M.Sc 4th Semester Examination, 2011

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER—MA-2202

Full Marks : 50

Time : 2 hours

The figures in the right-hand margin indicate marks

GROUP – A

(*Differential Geometry*)

[*Marks* : 25]

Answer any *two* questions :　　　　　　10 × 2

1. (a) Write down the Serret-Frenet formulii for a
   space curve and hence show that　　　　3 + 3

   $$x = \left(g_{mn} \; \frac{\delta \lambda^m}{\delta s} \frac{\delta \lambda^n}{\delta s} \right)^{1/2}$$

(b) Find first fundamental form on the surface

$$x^1 = u^1, \ x^2 = u^2, \ x^3 = f(u^1, u^2)$$ 2

(c) Define the metric tensor. 2

2. (a) Find the equation of Geodesic of a curve $c : u^\beta = u^\beta(t)$. 8

(b) Define total curvature of a surface S. 2

3. (a) Find out the 2nd fundamental form on a surface in E_3. 6

(b) Find the equation for the principal curvature on the surface given by 2

$$r = (u\cos v, \ u\sin v, \ cv).$$

(c) Define the word 'umbilic point'. 2

[*Internal Assessment* : 5 Marks]

GROUP – B

(*Magnetohydrodynamics*)

[*Marks* : 25]

Answer any *two* questions 10×2

1. Show that the magnetic flux linking any loop moving with a perfectly conducting fluid is constant.   10

2. (*a*) State and prove Alfvén's theorem. Write one consequence of Alfvén's theorem.   5

   (*b*) Give the definitions of three dimensionless numbers (*i*) Hartmann number, (*ii*) Magnetic Reynolds number, (*iii*) Alfvén number.   5

3. (*a*) Physically interpret the expression for Lorentz force per unit volume (simplified form). Hence indicate the existence of transverse Alfvén waves.   5

   (*b*) State and prove Ferraro's law of isorotation.   5

[*Internal Assessment* : 5 Marks]