SOUTH EASTERN KENYA UNIVERSITY

UNIVERSITY EXAMINATIONS 2017/2018

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN METEOROLOGY

SMR 306: QUANTITATIVE METHODS AND COMPUTER APPLICATIONS IN METEOROLOGY III

DATE: 08TH DECEMBER, 2017 **TIME: 4.00 -6.00 PM**

INSTRUCTIONS TO CANDIDATES

Answer Question 1 and other two Questions

Question 1

(a) Define

(i) Gibbs phenomena. (**2 Marks**)

(iii) Orthonormal functions. (**2 Marks**)

(b) For any order *n*, the Legendre function is given by $P_n(x) = \frac{1}{2^n n!} \frac{d^n}{dx^n}(x^2 - 1)^n$,

find $P_3(x)$. (**6 Marks**)

(c) Show that $Sin^2\ mx = \frac{1}{2}[1 - Cos(2m)x]$ (**6 Marks**)

(d) Given a dataset in network common data form (netcdf) containing two variables: rainfall (ppt) and temperature (tmp), running from 1901 to 2010, write a comprehensive executable script in Grid Analysis and Display System (GrADS) that calculates and displays the climatology of the two variables on the same page for the period 1951-2000. (**14 Marks**)

Question 2

Show that;

a) When $m = n \neq 0, \int_0^{2\pi} \text{Cos } nx \, \text{Cos } nx \, \text{dx} = \pi$ **(8 Marks)**

b) The function $f_m(x) = \text{Sin } mx$, for $m = 1,2,3, ...n$ over the integral $-\pi < x < \pi$ form an orthogonal set given;

(i) $m \neq n$ **(6 Marks)**

(ii) $m = n$ **(6 Marks)**

Question 3

a) Differentiate between even and odd functions. **(4 Marks)**

b) Find the Fourier series representative of $f(x) = \begin{cases} -1, & for -\pi < x < 0 \\ 1, & for \quad 0 < x < \pi \end{cases}$ **(16 Marks)**

Question 4

Consider the equation $2\frac{\partial^2 u}{\partial x^2} + 3\frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 y}{\partial y^2} = 0.$ Determine;

(a) The conical form of the curve. **(4 Marks)**

(b) The general solution of the function. **(16 Marks)**

Question 5

(a) Define Laplace transform. **(2 Marks)**

(b) Find $\mathscr{L}\left(3 + 5x + ax^3\right)$. **(6 Marks)**

(c) Use the Laplace transformations to solve the initial value ordinary differential equation (ODE) $y'' = 4y + 3y = 0$ given that $y(0) = 3$ and $y'(0) = 1$. **(12 Marks)**