



Name: ..... Roll No.: .....

Branch: ..... Signature of Invigilator: .....

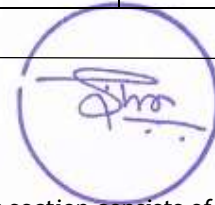
Semester: VIth

Date: 04/05/2022 (MORNING)

Subject with Code: ME355 ADVANCED SOLID MECHANICS

Marks Obtained	Section A (30)	Section B (20)	Total Marks (50)

INSTRUCTION TO CANDIDATE



1. The booklet (question paper cum answer sheet) consists of two sections. First section consists of MCQs of 30 marks. Candidates may mark the correct answer in the space provided / may also write answers in the answer sheet provided. The Second section of question paper consists of subjective questions of 20 marks. The candidates may write the answers for these questions in the answer sheets provided with the question booklet.
2. The booklet will be distributed to the candidates before 05 minutes of the examination. Candidates should write their roll no. in each page of the booklet.
3. Place the Student ID card, Registration Slip and No Dues Clearance (if applicable) on your desk. All the entries on the cover page must be filled at the specified space.
4. Carrying or using of mobile phone / any electronic gadgets (except regular scientific calculator)/chits are strictly prohibited inside the examination hall as it comes under the category of unfair means.
5. No candidate should be allowed to enter the examination hall later than 10 minutes after the commencement of examination. Candidates are not allowed to go out of the examination hall/room during the first 30 minutes and last 10 minutes of the examination.
6. Write on both side of the leaf and use pens with same ink.
7. The medium of examination is English. Answer book written in language other than English is liable to be rejected.
8. All attached sheets such as graph papers, drawing sheets etc. should be properly folded to the size of the answer book and tagged with the answer book by the candidate at least 05 minutes before the end of examination.
9. The door of examination hall will be closed 10 minutes before the end of examination. Do not leave the examination hall until the invigilators instruct you to do so.
10. Always maintain the highest level of integrity. Remember you are a BITian.
11. Candidates need to submit the question paper cum answer sheets before leaving the examination hall.

CLASS: B. Tech.  
BRANCH: PIE

SEMESTER: 6  
SESSION: SP/22

SUBJECT: ME 355 – Advanced Solid Mechanics  
TIME: 2 Hrs

FULL MARKS: 50

**INSTRUCTIONS:**

1. The question paper contains 15 MCQs in Section-I each carrying 2 marks, and 5 subjective questions in Section-II each carrying 5 marks.
  2. Candidates must attempt all the MCQs, a total of which carries 30 marks.
  3. For subjective questions, four out of five questions must be attempted, a total of which will carry 20 marks.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
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**Section – I**

1. The theory of elasticity deals with
  - (a) Elastic deformation
  - (b) Plastic deformation
  - (c) Both elastic as well as plastic deformation
  - (d) None of the above
  
2. Stresses and strains are
  - (a) Zeroth order tensors
  - (b) First-order tensors
  - (c) Second-order tensors
  - (d) Scalars
  
3. The theory of elasticity deals with
  - (a) Small deformations
  - (b) Large deformations
  - (c) Both (a) & (b)
  - (d) None of the above
  
4. The state of stress at a point provides
  - (a) A constant value of stresses
  - (b) A constant value of strains
  - (c) Both (a) & (b)
  - (d) None of the above
  
5. The term stress invariant represents
  - (a) A nonvarying stress value on any planes
  - (b) A varying stress values on different planes
  - (c) Both (a) & (b)
  - (d) None of the above
  
6. The planes representing the hydrostatic state of stress are
  - (a) Free from shear stresses
  - (b) Free from normal stresses
  - (c) Contains both normal and shear stresses
  - (d) None of the above

7. The deviatoric stresses are calculated by
- (a) Adding hydrostatic stress and the stress tensor
  - (b) Subtracting hydrostatic stress from the stress tensor
  - (c) Subtracting hydrostatic stress from the octahedral stress
  - (d) None of the above
8. The hydrostatic state of stress is responsible for a change in
- (a) The aspect ratio
  - (b) The shape
  - (c) The volume
  - (d) All the above
9. The state of stress is equivalent to a state of strain in one way or the other. This statement is
- (a) True
  - (b) False
  - (c) Both cannot be correlated directly at a point
  - (d) None of the above
10. The stress can be treated as a vector provided
- (a) Its value is a constant
  - (b) The plane on which it acts is held fixed
  - (c) Both (a) & (b)
  - (d) None of the above
11. If  $I_1^h$  and  $I_1^d$  are the first invariants of homogeneous as well as deviatoric stresses, respectively, which of the relations is true
- (a)  $I_1^h + I_1^d = I_1^{hd}$
  - (b)  $I_1^h - I_1^d = I_1^{hd}$
  - (c)  $I_1^h + I_1^d = I_1$
  - (d)  $I_1^h + I_1^d = I_1^p$
12. The expression for the generalized Hooke's law in terms of Lamé's constant  $\lambda$  is
- (a)  $\lambda = \frac{\nu E}{(1-\nu)(1+2\nu)}$
  - (b)  $\lambda = \frac{\nu E}{(1+\nu)(1+2\nu)}$
  - (c)  $\lambda = \frac{\nu E}{(1+2\nu)(1-2\nu)}$
  - (d)  $\lambda = \frac{\nu E}{(1+\nu)(1-2\nu)}$
13. For the plane stress condition, the harmonic function is given as
- (a)  $\nabla^2 I_1 = 0$
  - (b)  $\nabla^2 I_1^h = 0$
  - (c)  $\nabla^2 I_1^d = 0$
  - (d)  $\nabla^2 I_1^{h+d} = 0$
14. According to Saint Venant's principle, if a small, distributed load is applied on the surface of the body, then
- (a) This force will have the same intensity throughout the body
  - (b) This force will have the same intensity over the entire surface of the body
  - (c) This force will have an intensity varying uniformly along with the depth inside the body
  - (d) This force will have maximum intensity near the region of the applied load and becomes uniform after a small distance from the point of application of the load

15. The modulus of resilience is the energy absorbed by the body
- (a) Within the elastic region
  - (b) Within and beyond the elastic region
  - (c) Beyond the plastic region
  - (d) None of the above

## Section – II

- Q.1 At a point P in a body,  $S_x = 10,000 \text{ N/cm}^2$ ,  $S_y = -5,000 \text{ N/cm}^2$ ,  $S_z = -5,000 \text{ N/cm}^2$ ,  $T_{xy} = T_{yz} = T_{zx} = 10,000 \text{ N/cm}^2$ . Determine the normal and shearing stresses on a plane that is equally inclined to all the three axes. [5]
- Q.2 Explain how the octahedral planes corresponding to the given state and the pure shear state are identical. [5]
- Q.3 A cylindrical shaft made of steel with a yield strength of 700 MPa is subjected to a static load consisting of a bending moment of 10 kN·m and a torsional moment of 30 kN·m. Determine the diameter of the shaft using different theories of failure, and assuming a factor of safety 2. Take  $E = 210 \text{ GPa}$ , Poisson's ratio = 0.25. [5]
- Q.4 Derive an expression of the torque for a circular shaft. [5]
- Q.5 The axis of a cantilever ring, built-in at B and loaded at the free end A, forms a horizontal quarter circular arc of radius  $R$ , Fig. 1. Find the vertical deflection  $\delta$  of the free end A, assuming the ring to have a circular cross-section the diameter of which is small compared with the radius  $R$  of its centerline. [5]

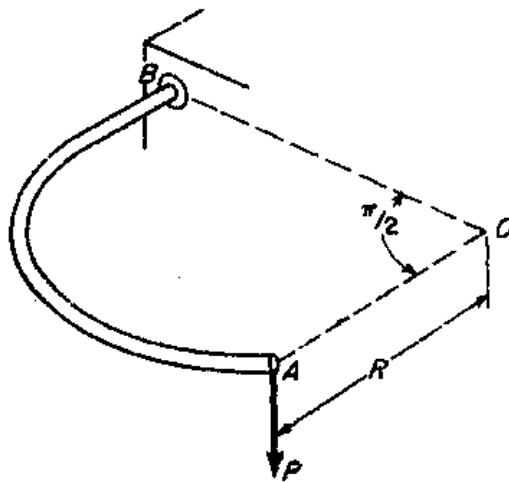


Fig. 1