



University School of Automation and Robotics
GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY
East Delhi Campus, Surajmal Vihar
Delhi - 110092

Paper Code: ARA 205

Subject: Mechanics of Material

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3

T/P

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Credits

3

Marking Scheme

1. Teachers Continuous Evaluation: 25 Marks
2. End Term Theory Examination: 75 Marks

INSTRUCTIONS TO PAPER SETTERS:

Maximum Marks : 75

1. There should be 9 questions in the end term examination question paper
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 15 marks.
3. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 15 marks.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes:

CO1:	Ability of students to design machine components, mechanisms, predict failure and understand the physical properties of materials.
CO2:	Ability of students to implement fundamentals of basic tools for stress, strain and deformation analysis and determine the stresses, strains and deformations produced by applied loads.
CO3:	Ability of students to analyze and design components and structural members subjected to tension, compression, torsion, bending and combined loads using fundamental concepts of stress, strain, elastic and inelastic behavior
CO4:	Ability of students to be able to conduct themselves in a professional manner and with regard to their responsibilities to society; especially with regard to design of mechanisms and prevention of failure

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale 1: Low, 2: Medium, 3: High)												
CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	3	1	1	1	3
CO2	3	3	3	3	3	1	2	3	2	1	1	3
CO3	3	3	3	3	3	1	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	3	2	2	3

Unit I

[10]

Compound stress and strains: Introduction, normal stress and strain, shear stress and strain, stresses on inclined sections, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's stress circle, three dimensional states of stress & strain, equilibrium equations, generalized Hook's law, theories of failure

Unit II

[10]

Stresses in Beams: Pure Bending, normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams.

Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams

Torsion: Torsion, combined bending & torsion of solid, hollow shafts and thin walled tubes.

Approved by PoS of USAR: 1/09/22

Approved by AC/Committee: 20/09/22
Prof. Ajay S. Singholi
Professor In-charge, USAR
Guru Gobind Singh Indraprastha University
(East Delhi Campus)
Surajmal Vihar, Delhi-110092



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Unit III

Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs. [10]

Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columns in mechanical equipments and machines.

Unit IV

Thin cylinders & spheres: Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain. [10]

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits.

Text Books:

1. Dr. Sadhu Singh (2016) *Strength of Materials*, Khanna Publication
2. Hibbeler, R. C. (2017). *Fluid Mechanics in SI Units*. Pearson Education India.

Reference Books:

1. Timoshenko S.P., Gere J. (2002) *Elements of Strength of Materials*, East-West affiliated, New Delhi
2. Bhavikatti S. S. (2000). *Strength of Materials*, Vikas Publishers 2000
3. Rajagopalan, R. (2020). *Fighting like a guerrilla: The Indian Army and counterinsurgency*. Routledge India.
4. Popov Eger P., Engg. (1998) *Mechanics of solids*, Prentice Hall, New Delhi, 1998
5. Fenner, Roger.T, (1990) *Mechanics of Solids*, U.K. B.C. Publication, New Delhi, 1990