

## AGRI C3F02: Agricultural Design, Simulation and Analysis

NFQ Level:       7         Module Delivered In       2 programme(s)         Teaching & Learning Strategies:       Lectures, laboratories, demonstrations, research, project work and some study will be used to ensure the student has a wide range of experiences.         Module Aim:       The aim of this module is to provide students with an in-depth knowledge of the design process and design and machinery.         Learning Outcomes       The aim of this module is to provide students with an in-depth knowledge of the material / components and machinery.         Consuccessful completion of this module the learner should be able to:       Describe the stress at a point within a material / component, predicting the behaviour and/or failure of the material / component when subjected to loads with particular emphasis on agricultural applications.         LO2       Apply models of stress / strain to representative agricultural systems in order to determine relationships between loads and the corresponding deflection.         LO3       Develop finite element models of simple agricultural structures to solve for load, deflection and stress.         LO4       Develop mesh generation strategies for two and three-dimensional geometrical arrangements using industry standard software.         LO5       Application of F.E.A. to typical agricultural engineering design problems.         LO6       Quantify, by calculation and experimental measurement, the characteristic response of an agricultural system.         Pre-requisite learning       Module Recommendations         This is prior lea					
Credits:       10         NFQ Level:       7         Module Delivered In       2 programme(s)         Teaching & Learning       Lectures, laboratories, demonstrations, research, project work and some study will be used to ensure the student has a wide range of experiences.         Module Aim:       The aim of this module is to provide students with an in-depth knowledge of the design process and design evolution of components as well as failure criteria and stress / strain analysis for agricultural components and machinery.         Learning Outcomes       The aim of this module the learner should be able to:         On successful completion of this module is to provide structures to agricultural applications.       Component when subjected to loads with particular emphasis on agricultural applications.         L01       Describe the stress at a point within a material / component, predicting the behaviour and/or failure of the material / component when subjected to loads with particular emphasis on agricultural applications.         L02       Apply models of stress / strain to representative agricultural systems in order to determine relationships between loads and the corresponding deflection.         L03       Develop finite element models of simple agricultural structures to solve for load, deflection and stress.         L04       Develop mesh generation strategies for two and three-dimensional geometrical arrangements using industry standard software.         L05       Application of F.E.A. to typical agricultural engineering design problems.         L06	Module Title:		Agricultural Design, Simulation and Analysis		
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On successful completion of this module the learner should be able to:         L01       Describe the stress at a point within a material / component, predicting the behaviour and/or failure of the material / component when subjected to loads with particular emphasis on agricultural applications.         L02       Apply models of stress / strain to representative agricultural systems in order to determine relationships between loads and the corresponding deflection.         L03       Develop finite element models of simple agricultural structures to solve for load, deflection and stress.         L04       Develop mesh generation strategies for two and three-dimensional geometrical arrangements using industry standard software.         L05       Application of F.E.A. to typical agricultural engineering design problems.         L06       Quantify, by calculation and experimental measurement, the characteristic response of an agricultural system.         Pre-requisite learning       Module Recommendations         This is prior learning (or a practical skill) that is recommended before enrolment in this module.         No incompatible Modules         These are modules listed         Co-requisite modules listed         No co-requisite modules listed         Requirements         No co-requisite modules listed         Requirements         This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.	Module Aim:		evolution of components as well as failure criteria and stress / strain analysis for agricultural components		
LO1       Describe the stress at a point within a material / component, predicting the behaviour and/or failure of the material / component when subjected to loads with particular emphasis on agricultural applications.         LO2       Apply models of stress / strain to representative agricultural systems in order to determine relationships between loads and the corresponding deflection.         LO3       Develop finite element models of simple agricultural structures to solve for load, deflection and stress.         LO4       Develop mesh generation strategies for two and three-dimensional geometrical arrangements using industry standard software.         LO5       Application of F.E.A. to typical agricultural engineering design problems.         LO6       Quantify, by calculation and experimental measurement, the characteristic response of an agricultural system.         Pre-requisite learning       Module Recommendations         This is prior learning (or a practical skill) that is recommended before enrolment in this module.         No incompatible Modules       These are modules listed         Co-requisite modules listed       Modules         No co-requisite modules listed       Requirements         No Co-requisite modules listed       Modules         Requirements       This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.	Learning Outco	omes			
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the corresponding deflection.       Intersection of the corresponding deflection.         LO3       Develop finite element models of simple agricultural structures to solve for load, deflection and stress.         LO4       Develop mesh generation strategies for two and three-dimensional geometrical arrangements using industry standard software.         LO5       Application of F.E.A. to typical agricultural engineering design problems.         LO6       Quantify, by calculation and experimental measurement, the characteristic response of an agricultural system.         Pre-requisite learning       Module Recommendations         This is prior learning (or a practical skill) that is recommended before enrolment in this module.         No recommendations listed         Incompatible Modules         These are modules listed         No incompatible modules listed         No Co-requisite modules listed         No Co-requisite modules listed         Requirements         Requirements         This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.					
LO4       Develop mesh generation strategies for two and three-dimensional geometrical arrangements using industry standard software.         LO5       Application of F.E.A. to typical agricultural engineering design problems.         LO6       Quantify, by calculation and experimental measurement, the characteristic response of an agricultural system.         Pre-requisite learning         Module Recommendations         This is prior learning (or a practical skill) that is recommended before enrolment in this module.         No recommendations listed         Incompatible Modules         These are modules which have learning outcomes that are too similar to the learning outcomes of this module.         No incompatible modules listed         Co-requisite modules listed         No Co-requisite modules listed         Requirements         This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.					
software.       Software.         LO5       Application of F.E.A. to typical agricultural engineering design problems.         LO6       Quantify, by calculation and experimental measurement, the characteristic response of an agricultural system.         Pre-requisite learning       Module Recommendations         This is prior learning (or a practical skill) that is recommended before enrolment in this module.         No recommendations listed         Incompatible Modules         These are modules which have learning outcomes that are too similar to the learning outcomes of this module.         No incompatible modules listed         Co-requisite Modules         No Co-requisite modules listed         Requirements         This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.	LO3 De	evelop finite	element models of simple agricultural structures to solve for load, deflection and stress.		
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CAD 1 or equivalent		ning (or a pr	actical skill) that is mandatory before enrolment in this module is allowed.		
	CAD 1 or equiva	lent			



# AGRI C3F02: Agricultural Design, Simulation and Analysis

## **Module Content & Assessment**

#### Indicative Content

#### Stress strain relations

Plane stress. 
 Mohr's stress circle. 
 Three-dimensional stress

#### Failure Criteria

· Rankine, Tresca & von Mises Failure criteria. • Stress concentrations.

# Slope and Deflection of Beams • Integration method. • Macaulay functions.

#### **Finite Element Method**

• Introduction to stiffness matrices. • Finite elements. • Co-ordinates systems. • Types of elements. • Manual analysis of simple structures.

### Meshing

ANSYS Meshing Basics 
 Meshing Methods 
 Global Mesh Controls 
 Local Mesh Control 
 Assembly Meshing 
 Mesh Quality

#### **Finite Element Analysis**

 General Pre-processing. • Modelling Connections. • Remote Boundary Conditions and Constraint Equations. • Static Structural Analysis. •
 Modal Analysis. • Thermal Analysis. • Multistep Analysis. • Results and Post-Processing. Mechanical Nonlinear Connections and Contact • Interface Treatments • Bolt Pretension • Modeling Gaskets • Accessing Advanced Contact Features via MAPDL • General Contact Technology • Best Practices

#### Shear and Torsion

Modulus of elasticity. • Application to compound sections. • Shear stress and shear strain. • Modulus of Rigidity. • Torsion in solid and hollow shafts: Relationship betweentorque, shear stress, polar second moment of area, angle of twist. • Drive shaft configurations, cardinal shafts, balancing effect and coupling arrangements. • Power Transmission.

Assessment Breakdown	%
Continuous Assessment	25.00%
Project	30.00%
Practical	45.00%

Continuous Assessment				
Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Examination	Class test	1,2,3	25.00	Week 12

Project				
Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Project	Students will complete projects investigating design issues and redesign solutions using CAD / FEA.	4,5,6	30.00	Sem 1 End

Practical				
Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Practical/Skills Evaluation	Laboratory Experiments utilising engineering labs and FEA software.	3,4,5,6	45.00	Every Week
r				

No End of Module Formal Examination

SETU Carlow Campus reserves the right to alter the nature and timings of assessment



## AGRI C3F02: Agricultural Design, Simulation and Analysis

## Module Workload

Workload: Full Time			
Workload Type	Frequency	Average Weekly Learner Workload	
Lecture	12 Weeks per Stage	2.00	
Laboratory	12 Weeks per Stage	3.00	
Lab/Lecture	12 Weeks per Stage	1.00	
Independent Learning	15 Weeks per Stage	11.07	
	Total Hours	238.00	

Module Delivered In			
Programme Code	Programme	Semester	Delivery
CW_EFARG_B	Bachelor of Engineering (Honours) in Agricultural Systems Engineering	5	Mandatory
CW_EFARG_D	Bachelor of Engineering in Agricultural Systems Engineering	5	Mandatory