

**Bachelor of Engineering in Mechanical Engineering**

**Final Examination 2017 (Supplementary)**

(4<sup>th</sup> year, 1<sup>st</sup> semester)

**Finite Element Analysis II**

Time : 3 hours

Full marks : 100

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**Answer any FIVE questions. All questions carry equal marks.**

1 (i) Consider the impeller of a centrifugal fan. What element would you recommend for its analysis. While doing a stress analysis of the impeller what loads do you need to consider? What type of analysis would you recommend for obtaining the stress for such loads?

(ii) Define Rayleigh Quotient. What is its importance? Which eigen value does it overestimate and which does it underestimate?

(iii) Explain the difference between Plate and shell. What are the various methods for shell modelling.

(iv) Explain the difference between Thin beam and Thick beam. Write the interpolation function in either case.

2 Consider Fig 2.

- (i) Deduce the equation of motion using both force method and finite element assembly.
- (ii) Obtain the torsional natural frequency and mode shape.
- (iii) Draw the mode shape.
- (iv) Verify orthogonality for the modal vectors of the system.

3.(i) What are the different methods for eigen solution? Which would you consider the fastest?

(ii) Explain the inverse iteration method for eigen solution using  $K = \underline{L}^{-1} M \underline{L}^{-T}$

4. (i) Obtain the eigen values with Jacobi's method for the system

$$[K] = \begin{bmatrix} 4 & 1 \\ 1 & 2 \end{bmatrix} \quad \& \quad [M] = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

(ii) Give the general proof of orthogonality of mode shapes.

5. Explain mode superposition for undamped system.

How do you propose to model damping so that it can be used by the method.

What are the advantages of the Mode Superposition method.

Do you need to perform eigen solution before starting the method?

6. Consider a 2d 2 noded bar element. Starting from the interpolation function, obtain the geometric stiffness matrix of the element . Explain how you can obtain the buckling load of a 1d structure using this element.

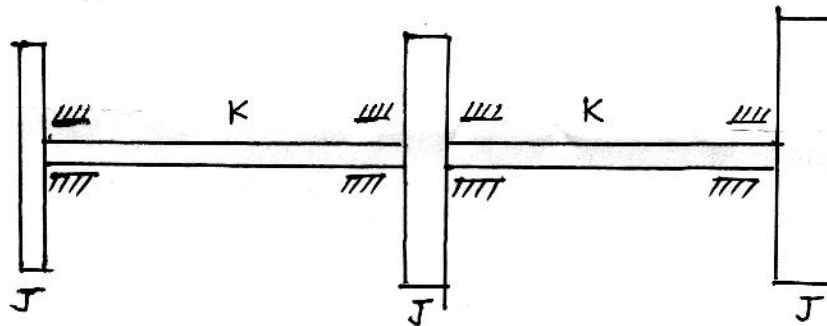


Fig-2