Course Specifications

Program(s) on which this course is given:	Aerospace Engineering
Department offering the program:	**Department of Aerospace Engineering**
Department offering the course:	**Department of Aerospace Engineering**
Academic Level:	B.Sc.
Date	March 23 2015
Semester (based on final exam timing)	☐x Fall ☐ Spring

A- Basic Information

1. Title:	Numerical method in structural analysis				**Code:**	AER 640		
2. Units/Credit hours per week:	Lectures	27	Tutorial	15	Practical	**3**	Total	45

B- Professional Information

1. Course description:	To introduce to the a range of numerical techniques based on different theories that can be applied to solve the structure subjected to static and dynamic loads and compare their applicability and compare the strength and weakness in each method.
2. Intended Learning Outcomes of Course (ILOs):	**a) Knowledge and Understanding**
	To know the importance hand calculation methods in solving structural static and dynamic load cases.
	To understand the wide range of hand calculation method applied to static and dynamic structural calculation.
	b) Intellectual Skills
	To learn theories for a wide range of hand calculation method for structures under static loads and their solution convergence properties.
	To learn theories for a wide range of hand calculation method for structures response under dynamic loads in frequency domain and in time domain. and their solution convergence properties.
	c) Professional and Practical Skills
	Application of hand calculation method for structures analysis to solve structures under static and dynamic loads
	Estimate the accuracy of the numerical solution. Application to linear and nonlinear structures.
	d) General and Transferable Skills
	Gain the ability to apply hand calculations for structural analysis which helps to check on the results obtained from structural software.

3. Contents

Topic	Total hours	Lectures hours	Tutorial/ Practical hours
Basic concepts in computational mechanics. Variational methods. Energy methods, force equilibrium kinematic methods,.		3	
Constitutive equations. Structural continuity, Natural and essential boundary conditions		3	
Method in structural statics: Minimum total potential energy (force method), Minimum total complementary energy (displacement method),		6	3

Minimum strain energy, Castiglione theorems. Application to linear and nonlinear structures			
Methods in structural dynamics: principle of virtual work, Variational principle, Hamilton principle, Lagrange equations (Holonomic system), Lagrange equations in matrix form, Rayleigh energy method, Rayleigh-Ritz method, Assumed modes method, Lagrange equations formulation and integral formulation, Galerkin method, Collocation method, integral formulation, Holzer method for torsion vibration Myklestad method for bending vibration, lumped parameter method Lagrange's multipliers method		9	6
Application to linear and nonlinear structures under static and dynamic loads		3	6
Numerical integration methods. Accuracy of the numerical integration. Application to nonlinear structures.		3	3
4. Teaching and Learning Methods	Lectures (27)	Practical Training/ Laboratory (15)	Seminar/Workshop (3)
	Class Activity (4)	Case Study (1)	Projects (1)
	E-learning (2)	Assignments /Homework (5)	Other:

5. Student Assessment Methods	
• **Assessment Schedule**	**Week**
-Assessment 1;Class test	4,5,6
-Assessment 2; Project Assignment	7
-Assessment 3; Presentations	10
-Assessment 3; Midterm Exam	9
-Assessment 4; Final Exam	16
• **Weighting of Assessments**	
-Mid-Term Examination	20
-Final-term Examination	40
-Project	20
-Class Test	15
-Presentation	5
-Total	100

6. List of References

Analytical methods in vibration, Editor: L. Meriovitch, library of Congress catalog number: 67-15548

Structural Dynamics and Vibration in Practice, Editor: Douglas Thorby, ISBN: 978-0-7506-8002-8

The finite element method, Editor: O.CC. Zienkeiwicz, ISBN: 9780080531670

7. Facilities Required for Teaching and Learning	
Computer lab	
Course Coordinator:	**Nader M. Abuelfoutouh**
Head of Department:	**Ayman H. Kassem**