Roll No.												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

SUMMER TERM/MAKE-UP END TERM EXAMINATION

Semester: Summer Term 2019 | **Date**: 26 July 2019

Course Code: MEC 218 | **Time**: 2 Hours

Course Name: Advanced Mechanics of Solids | **Max Marks**: 80

Program & Sem: B. Tech. & VI Sem | **Weightage**: 40%

Instructions:

(i) Answer all the questions!

Part A

Answer **all** the Questions. (6Q=29M)

1. Explain elastic behaviour. (2 Marks)
2. This Course deals with the analysis of stresses and strains in different situations. Explain the reason for our interest in stresses and strains in the context of mechanical engineering. (2 Marks)
3. This Course is titled Advanced Mechanics of Solids and is studied after the Course Mechanics of Solids. Explain how this Course advances the contents of Mechanics of Solids in two ways. (2 Marks)
4. Explain the need to make assumptions in the context of this Course. Your answer must be specific to this Course and not generic. (2 Marks)
5. List any five assumptions we have made in this Course. (10 Marks)
6. Answer the following questions on stresses.
   (a) Explain the concept of stress for an arbitrarily shaped body subjected to external loads. Use this explanation to write the limit definition of stress. (5 Marks)
   (b) Explain normal and shear stress and write the limit definitions for the same. (6 Marks)

Part B

Answer the Question. (1Q=19M)

7. A machine member in a lathe is to be analysed using concepts of state of stress at a point and theories of failure.This machine member can be modelled as a simply supported beam. An early analysis of the beam in bending and shear reveals the state of stress at the critical point to be $\sigma_x = 150$ MPa, $\sigma_y = 0$ MPa and $\tau_{xy} = 65$ MPa. (Assume the X- and Y-axes to be the horizontal and vertical axes, respectively.) Answer the following questions on Page 2.

(a) Sketch a differential stress element showing the stresses at the critical point. (7 Marks)

(b) Determine the normal and shear stresses at the critical point on an element rotated 30^o clockwise from the positive X-axis. (4 Marks)

(c) Determine the principal stresses at the point. (3 Marks)

(d) Determine the maximum shear stress at the point. (2 Marks)

(e) Suppose this machine member is made of steel. Suggest a suitable theory of failure to analyse the member for failure. (1 Mark)

(f) Use the theory of your choice in (e) to analyse whether the machine member is safe or will fail under the applied load. Assume the yield stress of the material of the member is 250 MPa. (2 Marks)

Part C

Answer **all** the Questions. (2Q=32M)

8. Claude-Louis Navier developed a simple particle model to explain ideas like stress and strain in the early 1800s. The interest in this model did not last long though. By the 1820s the solid mechanics research community felt that working with the particle model to analyse stress and strain in machine members would be too cumbersome. The community decided to switch to the continuum mechanics approach. Imagine you are a research in the 1820s using the continuum mechanics approach and answer the following questions. The questions require the use of calculus and lead to the expression for change in length of linear element subjected to external loads.

   (a) Sketch a line element in an undeformed body giving suitable coordinates to its end points in the Cartesian coordinate system. (7 Marks)

   (b) Write an expression for the length of this line element in terms of the coordinates of its end points. (2 Marks)

   (c) Suppose this body is acted on by external loads and undergoes elastic deformation. Sketch the same line element showing its deformation by giving its end points suitable coordinates. (10 Marks)

   (d) Obtain an expression for the length of this line element after deformation. (5 Marks)

   (e) Explain how the work you have done so far can help us obtain an expression for the change in length of this line element. Do not obtain the actual expression. (2 Marks)

9. Explain "linear components of strains" using the expression for change in length of a linear element as an illustration. (6 Marks)

The End
