INDIAN INSTITUTE OF TECHNOLOGY

Date: FN/AN Time *3* Hrs. Full Marks *100* No. of Students *11 + 4 = 15*
End-Spring Semester *2009-2010* Department of *Geology & Geophysics* Sub. No. *EX52002*
2 Yr. M.Sc. *Geophysics* + 5 Yr. M.Sc. *Exploration Geophysics* Sub. Name *Tectonics & Geodynamics*
Instruction **Answer all questions.**

Q1. (a) Define "First Percolation Threshold" and explain the different melt extraction mechanisms between the First and Second Percolation Thresholds.
(b) Explain the basic principle of "magnetic susceptibility". How is Anisotropy of Magnetic Susceptibility (AMS) useful in identifying fabrics in granites?
(c) Giving sketches explain how gravity measurements are useful in the study of granites?
(20+5+5=30)

Q2. Magnetic measurements made on a basalt flow (presently at 47°N, 27°E) show an angle of inclination, of the remanent magnetization, of 30° and declination of 80°.
(a) Calculate the magnetic latitude of this site at the time the basalt was magnetized.
(b) Calculate the latitude and longitude of the palaeomagnetic pole.
(c)If the measurement of the angle of inclination of the lavas is in error by 5°, what is the subsequent error in the calculated palaeolatitude?
(2+5+3=10)

Q3. Assume that the earth's magnetic field is a dipole aligned along the geographic north-south axis.
(a) What is the angle of inclination at London, U.K. (51°N, 0°E)?
(b) What is the angle of inclination at Canberra, Australia (35°S, 149°E)?
(c) If the angle of inclination is 76°, where are you?
(d) If the angle of inclination is -36°, where are you?
(3+2+3+2=10)

Q4. What is absolute plate motion? Explain with an example. On what assumption is its measurement dependent? Illustrate the difference between hotspot track and flow-line.
(5+1+4=10)

Q5. (a) Explain why the conductive cooling of a lithospheric plate is essentially a two-dimensional problem. What assumptions / approximations are necessary to reduce this to a one-dimensional form?
(b) Show how the bathymetric depth (d, in kilometres) can be related to the rate of cooling of the oceanic lithosphere as given by the half-space cooling model. Hence find the bathymetric depth for oceanic lithosphere that is 20 million years old.(density of the asthenosphere, $\rho_a = 3.3 \times 10^{-3}$ kg m^{-3}; density of sea-water, $\rho_w = 1.0 \times 10^{-3}$ kg m^{-3}; co-efficient of thermal expansion, $\alpha = 3 \times 10^{-5}$ °C^{-1}; thermal diffusivity, $\kappa = 10^{-6}$ m^{2}s^{-1}; temperature of the asthenosphere = 1200 °C; bathymetric depth at the mid-oceanic ridge, $d_r = 2.5$ km).
(c) How would you calculate the total subsidence at the surface for lithosphere that has been instantaneously extended by a factor β? Consider both isostatic and thermal subsidence.
(5+10+5=20)

Q6. (a) What is a 'transform valley'? Why does it exist?
(b) How is a fracture zone different from a transcurrent fault?
(c) Why are subduction zones arcuate?
(d) Do mantle phase transitions aid or inhibit subduction?
(5x4=20)

Name of Paper setter
S. Gupta
M. A. Maruthi
S. Mitra

Signature of Paper-setter
Saibal Gupta