MERU UNIVERSITY COLLEGE OF SCIENCE & TECHNOLOGY

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University Examinations 2011/2012

FIRST YEAR, FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF MASTER OF SCIENCE IN APPLIED MATHEMATICS

SMA 3132: ANALYTICAL APPLIED MATHEMATICS

DATE: AUGUST 2011 **TIME: 3 HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions.*

QUESTION ONE – (30 MARKS)

(a) Determine the residue of $f(Z) = \frac{1}{1+\mathbb{Z}^4}$ at each of its poles in a finite $Z -$ plane. (8 Marks)

(b) Find in finite $\oint f(Z)dZ$ where c is the unit circle $|Z| = 1$ and
$f(Z) = \frac{Z^2+1}{(Z-2)(2Z+1)^2(2Z-1)}$ (6 Marks)

(c) Find g and g^{ii} corresponding to the metric

(i) $ds^2 = 5(dx^1)^2 + 3(dx^2)^2 + 4(dx^3)^2 - 6dx^1dx^2 + 4dx^2dx^3$

(ii) $ds^2 = \frac{dr^2}{1-{r^2}/{R^2}} + r(d\theta^2 + sin^2\theta d\emptyset^2)$ where R is a constant. (11 Marks)

(d) Use the Laplace transform method to solve
$y'' - 3y' + 2y = e^{-t}$, given
$y(0) = 1,\ y'(0) = 0$ (5 Marks)

QUESTION TWO – (20 MARKS)

(a) Evaluate the contour integral
$\oint \frac{dZ}{Z^3(Z^2+2Z+2)}$, where c is the circle $|Z| = 3$. (12 Marks)

(b) Evaluate $\int_{-\infty}^{\infty} \frac{dx}{(1+x^2)^3}$ (8 Marks)

QUESTION THREE – (20 MARKS)

(a) Evaluate using the Residue theorem,

$\int \frac{d\theta}{3+2\cos\theta}$ (5 Marks)

(b) A contravariant tensor has components a, b, c in rectangular coordinate system. Find the components in spherical coordinate system. (15 Marks)

QUESTION FOUR – (20 MARKS)

Use the complex form of the fourier transform to show that

$u(x,t) = \frac{1}{2\sqrt{\pi k t}} \int_{-\infty}^{\infty} f(\xi) e^{-(x-\xi)^2/4kt}\, d\xi$ is a solution of the boundary value problem below, governing the heat conduction in a very long metal bar which extends from $-\infty$ to ∞

$u_{t=KU_{xx}}, \quad u(x,0)=f(x), -\infty<x<\infty$

(20 Marks)