2- Course Specification of Applied Finite Element

Course Code (ME502)

• General Information About the Course:						
1.	**Course Title:**	Applied Finite Element				
2.	**Course Code and Number:**	ME502				
3.	**Credit Hours:**	**Credit Hours**			**Total**	
		Lecture	Practical	Seminar/Tutorial		
		3	-	--	3	
4.	**Study Level and Semester:**	1st Level / 1st Semester				
5.	**Pre-requisites (if any):**	Engineering Mathematics (BR231), Computer programming and Application (ME201), Mechanical Vibrations (E222), Mechanics of Materials – 2 (ME234) Heat and Mass Transfer (ME353)				
6.	**Co-requisites (if any):**	None				
7.	**Program (s) in which the course is offered:**	MSc. In Mechanical Engineering Program				
8.	**Language of teaching the course:**	English				
9.	**Study System:**	Courses & Thesis				
10.	**Prepared By:**	Dr. Hamoud A. Al-Nehari Dr. Abdulsalam Al-Mekhlafi				
11.	**Reviewed by:**	Dr. ……				
12.	**Date of Approval:**					

• Course Description:

The primary aim of this course is to train the student to solve complex engineering mechanics problems with finite element analysis. The course will provide deep insight into the operation of finite element analysis software by teaching the underlying computational methods involved. The student will be taught to execute a detailed finite element study including planning, modelling, meshing, solving, evaluating results and validating against real world data. The course introduces the mathematical basis of finite element analysis, on which nearly all structural analysis software is built. The student will learn how to apply commercially available finite element software to solve mechanical engineering problems. The course will cater to the specific challenges of engineers across all mechanical disciplines.

• Course Intended Learning Outcomes (CILOs):

Upon successful completion of **Advanced Thermodynamics Course**, the graduates will be able to:

a1.	Demonstrate the fundamental theory of the Finite Element Method.
a2.	Explain the underlying mathematics behind finite element analysis software solvers.
a3.	Show Understanding basic formulation techniques and the general steps of Finite Element Analysis.
b1.	Solve the mechanical engineering problems using finite element analysis technique.
b2.	Analyze model convergence, stability, and accuracy.
c1.	Build computer models for a mechanical system using a commercial finite element software package like ANSYS.

c2.	Perform a detailed finite element study to investigate a real-world engineering problem.
d1	Communicate effectively with a range of audiences, mechanical components or systems.
d2.	Collaborate within a team work on a group project to apply FEA for improving performance in real-world problems.

• Alignment of Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs)

CILOs		PILOs
• **Knowledge and Understanding:** Upon successful completion of **Advanced Solid Mechanics and Engineering Materials Course**, the graduates will be able to:		• **Knowledge and Understanding:** Upon successful completion of the **MSc. In Mechanical Engineering Program**, the graduates will be able to:
a1.	Demonstrate the fundamental theory of the Finite Element Method.	**A1.** Acquire advanced concepts and knowledge of mathematics, scientific, mechanical engineering and associated technologies as well as across the boundaries of interdisciplinary disciplines.
a2.	Explain the underlying mathematics behind finite element analysis software solvers.	**A2.** Identify and critically evaluate contemporary engineering technologies, current developments and emerging trends within the mechanical engineering contexts.
a3.	Show Understanding basic formulation techniques and the general steps of Finite Element Analysis.	**A3.** Provide a holistic description of principles, concepts, approaches, techniques and analysis tools to design and development of existing and novel mechanical systems, while taking a sustainable and environmentally-friendly approach.
• **Cognitive/ Intellectual Skills:** Upon successful completion of the **Advanced Solid Mechanics and Engineering Materials Course,** the graduates will be able to:		• **Cognitive/ Intellectual Skills:** Upon successful completion of the **MSc. In Mechanical Engineering Program,** the graduates will be able to:
b1.	Solve the mechanical engineering problems using finite element analysis technique.	**B2.** Creatively thinking and apply analysis tools to formulate and solve complex engineering problems in the mechanical engineering context using modern techniques and tools.
b2.	Analyze model convergence, stability, and accuracy.	**B3.** Design and optimize mechanical components, systems and process to meet desired needs within realistic constraints.
• **Professional and Practical Skills:** Upon successful completion of the **Advanced Solid Mechanics and Engineering Materials Course,** the graduates will be able to:		• **Professional and Practical Skills:** Upon successful completion of the **MSc. In Mechanical Engineering Program,** the graduates will be able to:
c1.	Build computer models for a mechanical system using a commercial finite element software package like ANSYS.	**C1.** Use modern manufacturing processes and materials, experimental tests, appropriate

		software packages and other modern tools for the design analysis and manufacture of mechanical components and systems.
c2.	Perform a detailed finite element study to investigate a real-world engineering problem.	**C2.** Perform mechanical engineering studies professionally, ethically and responsibly within realistic constraints.
• **Transferable Skills:** Upon successful completion of the **Advanced Solid Mechanics and Engineering Materials Course,** the graduates will be able to:		• **Transferable Skills:** Upon successful completion of the **MSc. In Mechanical Engineering Program,** the graduates will be able to:
d1.	Communicate effectively with a range of audiences, mechanical components or systems.	**D2.** Communicate, present, challenge and defend research ideas, results and conclusions in both orally and writing forms to different audiences in contexts.
d2.	Collaborate within a team work on a group project to apply FEA for improving performance in real-world problems.	**D4.** Collaborate effectively within multidisciplinary teams and lead them in different professional contexts

• Alignment of CILOs to Teaching and Assessment Strategies

• Alignment of Knowledge and Understanding CILOs:

Knowledge and Understanding CILOs		Teaching Strategies	Assessment Strategies
a1.	Demonstrate the fundamental theory of the Finite Element Method.	▪ Lectures, ▪ Self-Learning ▪ Problems/Studies, ▪ Active learning	▪ Oral & Writing Exams ▪ Assignments
a2.	Explain the underlying mathematics behind finite element analysis software solvers.	▪ Lectures, ▪ Self-Learning Problems/Studies, ▪ Case study, ▪ Individual/Group Projects and Studies, ▪ Active learning, ▪ Computer hands-on sessions	▪ Oral & Writing Exams ▪ Individual Projects and Studies Reports, ▪ Assignments
a3.	Show Understanding basic formulation techniques and the general steps of Finite Element Analysis.	▪ Lectures, ▪ Self-Learning Problems/Studies, ▪ Case study, ▪ Individual/Group Projects and Studies, ▪ Active learning ▪ Computer hands-on sessions	▪ Oral & Writing Exams ▪ Individual Projects and Studies Reports, ▪ Assignments

• Alignment of Intellectual Skills CILOs:

Intellectual Skills CILOs		Teaching Strategies	Assessment Strategies
b1.	Solve the mechanical engineering problems using finite element analysis technique.	▪ Lectures, ▪ Self-Learning	▪ Oral & Writing Exams

		▪ Problems/Studies, ▪ Case study, ▪ Individual/Group Projects and Studies ▪ Active learning, ▪ Computer hands-on sessions.	▪ Individual Projects and Studies Reports, ▪ Assignments
b2.	Analyze model convergence, stability, and accuracy.	▪ Lectures, ▪ Self-Learning ▪ Problems/Studies, ▪ Case study, ▪ Individual/Group Projects and Studies, ▪ Active learning ▪ Computer hands-on sessions	▪ Oral & Writing Exams ▪ Individual Projects and Studies Reports, ▪ Assignments

- **Alignment of Professional and Practical Skills CILOs:**

Professional and Practical Skills CILOs		Teaching Strategies	Assessment Strategies
c1.	Build computer models for a mechanical system using a commercial finite element software package like ANSYS.	▪ Lectures, ▪ Self-Learning ▪ Problems/Studies, ▪ Case study, ▪ Individual/Group Projects and Studies, ▪ Active learning, ▪ Computer hands-on sessions.	▪ Oral & Writing Exams ▪ Individual Projects and Studies Reports, ▪ Assignments
c2.	Perform a detailed finite element study to investigate a real-world engineering problem.	▪ Lectures, ▪ Self-Learning ▪ Problems/Studies, ▪ Case study, ▪ Individual/Group Projects and Studies, ▪ Active learning ▪ Computer hands-on sessions	▪ Oral & Writing Exams ▪ Individual Projects and Studies Reports, ▪ Assignments

- **Alignment of Transferable (General) Skills CILOs:**

Transferable (General) Skills CILOs		Teaching Strategies	Assessment Strategies
d1.	Communicate effectively with a range of audiences, mechanical components or systems.	▪ Independent Study, ▪ Individual/Group Projects and Studies, ▪ Presentation	▪ Presentation, ▪ Written Report
d2.	Collaborate within a team work on a group project to apply FEA for improving performance in real-world problems.	▪ Independent Study, ▪ Individual/Group Projects and Studies ▪ Presentation	▪ Presentation, ▪ Written Report.

• Course Content

• Theoretical Aspect

Order	Topic List / Units	Sub -Topics List	Number of Weeks	Contact Hours	Course ILOs
1.	**Introduction to Finite Element Method (FEM)**	- Discretization; - FE Terminology; - Stiffness Matrices for Bars and Trusses; - Element Library Introduction.	1	3	a1
2.	**Numerical Solution Procedure**	- Applying Loads and Boundary Conditions; - Assembly; - Solving for Nodal Displacements; - Constitutive Laws; - Interpolation of Stress and Strain.	1	3	a1, a2
3.	**The Element Library**	- 2D Triangles and Quads; - Shells; - 3D Test and Hexes; - Solid Shells; - Isoparametric Elements; - Quadratic and Higher Order Elements; - Choice of Element Types.	1	3	a1, a2, a3, b1, b2, c1, c2, d1, d2
4.	**Good FE Practice**	- FE Problem Solving Approach; Assumptions, Mistakes and Errors; Meshing Strategy; - Convergence; - Validation; - Computational Resources; - CAD; - FE Reporting.	1	3	a1, a2, a3, b1, b2, c1, c2, d1, d2
5.	**Buckling and Non-linear Analyses**	- Eigenvalue Solutions; - Linear Buckling; - Material Non-linearity; - Geometric Non linearity and Buckling; - Iteration Schema and Incremental Analysis;	1	3	a1, a2, a3, b1, b2, c1, c2, d1, d2

6.	**Composite Analysis**	- Basics of Composites and Composite Mechanics; - Modelling Challenges; - General Approaches to Modelling Orthotropic and Layered Materials; Industry Case Study.	1	3	a1, a2, a3, b1, b2, c1, c2, d1, d2
7.	**Vibration and Transient Analyses**	- Modal Analysis; - Harmonic Analysis; - Other Vibration Solutions; Transient Solutions and their applications; - Choice of Time Discretization.	1	3	a1, a2, a3, b1, b2, c1, c2, d1, d2
8.	**Heat Transfer Analysis**	- Scalar Field Problems; - Heat Transfer Refresher; - Steady-state Thermal Analysis; - Transient Analysis; - Radiation; - Thermo-mechanical Analysis.	2	6	a1, a2, a3, b1, b2, c1, c2, d1, d2
9.	**Fluid Mechanics Analysis**	- Flow of viscous incompressible fluids; - Nonlinear analysis of transient problems; - Compressible flows; - Solid fluid interactions.	2	6	a1, a2, a3, b1, b2, c1, c2, d1, d2
10.	**Advanced FE Topics**	- Topics may include: - Mechanisms and Rigid Dynamics; - Fluid-Structure Interaction; Magnetostatics; - Soil Modelling; etc.	1	3	a1, a2, a3, b1, b2, c1, c2, d1, d2
11.	**Final projects**	Follow up on final projects	1	3	a1, a2, a3, b1, b2, c1, c2, d1, d2
12.	**Final projects**	Presentation of final projects	1	3	a1, a2, a3, b1, b2, c1, c2, d1, d2
Number of Weeks /and Contact Hours Per Semester			**14**	**42**	

- **Practical Aspect**

Order	Practical / Tutorials topics	Number of Weeks	Contact Hours	Course ILOs
1	▪ None			
Number of Weeks /and Contact Hours Per Semester				

- **Tutorial Aspect:**

No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	• None			
Number of Weeks /and Units Per Semester				

• Teaching Strategies:

- Lectures,
- Self-Learning Problems/Studies,
- Case study,
- Individual Projects and Studies,
- Active learning,
- Computer hands-on sessions.
- Independent Study, and
- Presentation

• Assessment Methods of the Course:

- Oral & Writing Exams
- Individual/Group Projects and Studies Reports,
- Presentation,
- Assignments

• Tasks and Assignments:

No	Assignments/ Tasks	Individual/ Group	Mark	Week Due	CILOs (symbols)
1	**Assignment on Numerical Solution Procedure**	Individual	4	3rd	a1, a2, a3, b1, b2, c1, c2, d1, d2
2	**Assignment on Buckling and Non-linear Analyses**	Individual	4	6th	a1, a2, a3, b1, b2, c1, c2, d1, d2
3	**Assignment on Composite Analysis**	Individual	4	7th	a1, a2, a3, b1, b2, c1, c2, d1, d2

4	**Assignment on Vibration and Transient Analyses**	Individual	4	8th	a1, a2, a3, b1, b2, c1, c2, d1, d2
5	**Assignment on Heat Transfer and Fluid Mechanics Analysis**	Individual	4	11th	a1, a2, a3, b1, b2, c1, c2, d1, d2
6	**Major Project**	Group	10	15th	a1, a2, a3, b1, b2, c1, c2, d1, d2
	Total Score		**30**	==	===

• Learning Assessment:

No.	Assessment Tasks	Week due	Mark	Proportion of Final Assessment	CILOs
1	**Tasks and Assignments**	3rd , 6th , 7th , 8th , 11th, 13th	30	20%	a1, a2, a3, b1, b2, c1, c2, d1, d2
2	**Quizzes 1, 2**	5th , 10th	10	6.7%	a1, a2, a3, b1, b2, c1, c2
3	**Midterm Exam (Theoretical)**	8th	30	20%	a1, a2, a3, b1, b2, c1, c2
4	**Final Exam (Theoretical)**	16th	80	53.3%	a1, a2, a3, b1, b2, c1, c2
Total			**150**	**100%**	**===**

• Learning Resources :

1. Required Textbook(s) :

1. Saeed Moaveni, 2015, **Finite Element Analysis: Theory and Application with ANSYS**, 4th ed., Pearson (Lecture session).
2. Chandrupatla, T. R., Belegundu, A. D. 2011, **Introduction to Finite Elements in Engineering**, 4th Ed, Prentice Hall (Pearson).

2. Essential References:

1. Cook, R. D., Malkus, D. S., Plesha, M. E., Witt, R. J., 2002, **Concepts and Applications of Finite Element Analysis**, 4th Ed, John Wiley & Sons.
2. Huei-Huang Lee, 2001, **Finite Element Simulations with ANSYS Workbench 19: Theory, Applications, Case Studies**, SDC Publications (Lab session).

3. Electronic Materials and Web Sites *etc.*

Course:

1. https://www.coursera.org/courses?query=finite%20element
2. https://www.udemy.com/topic/finite-element-analysis/
3. https://onlinecourses.nptel.ac.in/noc22_me43/preview
4. https://www.nafems.org/training/e-learning/basic-fea/

Websites:

1. https://www.comsol.com/multiphysics/finite-element-method
2. https://www.sciencedirect.com/topics/engineering/finite-element-method
3. https://graitec.com/finite-element-analysis-fea/

• **الضوابط والسياسات المتبعة في المقرر Course Policies**	
بعد الرجوع للوائح الجامعة يتم كتابة السياسة العامة للمقرر فيما يتعلق بالآتي:	
1	**سياسة حضور الفعاليات التعليمية Class Attendance:** **- يلتزم الطالب بحضور 75% من المحاضرات ويحرم في حال عدم الوفاء بذلك.** **- يقدم أستاذ المقرر تقريرا بحضور وغياب الطلاب للقسم ويحرم الطالب من دخول الامتحان في حال تجاوز الغياب 25% ويتم اقرار الحرمان من مجلس القسم.**
2	**الحضور المتأخر Tardy:** **- يسمح للطالب حضور المحاضرة إذا تأخر لمدة ربع ساعة لثلاث مرات في الفصل الدراسي، وإذا تأخر زيادة عن ثلاث مرات يحذر شفويا من أستاذ المقرر، وعند عدم الالتزام يمنع من دخول المحاضرة.**
3	**ضوابط الامتحان Exam Attendance/Punctuality:** **- لا يسمح للطالب دخول الامتحان النهائي إذا تأخر مقدار (20) دقيقة من بدء الامتحان** **- إذا تغيب الطالب عن الامتحان النهائي تطبق اللوائح الخاصة بنظام الامتحان في الكلية.**
4	**التعيينات والمشاريع Assignments & Projects:** **- يحدد أستاذ المقرر نوع التعيينات في بداية الفصل ويحدد مواعيد تسليمها وضوابط تنفيذ التكليفات وتسليمها.** **- إذا تأخر الطالب في تسليم التكليفات عن الموعد المحدد يحرم من درجة التكليف الذي تأخر في تسليمه.**
5	**الغش Cheating:** **- في حال ثبوت قيام الطالب بالغش في الامتحان النصفي أو النهائي تطبق عليه لائحة شؤون الطلاب.** **- في حال ثبوت قيام الطالب بالغش او النقل في التكليفات والمشاريع يحرم من الدرجة المخصصة للتكليف.**
6	**الانتحال Plagiarism:** **– في حالة وجود شخص ينتحل شخصية طالب لأداء الامتحان نيابة عنه تطبق اللائحة الخاصة بذلك**
7	**سياسات أخرى Other policies:** **- أي سياسات أخرى مثل استخدام الموبايل أو مواعيد تسليم التكليفات ..... الخ**

Academic Year: ……....

Course Plan (Syllabus) Applied Finite Element
Course Code (502)

• Information about Faculty Member Responsible for the Course:

Name	**Dr. Hamoud A. Al-Nehari**	**Office Hours**					
Location &Telephone No.	772223240	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	H_nahary@hotmail.com						

• General information about the course:

10	**Course Title**	Applied Finite Element			
11	**Course Code and Number**	ME502			
12	**Credit Hours**	**Credit Hours**			**Total**
		Lecture	**Practical**	**Seminar/Tutorial**	
		3	--	--	**3**
13	**Study Level and Semester**	1st Level / 1st Semester			
14	**Pre-requisites**	Engineering Mathematics (BR231), Computer programming and Application (ME201), Mechanical Vibrations (E222), Mechanics of Materials – 2 (ME234) Heat and Mass Transfer (ME353)			
15	**Co –requisite**	None			
16	**Program (s) in which the course is offered**	MSc. In Mechanical Engineering Program			
17	**Language of teaching the course**	English			
18	**Location of teaching the course**	Faculty Buildings			

• Course Description:

The primary aim of this course is to train the student to solve complex engineering mechanics problems with finite element analysis. The course will provide deep insight into the operation of finite element analysis software by teaching the underlying computational methods involved. The student will be taught to execute a detailed finite element study including planning, modelling, meshing, solving, evaluating results and validating against real world data. The course introduces the mathematical basis of finite element analysis, on which nearly all structural analysis software is built. The student will learn how to apply commercially available finite element software to solve mechanical engineering problems. The course will cater to the specific challenges of engineers across all mechanical disciplines.

• Course Intended Learning Outcomes (CILOs):

Upon successful completion of **Advanced Thermodynamics Course**, the graduates will be able to:

a1.	Demonstrate the fundamental theory of the Finite Element Method.

a2.	Explain the underlying mathematics behind finite element analysis software solvers.
a3.	Show Understanding basic formulation techniques and the general steps of Finite Element Analysis.
b1.	Solve the mechanical engineering problems using finite element analysis technique.
b2.	Analyze model convergence, stability, and accuracy.
c1.	Build computer models for a mechanical system using a commercial finite element software package like ANSYS.
c2.	Perform a detailed finite element study to investigate a real-world engineering problem.
d1	Communicate effectively with a range of audiences, mechanical components or systems.
d2.	Collaborate within a team work on a group project to apply FEA for improving performance in real-world problems.

• Course Content

• Theoretical Aspect

Order	Topic List / Units	Sub -Topics List	Number of Weeks	Contact Hours
1.	**Introduction to Finite Element Method (FEM)**	- Discretization; - FE Terminology; - Stiffness Matrices for Bars and Trusses; - Element Library Introduction.	1	3
2.	**Numerical Solution Procedure**	- Applying Loads and Boundary Conditions; - Assembly; - Solving for Nodal Displacements; - Constitutive Laws; - Interpolation of Stress and Strain.	1	3
3.	**The Element Library**	- 2D Triangles and Quads; - Shells; - 3D Test and Hexes; - Solid Shells; - Isoparametric Elements; - Quadratic and Higher Order Elements; - Choice of Element Types.	1	3
4.	**Good FE Practice**	- FE Problem Solving Approach; Assumptions, Mistakes and Errors; Meshing Strategy; - Convergence; - Validation; - Computational Resources; - CAD; - FE Reporting.	1	3

5.	**Buckling and Non-linear Analyses**	- Eigenvalue Solutions; - Linear Buckling; - Material Non-linearity; - Geometric Non linearity and Buckling; Iteration Schema and Incremental Analysis;	1	3
6.	**Composite Analysis**	- Basics of Composites and Composite Mechanics; - Modelling Challenges; - General Approaches to Modelling Orthotropic and Layered Materials; - Industry Case Study.	1	3
7.	**Vibration and Transient Analyses**	- Modal Analysis; - Harmonic Analysis; - Other Vibration Solutions; Transient Solutions and their applications; - Choice of Time Discretization.	1	3
8.	**Midterm Exam**	All previous topics	1	3
9.	**Heat Transfer Analysis**	- Scalar Field Problems; - Heat Transfer Refresher; - Steady-state Thermal Analysis; - Transient Analysis; - Radiation; - Thermo-mechanical Analysis.	2	6
10.	**Fluid Mechanics Analysis**	- Flow of viscous incompressible fluids; - Nonlinear analysis of transient problems; - Compressible flows; - Solid fluid interactions.	2	6
11.	**Advanced FE Topics**	- Topics may include: - Mechanisms and Rigid Dynamics; - Fluid-Structure Interaction; Magnetostatics; - Soil Modelling; etc.	1	3
12.	**Final projects**	Follow up on final projects	1	3
13.	**Final projects**	Presentation of final projects	1	3

14.	**Final Theoretical Exam**	All Previous Topics	1	3
Number of Weeks /and Contact Hours Per Semester			**16**	**48**

• Practical Aspect

Order	Practical / Tutorials topics	Number of Weeks	Contact Hours	Course ILOs
1	▪ None			
Number of Weeks /and Contact Hours Per Semester				

• Training/ Tutorials/ Exercises Aspects:

Order	Tutorials/ Exercises	Week Due	Contact Hours
1	▪ None		
Number of Weeks /and Contact Hours Per Semester			

• Teaching Strategies:

- Lectures,
- Self-Learning Problems/Studies,
- Case study,
- Individual Projects and Studies,
- Active learning,
- Computer hands-on sessions.
- Independent Study, and
- Presentation

• Assessment Methods of the Course:

- Oral & Writing Exams
- Individual/Group Projects and Studies Reports,
- Presentation,
- Assignments

• Tasks and Assignments:

No	Assignments	Individual /Groups	Mark	Week Due
1	**Assignment on Numerical Solution Procedure**	Individual	4	3rd
2	**Assignment on Buckling and Non-linear Analyses**	Individual	4	6th
3	**Assignment on Composite Analysis**	Individual	4	7th

4	**Assignment on Vibration and Transient Analyses**	Individual	4	8th
5	**Assignment on Heat Transfer and Fluid Mechanics Analysis**	Individual	4	11th
6	**Major Project**	Group	10	15th
	Total Score		**30**	

• Learning Assessment:

No	Assessment Method	Week Due	Mark	Proportion of Final Assessment %
1	**Tasks and Assignments**	3rd , 6th , 7th , 8th , 11th, 13th	30	20%
2	**Quizzes 1, 2**	5th , 10th	10	6.7%
3	**Midterm Exam (Theoretical)**	8th	30	20%
4	**Final Exam (Theoretical)**	16th	80	53.3%
	Total		**150**	**100%**

• Learning Resources :

1. Required Textbook(s) :

1. Saeed Moaveni, 2015, **Finite Element Analysis: Theory and Application with ANSYS**, 4th ed., Pearson (Lecture session).
2. Chandrupatla, T. R., Belegundu, A. D. 2011, **Introduction to Finite Elements in Engineering**, 4th Ed, Prentice Hall (Pearson).

2. Essential References:

1. Cook, R. D., Malkus, D. S., Plesha, M. E., Witt, R. J., 2002, **Concepts and Applications of Finite Element Analysis**, 4th Ed, John Wiley & Sons.
2. Huei-Huang Lee, 2001, **Finite Element Simulations with ANSYS Workbench 19: Theory, Applications, Case Studies**, SDC Publications (Lab session).

3.Electronic Materials and Web Sites *etc.*

Course:

1. https://www.coursera.org/courses?query=finite%20element
2. https://www.udemy.com/topic/finite-element-analysis/
3. https://onlinecourses.nptel.ac.in/noc22_me43/preview
4. https://www.nafems.org/training/e-learning/basic-fea/

Websites:

1. https://www.comsol.com/multiphysics/finite-element-method
2. https://www.sciencedirect.com/topics/engineering/finite-element-method
3. https://graitec.com/finite-element-analysis-fea/

• الضوابط والسياسات المتبعة في المقرر Course Policies

بعد الرجوع للوائح الجامعة يتم كتابة السياسة العامة للمقرر فيما يتعلق بالآتي:

1	**سياسة حضور الفعاليات التعليمية Class Attendance:** - يلتزم الطالب بحضور 75% من المحاضرات ويحرم في حال عدم الوفاء بذلك. - يقدم أستاذ المقرر تقريرا بحضور وغياب الطلاب للقسم ويحرم الطالب من دخول الامتحان في حال تجاوز الغياب 25% ويتم

	اقرار الحرمان من مجلس القسم.
2	**الحضور المتأخر Tardy:** - يسمح للطالب حضور المحاضرة إذا تأخر لمدة ربع ساعة لثلاث مرات في الفصل الدراسي، وإذا تأخر زيادة عن ثلاث مرات يحذر شفويا من أستاذ المقرر، وعند عدم الالتزام يمنع من دخول المحاضرة.
3	**ضوابط الامتحان Exam Attendance/Punctuality:** - لا يسمح للطالب دخول الامتحان النهائي إذا تأخر مقدار (20) دقيقة من بدء الامتحان - إذا تغيب الطالب عن الامتحان النهائي تطبق اللوائح الخاصة بنظام الامتحان في الكلية.
4	**التعيينات والمشاريع Assignments & Projects:** - يحدد أستاذ المقرر نوع التعيينات في بداية الفصل ويحدد مواعيد تسليمها وضوابط تنفيذ التكليفات وتسليمها. - إذا تأخر الطالب في تسليم التكليفات عن الموعد المحدد يحرم من درجة التكليف الذي تأخر في تسليمه.
5	**الغش Cheating:** - في حال ثبوت قيام الطالب بالغش في الامتحان النصفي أو النهائي تطبق عليه لائحة شؤون الطلاب. - في حال ثبوت قيام الطالب بالغش او النقل في التكليفات والمشاريع يحرم من الدرجة المخصصة للتكليف.
6	**الانتحال Plagiarism:** – في حالة وجود شخص ينتحل شخصية طالب لأداء الامتحان نيابة عنه تطبق اللائحة الخاصة بذلك
7	**سياسات أخرى Other policies:** - أي سياسات أخرى مثل استخدام الموبايل أو مواعيد تسليم التكليفات ..... الخ