

**COURSE CONTENT**

Introduction, Weighted Residual Methods, Shape functions, Coordinate systems, Numerical Integration. Modeling of Heat Conduction, Variational Formulation, Galerkin's Approach for one dimensional and two-dimensional problems. One dimensional Problem solved using a single element – Linear element, Quadratic element, the use of numerical integration. A one-dimensional problem solved using an assembly of elements. Time stepping methods for Heat Transfer – Galerkin's approach in Non-linear transient heat conduction problems. Basic Equations, Galerkin's Methods for steady Convection – Diffusion problems, Upwind Finite Elements in One Dimension, Heat Transfer in fluid flow between parallel planes, Convection on melting and solidification.

**PERIOD** : ODD SEMESTER AUGUST 2022

**NUMBER OF CREDITS:** 3

**INSTRUCTOR** : S Shanmugam Ph.D

**Title** : Professor [ Higher Administrative Grade]

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**CLASS HOURS** : 0830-0920 Wednesday; 0920-1010 Thursday; 1030-1120 Friday.

However, you are expected to attend special lectures arranged any time at short notice.

**DESCRIPTION**

This course teaches the basic concepts of finite element analysis through heat transfer. It emphasises the application of Laplace equation, Poisson's equation, and Fourier equation as to heat transfer such that it enhances the cognitive and analytic skill of students. It also improves the communications through interaction. It also seeks to develop the students' skills in independent learning outside of the class room.

**LEARNING OUTCOMES**

At the end of course, students will be able to

1. Demonstrate basic concepts of finite element method.
2. Apply basic concepts to develop element matrices for a given field problem.
3. Acquire ability to distinguish and apply different boundary conditions.

**REFERENCES**

1. David v Hutton., Fundamentals of Finite Element Analysis, McGraw Hill education (India), 2013.
2. Thomas, HR., Seetharamu, KN., Morgan, KR., and Lewis, W., The Finite Element Method in Heat Transfer Analysis, John Wiley & Sons Inc, 1996.
3. Lewis, RW., Nithiarasu P., and Seetharamu KN., Fundamentals of the Finite Element Method for Heat and Fluid Flow, Wiley; 1st edition, 2004.
4. Reddy, JN., The Finite Element Method in engineering
5. Larry J. Segerlind, Applied finite element analysis, 2<sup>nd</sup> ed., John Wiley and Sons, New York, 1984.
6. Presentations/Hand-outs of class materials.

**GRADING PLAN**

Course work is weighted as follows:

Surprize quiz -20%, Mid-semester examination - 20%, Assignments - 10%, End semester examination - 50%.

All students are expected to attend the classes without fail. Those students who have attendance less than 85% will have to REDO the course. Absences for which a medical excuse and/or an institutional sponsor excuse is provided (professional letterhead required for both) will be recorded only. The preparatory or other works for institutional participation should not be taken up during regular class hours. *Any significant tardy or early departure from class will be considered as absence. Also, anyone who has more than three class-long, unexcused absences will have to bring their parents and/or produce explanations from their parents within five days from the date of first absence, failing which the students will not be permitted to attend further classes.*

**SURPRIZE QUIZ**

There will be two such quizzes of which the better will be taken into account for final grading process. The quizzes will be conducted during regular class period and the portion for the quizzes will be the topics covered till the end of previous class period. If any student misses any of the quizzes or both, there will be no separate quiz conducted for them.

**MID-SEMESTER EXAMINATION**

The portion for the mid-semester examination is the topics covered one day before the commencement of the examination. This will be normally conducted during middle of the semester. However, the date of examination will be notified in advance. The duration of examination will be 90 minutes.

### ASSIGNMENTS

There will be minimum two assignments. Each student is expected to attempt the assignments on his/her own. Due dates will be given to you for each assignment. Assignments will *usually* be due at the *beginning* of class periods on the due dates (unless specifically stated otherwise). Unless you are absent on the day an assignment is due, it will not be accepted later than at the beginning of the class period when it is due. If you are absent from class when an assignment is due, it will be accepted late -- but only if submitted *immediately* upon your return and only if an acceptable, written *excuse*, is presented. If you cannot attend class when an assignment is due and cannot provide an acceptable written excuse, you should send your assignment to class with a friend, or other person. An *acceptable* excuse for an absence is only one which is judged so by the instructor. Due dates will not be changed because of earlier absences.

The assignments will be graded like this: (i) those students who have understood the concepts and attempted correctly, on their own, all the assignments will be awarded full weightage; (ii) those who have understood partly the concepts and copied the assignments will be awarded 40% of weightage; (iii) those who have not understood the concepts and copied the assignments will be awarded no marks.

All assignments should be submitted as Microsoft Word document file only. To insert an equation in a word file, you may use Microsoft Equation 3.0 or the  $\pi$  Equation. Figures, if any, may be drawn using AutoCAD, MS Word, or MS ppt and should be attached in the word file with source. The assignments with the scanned figures in it will never be considered for evaluation.

### END SEMESTER EXAMINATION

It will be comprehensive. The duration of examination will be three hours. The date of examination will be notified well in advance. However, you can consult the academic calendar of the institute.

### GENERAL

Do remember to *keep all quizzes, assignments, mid-semester materials returned to you* so that any discrepancies can be easily and fairly straightened out. Except in cases of actual error, the marks awarded are permanent.

No makeup examinations will be conducted.

### CLASSROOM RULES OF CONDUCT

1. No mobile phone is permitted during lecture periods/class.
2. No radios are allowed in class.
3. Food and beverages are not permitted in the classroom. This includes plate lunches, drinks, candy, etc. whether opened or not.

### EMERGENCY PROCEDURES

1. Emergency ambulance: 9486001162
2. Campus security: (0431) 2503900

### YOUR IDEAS, EVALUATIONS, etc.

In general, your ideas, comments, suggestions, questions, grade challenges, etc. are welcome. Your discretion in these matters is expected, however. No part of your grade will be based on anything other than your tasks pertinent to the course.

You are encouraged to take advantage of instructor office hours for help with coursework or anything else connected with the course and your progress.

### SUGGESTIONS FOR SUCCESS

For most students this will not be a *difficult* course. However, there will probably be some students who did well in academic courses where information was most important and who will be surprised at the relative difficulty of this course where manual skills and visualization are most important. So do not think that if you are an *A* student you will probably get an *A* in this course. You might get an *S* with relative ease, or a *B* with difficulty, and still be (and correctly so) an *A* student in your mainly lecture-type courses.

Course Faculty

  
Shanmugam

CC- Chair Person

T. RAMESH

  
HOD/Mechanical Engineering