(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2017/2018 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER

SPECIAL/ SUPPLEMENTARY EXAMINATION

FOR THE DEGREE OF MASTER OF SCIENCE IN APPLIED MATHEMATICS

COURSE CODE: MAT 865 E

COURSE TITLE: FLUID MECHANICS II

DATE: 04/10/18 **TIME:** 8 AM -11 AM

INSTRUCTIONS TO CANDIDATES

Answer Any THREE Questions

TIME: 3 Hours

This Paper Consists of 3 Printed Pages. Please Turn Over.

(a) Precisely define

i) an eigen mode. (2Mks)

ii) a plane wave. (2Mks)

b) The three dimensional wave equation $\frac{\partial^2 q}{\partial t^2} = c^2\frac{\partial^2 q}{\partial x^2} + \frac{\partial^2 \epsilon}{\partial y^2} + \frac{\partial^2 \epsilon}{\partial z^2}$ can be used to describe the propagation of sound waves in a fluid. Show that the dispersion relation can be written compactly as ω=c|k| (16Mks)

QUESTION TWO (20MKS)

(a) Describe the wave equation $\frac{\partial^2 u}{\partial t^2} = C^2\nabla^2 u$ (10Mks)

(b) Consider the gravitational force on a particle near the earth's surface,

(i)What is the force on this particle?

(ii)What are the surfaces of constant in this case? (10Mks)

QUESTION THREE (20MKS)

(a) Define the laplacian in Cartesian co-ordinates (3Mks)

(b) Distinguish between a field and a vector field using examples (4Mks)

(c) Define the gradient of a function (3Mks)

(b) From Hook's law show that the forces exerted on a mass M at any location $x + h$ is

$\frac{\partial^2 u}{\partial t^2} = (x,t) = {}^{KL^2}/_{M}\frac{\partial^2 u}{\partial x^2}(x,t)$ (10Mks)

QUESTION FOUR (20 MKS)

a) Consider the function $(x,y,z) = \frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2}$

i) Is it appropriate to calculate the divergence or gradient of this function? (5 mks)

calculate whichever is appropriate

ii) Calculate either the gradient or divergence of the new function (5mks)

b) Find the divergence of $\vec{F} = 3x^2y\hat{\imath} - 3xy^2z\hat{\jmath} + z^3\hat{k}$ (10Mks)

QUESTION FIVE (20 MKS)

a) For a beam of constant cross-section made from a linear elastic material with stiffness K given by $K = EA/L$

Show that the wave equation reduces to $\frac{\partial^2 u}{\partial t^2}(x,t) = \frac{E}{\rho}\frac{\partial^2 u}{\partial x^2}(x,t)$ and identify the stress wave speed in a beam from the equation (10Mks)

(b) Using the Cartesian co-ordinate form of the divergence $\nabla = \left(\frac{\partial}{\partial x}\hat{x} + \frac{\partial}{\partial y}\hat{y} + \frac{\partial}{\partial z}\hat{z}\right)$

Compute $B(r) = -\frac{y}{x^2+y^2}\hat{X} + \frac{x}{x^2+y^2}\hat{Y} x^2 + y^2 > 0$ (6Mks)

(c) Find the gradient if $f = xy^2z^3$ (4Mks)