

# NUMERICAL METHODS

## TOPICS FOR RESEARCH PAPERS

### 1. NUMERICAL METHODS IN FINITE ELEMENT ANALYSIS

- Matrices and linear algebra in FEA-
  - elementary operations
  - matrices and vector spaces

**Task:** - Explain the algorithms and realize them in FORTRAN  
/PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation  
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### 2. DEFINITION AND FORMULATION OF FINITE ELEMENT METHOD

**Task:** - Explain the algorithms and realize them in FORTRAN  
/PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation

### 3. FORMULATION AND CALCULATION OF ISOPARAMETRIC FINITE ELEMENT MATRICES

**Task:** - Explain the algorithms and realize them in FORTRAN  
/PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation.

### 4. VARIATIONAL FORMULATION OF THE FINITE ELEMENT METHOD

**Task:** - Explain the algorithms and realize them in FORTRAN  
/PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation.

### 5. SOFTWARE IMPLEMENTATION OF THE FEM

**Task:** - Explain the algorithms and realize them in FORTRAN  
/PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation.

## 6. SOLUTION OF FINITE ELEMENT EQUILIBRIUM EQUATIONS

- Task:** - Explain the algorithms and realize them in FORTRAN  
/PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation.

## 7. SOLUTION OF EQUILIBRIUM EQUATIONS IN DYNAMICAL ANALYSIS

- Task:** - Explain the algorithms and realize them in FORTRAN  
/PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation.

## 8. INTEGRATION METHODS FOR SOLVING OF DIFFERENTIAL EQUATIONS IN FEM

- Task:** - Explain the algorithms and realize them in FORTRAN  
/PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation.

## 9. EIGENPROBLEMS IN FEM (INTRODUCTION)

- Task:** - Explain the algorithms and realize them in FORTRAN  
/PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation.

## 10. SOLUTION METHODS FOR EIGENPROBLEMS

- Task:** - Explain the algorithms and realize them in FORTRAN  
/PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation.

## 11. PROGRAM PACKAGE FOR POLYNOMIAL APPROXIMATION OF TABULAR GIVEN FUNCTIONS GIVEN IN TABULAR FORM BY FINITE DIFFERENCE METHOD (I, II Newton, Bessel method)

- Task:** - Explain the algorithms and realize them in FORTRAN  
/PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation.

**12. PROGRAM PACKAGE FOR POLYNOMIAL APPROXIMATION OF GIVEN FUNCTIONS IN TABULAR FORM BY LEAST SQUARE METHOD**

- Task:** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation.

**13. WRITE A PROGRAM FOR CALCULATION OF A DEFLECTION OF A UNIFORM LOADED SQUARE PLATE USING GAUSS-SEIDEL METHOD FOR SOLUTION OF POISSON DIFFERENTIAL EQUATION**

- Task:** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Write the Medium term/Final report and Power Point presentation.

**14. PROGRAM FOR EXPONENTIAL APPROXIMATION OF FUNCTIONS BY PRONY'S METHOD**

- Task:** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Give an example in constructional engineering  
- Write the Medium term/Final report and Power Point presentation.

**15. SPLINE APPROXIMATIONS AND SOME APPLICATIONS IN CONSTRUCTIVE ENGINEERING**

- Task:** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Give graphical presentation  
- Write the Medium term/Final report and Power Point presentation.

**16. APPLICATION OF FOURIER ANALYSIS AND LAPLACE TRANSFORM IN DYNAMICS OF CONSTRUCTIONS AND EARTHQUAKE ENGINEERING**

- Task:** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Give simple examples  
- Write the Medium term/Final report and Power Point presentation.

### **17. GAUSS ELIMINATION METHOD WITH PIVOTING**

- **Relation of pivoting and denotation in program packages (STRESS, SAP)**
- **Write a procedure in Mathematica with pivoting and arbitrary precision (4-100 digits).**

**Task:** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Give mechanical - structural presentation  
- Write the Medium term/Final report and Power Point presentation.

### **18. OPTIMIZATION METHODS BY USING ANSYS PROGRAM**

**Task :** - Using ANSYS program prepare some preprocessing mathematical tools for some structure optimization according to given criteria. (Use some objective-oriented programming tools).

### **19. PROGRAMMING OF FEM (EDUCATIONAL) SYSTEM IN MATLAB USING UNDER 100 LINES OF CODE**

**Task:** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Give mechanical - structural presentation  
- Write the Medium term/Final report and Power Point presentation.

### **20. PROGRAMMING OF FEM (EDUCATIONAL) SYSTEM IN MATHEMATICA USING UNDER 100 LINES OF CODE**

**Task:** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Give mechanical - structural presentation  
- Write the Medium term/Final report and Power Point presentation.

### **21. FORM STIFFNESS MATRIX OF ARBITRARY STRUCTURE USING STRESS PROGRAM COMMAND "ALTER STIFFNESS PRINT" AND PROCESS IT BY EIGENPACK SOFTWARE PACKAGE**

**Task: :** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Give mechanical - structural presentation  
- Write the Medium term/Final report and Power Point presentation.

**22. FORM STIFFNESS MATRIX OF ARBITRARY STRUCTURE USING STRESS PROGRAM COMMAND "ALTER STIFFNESS PRINT" AND PROCESS IT BY LINPACK SOFTWARE PACKAGE**

**Task: :** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Give mechanical - structural presentation  
- Write the Medium term/Final report and Power Point presentation.

**23. FORM STIFFNESS MATRIX OF ARBITRARY STRUCTURE USING STRESS PROGRAM COMMAND "ALTER STIFFNESS PRINT" AND PROCESS IT BY EIGENPACK SOFTWARE PACKAGE**

**Task: :** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Give mechanical - structural presentation  
- Write the Medium term/Final report and Power Point presentation.

**24. ROUND-OFF ERROR IN SOME ENGINEERING COMPUTATIONS**

**Task:** - Explain the algorithms and realize them in FORTRAN /PASCAL/C/Mathematica/Matlab (JAVA)  
- Give some engineering examples  
- Write the Medium term/Final report and Power Point presentation.

**25. INFLUENCE OF NUMERICAL ORTHOGONALIZATION TO CONSTRUCTIVE IMPROVEMENTS**

**Task: :** - Solution of linear algebraic system of equations by orthogonalization (Gramm-Schmidt procedure) and possible influence to the constructive system.  
- Give some engineering example  
- Write the Medium term/Final report and Power Point presentation.

**26. OBJECT-ORIENTED METHODS AND FINITE ELEMENT ANALYSIS**

**Task:** - Explain the object-oriented programming technique applied to Final Element Analysis. Write small programs in PASCAL/C/Java.  
- Give mechanical - structural presentation  
- Write the medium term / final report and Power Point presentation

## 27. INTERVAL MATHEMATIC IN STRUCTURE DESIGN

**Task:** - Explain elements of interval mathematics and applications in structure design

- Give elementary examples
- Write the medium term / final report and Power Point presentation