a) Major diameter of threads (c) Minor diameter of threads
   (b) Pitch diameter of threads (d) Nominal diameter of threads
7. A bolt of uniform strength can be developed by
   (a) Keeping the core diameter of threads equal to the diameter of unthreaded portion of the bolt
   (b) Keeping the core diameter smaller than the diameter of the unthreaded portion
   (c) Keeping the nominal diameter of threads equal the diameter of unthreaded portion of the bolt
   (d) One end fixed and the other end free Elongation of a Taper Rod
8. Two tapering bars of the same material are subjected to a tensile load P. The lengths of both the bars are the same. The larger diameter of each of the bars is D. The diameter of the bar A at its smaller end is D/2 and that of the bar B is D/3. What is the ratio of elongation of the bar A to that of the bar B?
   (a) 3 : 2 (b) 2: 3 (c) 4 : 9 (d) 1: 3
9. A bar of length L tapers uniformly from diameter 1.1 D at one end to 0.9 D at the other end. The elongation due to axial pull is computed using mean diameter D. What is the approximate error in computed elongation?
   (a) 10% (b) 5% (c) 1% (d) 0.5%
10. The stretch in a steel rod of circular section, having a length 'l' subjected to a tensile load' P' and tapering uniformly from a diameter d1 at one end to a diameter d2 at the other end, is given
11. A tapering bar (diameters of end sections being d) and a bar of uniform cross section 'd' have the same length and are subjected the same axial pull. Both the bars will have the same extension if 'd' is equal to ____.
12. In the case of an engineering material under unidirectional stress in the x direction, the Poisson's ratio is equal to _____ .(use symbols have the usual meanings)

13. Match List-I (Elastic properties of an isotropic elastic material) with List-II (Nature of strain produced) and select the correct answer using the codes given below the Lists:

List-I	List-II
(A) Young's modulus	(1) Shear strain
(B) Modulus of rigidity	(2) Normal strain
(C) Bulk modulus	(3) Transverse strain
(D) Poisson's ratio	(4) Volumetric strain

Codes: A B C D

(a) 1 2 3 4 (b) 2 1 3 4 (c) 2 1 4 3 (d) 1 2 4 3

14. If the value of Poisson's ratio is zero, then it means that
    (a) The material is rigid (b) The longitudinal strain in the material is infinite.
    (b) The material is perfectly plastic (d) There is no longitudinal strain in the material
15. Which of the following is true (μ = Poisson's ratio)
    (a) $0\ 1/2 < < \mu$ (b) $1 < \mu < 0$ (c) $1 < \mu < -1$ (d) $\infty < << -\infty\ \mu$
16. If the area of cross-section of a wire is circular and if the radius of this circle decreases to half its original value due to the stretch of the wire by a load, then the modulus of elasticity of the wire be:
    (a) One-fourth of its original value (c) Doubled
    (b) Halved (d) Unaffected
17. The relationship between the Lame's constant 'λ', Young's modulus 'E' and the Poisson's ratio'μ'
18. Which of the following pairs are correctly matched?

i.	Resilience	Resistance to deformation.
ii.	Malleability	Shape change.
iii.	Creep	Progressive deformation.
iv.	Plasticity	Permanent deformation.

Select the correct answer using the codes given below:
(a) 2, 3 and 4 (b) 1, 2 and 3 (c) 1, 2 and 4 (d) 1, 3 and 4

19. What is the phenomenon of progressive extension of the material i.e., strain increasing with the time at a constant load, called?
    (a) Plasticity (b) Yielding (c) Creeping (d) Breaking
20. The correct sequence of creep deformation in a creep curve in order of their elongation is:
    (a) Steady state, transient, accelerated (c) Transient, accelerated, steady state
    (b) Transient, steady state, accelerated (d) Accelerated, steady state, transient
21. The highest stress that a material can withstand for a specified length of time without excessive deformation is called
    (a) Fatigue strength (c) Creep strength
    (b) Endurance strength (d) Creep rupture strength
22. Which one of the following features improves the fatigue strength of a metallic material?
    (a) Increasing the temperature (c) Overstressing

(b) Scratching the surface (d) Under stressing

23. Consider the following statements:
    For increasing the fatigue strength of welded joints it is necessary to employ
    1. Grinding 2. Coating 3. Hammer peening Of the above statements
    (a) 1 and 2 are correct (c) 1, 2 and 3 are correct
    (b) 2 and 3 are correct (d) 1 and 3 are correct
24. Direct tensile stresses of 120 MN/m^2 and 70 MN/m^2 act on a body on mutually perpendicular planes. What is the magnitude of shearing stress that can be applied so that the major principal stress at the point does not exceed 135 MN/m^2? Determine the value of minor principal stress and the maximum shear stress.
25. A hollow cast iron column of 300 mm external dia and 220 mm internal dia is used as a column 4 m long with both ends hinged. Determine the safe compressive load the column can carry without buckling using Euler's formula and Rankine's formula. E = 0.7 x 10^5 N/mm^2, Factor of safety = 4, Rankine constant a = 1/1600, Crushing stress f3 = 567 N/mm^2.
26. A thin cylinder with closed ends has an internal diameter of 50 mm and a wall thickness of 2.5 mm. It is subjected to an axial pull of 10 kN and a torque of 500 Nm while under an internal pressure of 6 MN/m^2.
    (a) Determine the principal stresses in the tube and the maximum shear stress.
    (b) Represent the stress configuration on a square element taken in the load direction with direction and magnitude indicated (schematic).
    (c) Sketch the Mohr's stress circle.
27. A tube 40 mm outside diameter, 5 mm thick and 1.5 m long is simply supported at 125 mm from each end and carries a concentrated load of 1 KN at each extreme end
    (a) Neglecting the weight of the tube, sketch the shearing force and bending moment diagrams, and
    (b) Calculate the radius of curvature and the deflection of mid-span. Take the modulus of elasticity of the material as 208 GN/m^2.
    (c) Give an example where maximum deflection and maximum stress do not occur at the same point.
    (d) Give an example where they occur at the same point.
28. A solid right cone of axial length h is made of a material having density and elasticity modulus E. It is suspended from its circular base. Determine its elongation under its own weight. 30. The pressure within the cylinder of a hydraulic press is 9 MPa. The inside diameter of the cylinder is 25 mm. Determine the thickness of the cylinder wall, if the permissible tensile stress is 18 N/mm^2.
29. A solid shaft of diameter 3 cm is fixed at one end. It is subjected to a tensile force of 10 KN and a torque of 60 Nm. At a point on the surface of the shaft, determine the principal stresses and the maximum shearing stress

30. What are lame equations? For a long hollow thick walled cylinder subjected to a high internal pressure, determine the radial and circumferential stresses throughout the vessel in terms of internal pressure ‘p’ and internal external radii.

XI. GATE SYLLABUS:

Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain, thin cylinders, shear force and bending moment diagrams, bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; strain energy methods; thermal stresses.

IES SYLLABUS:

Stress and strain in two dimensions, Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and anisotropy, stress-strain relations, uniaxial loading, thermal stresses. Beams: Bending moment and shear force diagram, bending stresses and deflection of beams. Shear stress distribution. Torsion of shafts, helical springs. Combined stresses, Thick and thin walled pressure vessels. Struts and columns. Strain energy concepts and theories of failure.

XII. WEBSITES:

1. www.sciencedirect.com
2. www.springer.com
3. http://nptel.ac.in/courses/112107147/
4. www.nptel.iitm.ac.in/courses.php
5. http://appliedmechanicsreviews.asmedigitalcollection.asme.org/article.aspx?articleid=1397050
6. http://freevideolectures.com/Course/96/Strength-of-Materials

XIII. EXPERT DETAILS:

1. Stephen P. Timoshenko, Professor. Stanford University, USA
2. Dr. V. S. S. Kumar, Professor, OU, Hyderabad
3. Dr. R.K.Bansal, Formerly Professor and Head Department of Mechanical Engineering, Delhi College of Engineering, Delhi.

XIV. JOURNALS:

1. International Journal of Solids and Structures
2. Journal of Structural Engineering
3. International Journal of Engineering Science and Technology
4. International Journal of Engineering Science and Research
5. International Journal of Engineering Science and Innovative Technology

XV. LIST OF TOPICS FOR STUDENT SEMINARS:

1. Types of stresses and strains, working stress and factor of safety
2. Concept of shear force and bending moment
3. Determination of bending stresses in various sections
4. Shear stress distribution across various beam section
5. Thin cylinders subjected to inside and outside pressure.

XVI. CASE STUDIES / SMALL PROJECTS

1. To study the compressive strength of the brick.
2. To study the strength of steel bars