M.Sc. 4th Semester Examination, 2012

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER – MTM- 402

(*Differential Geometry/Magneto hydrodynamics*)

Full Marks : 50

Time : 2 hours

The figures in the right hand margin indicate marks

GROUP – A

(*Differential Geometry*)

[*Marks* : 25]

Answer **Q.No.1** and any *three* from the rest

1. (*a*) Define the word "Geodesic for a curve C". 2

(*b*) What is the difference between contravarient and co-varient tensor ? Give examples. 3

2. Find the principal curvature of the surface S defined by :

$$x^1 = u^1 \cos u^2, \quad x^2 = u^1 \sin u^2,$$
$$x^3 = a \log\left(u^1 + \sqrt{(u^1)^2 - a^2}\right)$$

and prove that it is minimal surface. 5

3. Deduce the Serret-Frenet formula for a space curve S. 5

4. Calculate the geodesic curvature of the circle C :

$u^1 = \text{constant} = u_0^1 \neq 0$
$u^1 = u^2$

on the surface of the sphere. 5

5. Deduce the equation of lines of curvature from the equation of principal curvature of a surface S. 5

6. Prove that a geodesic is an auto parallel curve. 5

[*Internal Assessment* – 5 Marks]

GROUP – B

(*Magneto hydrodynamics*)

[*Marks* : 25]

1. Answer any *two* questions :

(*a*) Write down the basic equation of magneto hydrodynamics and hence deduce the magnetic induction equation in MHD flows. Explain the significance of high and low magnetic Reynolds number. 10

(*b*) A viscous incompressible finitely conducting fluid flows steadily under a uniform pressure gradient in a channel formed by two infinite parallel plates which are non-conducting. If a uniform magnetic field acts perpendicular to the channel walls, find the velocity and the magnetic field. 10

(*c*) A viscous incompressible fluid of uniform density is confined between the horizontal

non-conducting planes $z = 0$ (lower) and $z = h$ (upper). The lower plane is held at rest and the upper one is moved horizontally in its own plane with uniform velocity U_0. A uniform magnetic field H_0 acts perpendicular to the planes. Find the velocity and the magnetic field between the planes. 10

[*Internal Assessment* – 5 Marks]