# MODEL QUESTION PAPER-2
# UNIVERSITY OF KERALA

**FIFTH SEMESTER B.TECH DEGREE EXAMINATION NOVEMBER 2015.**

Mechanical Engineering

**13.504 MECHANICS OF MATERIALS (M)**

(2013 Admissions)

Time : Three Hours Maximum : 100 Marks

**Part A**

Answer all questions

1. Define stress tensor.
2. What is meant by devitorial stress?
3. What are Lame's constants?
4. What is plane strain?
5. Define components of stress in terms of stress function.
6. Write down the expression for tangential stress in thick cylinder.
7. What is meant by virtual work.
8. Give the expressions for strain energy due to shear stress
9. What is meant by a thin walled section?
10. Define the term *shear flow*.

(10x2= 20 marks)

**Part B**

Answer any ONE from each module.

**Module I**

11. Derive the differential equations of equilibrium in 3-D for rectangular co-ordinates.

Or

12. The state of stress at a point is characterised by the components $\sigma_x = 12.31, \sigma_y = 8.96, \sigma_z = 4.34, \tau_{xy} = 4.20, \tau_{yz} = 5.27, \tau_{xz} = 0.84$. Determine the values of principal strains.

**Module II**

13. Investigate whether the following polynomial is permissible as an Airy's stress function $\phi = Axy^3 + Bxy$. If permissible, derive the expressions for stress and explain which types of problems are represented by the function.

Or

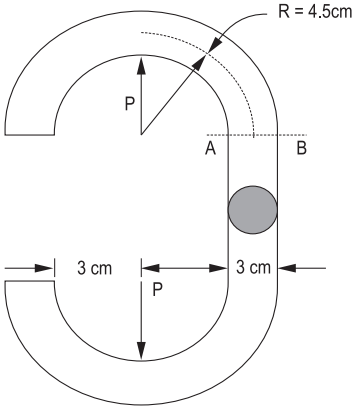
14. A flat steel disc of 75cm outside diameter is shrunk on a solid steel shaft of 50cm diameter. The shrink fit allowance is 1 part in 1000. Take *E*=200GPa and $\rho$ =7.8mg/m$^3$. Find the stress due to shrunk fit. As a result of rotation, at

what rpm will the shrunk fit loosens up.

**Module III**

15. a) Explain the procedure of determination of deflections in structures using fictitious load method with a suitable example. (8 marks)

b) The open link shown in figure is loaded by forces *P*, each of which is equal to 14700N. Find the maximum tensile and compressive stresses in the curved end at section AB.




(12 marks)

Or

16. a) Locate the shear centre for a channel section (12 marks)

b) Explain the Castigliano's theorem. (8 marks)

**Module IV**

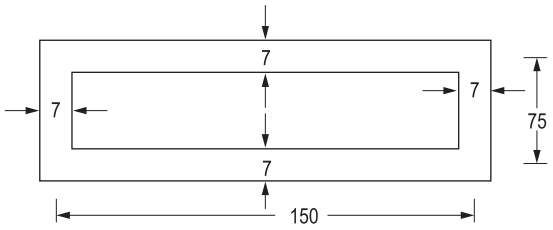
17. (a) Explain the St. Venant's approach in solving torsion problems. (12 marks)

(b) Compare effects of torsional loading on thin walled open and closed sections (8 marks)

Or

18. (a) Explain membrane analogy (5marks)

(b) A hollow section shown in figure is designed for a maximum shear stress of 40 MPa neglecting stress concentration. Find the twisting moment that can be taken up by the section and the angle of twist. If the section is to be redesigned as a hollow circular section of thickness 12mm, find its diameter to take up the same twisting moment.




(15 marks)

(4x20= 80 marks)