INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

COURSE OUTLINE

Kulliyyah	Engineering
Department	Mechanical Engineering
Programme	B.Eng. Aerospace / (Mechanical-Automotive)
Course Title	Finite Element Analysis
Course Code	MEC 4864
Status	Elective
Level	4
Credit Hours	3
Contact Hours	3
Pre-requisites *(if any)*	MEC 3611
Co-requisites *(if any)*	None
Instructor(s)	Qasim H. Shah
Semester Offered	*Alternate Semester*
Course Synopsis	Revision of matrix algebra. Introduction to formulating system equations for solid mechanics, heat transfer and fluid mechanics. Introduction to various elements. Concept of shape functions, properties and usages of linear, quadratic and cubic shape functions. Detailed training on commercial FEA software to solve problems from various disciplines.
Course Objectives	The objectives of this course are to: 1. Equip the students with the Finite Element Analysis fundamentals. 2. Enable the students to formulate the design problems into FEA. 3. Enable the students to perform engineering simulations using Finite Element Analysis software (ANSYS & LSDYNA).

<table>
<tr><td></td><td>4. Enable the students to understand the ethical issues related to the utilization of FEA in the industry.</td></tr>
<tr><td>Learning Outcomes</td><td>Upon completing this course, the students should be able to:
1. Identify mathematical model for solution of common engineering problems.
2. Formulate simple problems into finite elements.
3. Solve structural, thermal, fluid flow, impact and crash problems.
4. Solve complicated 3D structural problems for stress analysis under impact loads.
5. Solve Fluid Structure Interaction problems.
6. Appreciate the importance of ethical issues pertaining to the effective utilization of FEA from the Islamic perspective.</td></tr>
<tr><td>Instructional Strategies</td><td>Lectures</td></tr>
<tr><td>Course Assessment
State weightage of each type of assessment.</td><td>
<table>
<tr><td>LO</td><td>Method</td><td>%</td></tr>
<tr><td>1,2,3</td><td>Mid-term Test</td><td>30</td></tr>
<tr><td>1,2,3,4</td><td>Final Examination</td><td>40</td></tr>
<tr><td>4,5</td><td>Assignment and Project</td><td>30</td></tr>
</table>
</td></tr>
</table>

Content Outlines

Weeks	Topics	Task/Reading
1, 2	Introduction to finite element analysis, Brief history of FEA, Basic steps in the FEA, Matrix algebra, Direct formulation.	Chapter 1 Chapter 2 Handouts
3	Trusses: definition of a truss, finite element formulation, space trusses.	Chapter 3
4	Axial members, beams and Frames: Finite element formulation of beams and frames	Chapter 4
5	One dimensional problems: linear elements, quadratic elements, cubic elements, global, local, and natural coordinates, numerical integration: Gauss-Legendre Quadrature.	Chapter 5
6	Analysis of one dimensional problems: Heat transfer and fluid flow problems, solid mechanics problems.	Chapter 6
7	Two dimensional problems: rectangular elements, quadratic quadrilateral elements, linear triangular elements, isoparametric elements, two dimensional integrals: Gauss-Legendre Quadrature	Chapter 7
8	Analysis of two dimensional heat transfer problems: general	Chapter 9

	conduction problems, formulation with rectangular elements, formulation with triangular elements.	
9	Analysis of two dimensional solid mechanics problems: torsion of members with arbitrary cross-section shape, beams and frames, plane stress formulation, basic failure theory.	Chapter 10
10	Dynamic Problems: Review of dynamics, Vibrations, Lagrange equations. Introduction to ANSYS & LSDYNA	Chapter 11 ANSYS & LSDYNA Manuals
11	Laboratory session to solve structural problems using ANSYS and LSDYNA.	ANSYS & LSDYNA Manuals
12	Introduction to Smooth Particle Hydrodynamics, Solution of Fluid Structural Interaction problems pertaining to impact loads. LSDYNA session.	LSDYNA Manuals
13	LSDYNA session on machining process.	LSDYNA Manuals
14	Ethical Issues in the usage of Finite Element Analysis: Ethical utilization of Finite Element Analysis, Confidentiality and Trustworthiness in the usage of FEA	Handouts

References	**Required** Saeed Moaveni., (2008), *Finite Element Analysis: Theory and Applications with ANSYS*. 3rd Ed., Prentice Hall. **Recommended** Chandrupatla, T. R.,Belengundu, A. D., (2002), *Introduction to Finite Elements in Engineering*, 3rd Ed., Prentice Hall.	
Proposed Start Date (Semester)	*Semester I, 2011/2012*	
Batch of Students to be Affected	*Semester II, 2009/2010 and onwards*	

Prepared by:	Checked by:	Approved by:
Qasim H Shah **Associate Professor** **Kulliyyah of Engineering**	**Name** **Designation** **Kulliyyah**	**Prof. Ahmad Faris Ismail** **Dean** **Kulliyyah of Engineering**

Learning Outcomes Matrix: MEC 4864 / Finite Element Analysis

Course Learning Outcomes	Programme Outcomes											
	Outcome 1	**Outcome 2**	**Outcome 3**	**Outcome 4**	**Outcome 5**	**Outcome 6**	**Outcome 7**	**Outcome 8**	**Outcome 9**	**Outcome 10**	**Outcome 11**	**Outcome 12**
1. Identify mathematical model for solution of common engineering problems.	**3**	**2**	**1**	**1**	**2**	**1**		**1**				
2. Formulate simple problems into finite elements.	**3**	**3**	**2**	**2**	**2**	**1**		**1**				
3. Solve structural, thermal, fluid flow, impact and crash problems.	**3**	**3**		**3**	**3**	**1**		**1**	**3**			
4. Solve complicated 3D structural problems for stress analysis under impact loads.	**3**	**3**	**3**	**3**	**3**	**1**		**1**	**3**			
5. Solve Fluid Structure Interaction problems.	**3**	**3**	**3**	**3**	**3**	**1**		**1**	**3**			
6. Appreciate the importance of ethical issues pertaining to the effective utilization of FEA from the Islamic point of view.							**2**	**3**		**3**	**3**	
Total	**15**	**14**	**9**	**12**	**13**	**5**	**2**	**8**	**9**	**3**	**3**	

*	1 =	objective addresses outcome slightly,	2 =	moderately,	3 =	substantive

The educational outcomes of the programmes conducted by the Kulliyyah are as follows:

1.	The ability to acquire and apply knowledge of mathematics, computers, science, and engineering.(T)
2.	The ability to have in-depth understanding and technical competency in relevant engineering discipline. (T)
3.	The ability to identify, formulate and provide solutions to engineering problems. (T)
4.	The ability to design and conduct experiments, as well as to analyze and interpret data. .(A/D)
5.	The ability to analyze and design a system, component, or process to achieve the required objectives.(A/D)
6.	The ability to understand and apply design principles for sustainable development..(A/D)
7.	The ability to communicate effectively.(S)
8.	The ability to function effectively as an individual and in group with the capacity to be a leader or manager as well as an effective team member.(S)
9.	The ability to recognize the need for lifelong learning and to pursue independent learning for professional development.(S)
10.	The ability to understand the responsibility of a professional engineer in the context of contemporary social, cultural, global and environmental issues.(ESSE)
11.	The ability to demonstrate understanding and commitment to professional and ethical responsibilities.(ESSE)
12.	The ability to understand the impact of engineering solutions in a global and societal context through broad-based education.(ESSE)

NOTE:

1. The course outlines should reflect the course description/synopsis and Islamic mission of the university as well as to provide the room for Islamic critique.
2. Latest editions of textbooks and references should be used unless otherwise necessary or if the course is classical in nature. Please check with the library to ensure that the books are up-to-date and incorporating the latest edition.
3. The reference lists shall be presented in accordance with APA bibliographic practices and in alphabetical order.
4. The reference title shall be italicised or underlined or bold. If in doubt, please consult the Librarian.
5. Proposed new course outlines should be presented to the Senate Standing Committee for approval at least **four months** prior to the course offering.
6. Any changes to the course outlines must be reported back to the Standing Senate Committee **two months** prior to the course offering.