Syllabus

(GM Part – 1)

Algebra: Properties of real numbers. Geometry of complex variables,. DeMoiver's theorem. Algebra of matrices. Rank & inverse of a matrix. Determinants. Solution of linear equations. Orthogonal & unitiary matrices. Eigenvalues & eigenvectors of a matrix.

Calculus: Sequence & series. Taylor series. Limit & continuity. Derivatives. Integration of functions of one variable. Definite integrals. Functio ns of several variables. Partial derivatives. Maxima & minima. Ordinary linear differential equations. Elementary linear partial differential equations, Heat conduction equations.

Co-ordinate Geometry : Straight line, Conic sections, Elementary 3-D co-ordinate geometry.

(Test GM Part II-A)

Geomathematics and statistics: Paleo-Vector determinations, Analysis of time-series data, Mohr's Circle of stress and strain, Geological Strain Analysis, Rheology of materials, Heat flow within the Earth, Flow through porous media, Thermodynamic Principles, Stereographic Projection of geological data.

Elementary probability theory, Measures of central tendency, Dispersion, Binomial, Poisson, Normal distributions, Student's T test, ANOVA models, Snedecor's F test, Correlation & regression.

Sample Questions

NAME : ---------- TEST BOOKLET NO

CENTRE: ----------

On the test booklet and the answer booklet write your Name, Registration No., Test Code. Write the question booklet number on the answer booklet

ATTENTION

Read the following carefully before answering the test.

There are two parts

Part I 10 questions 30 marks (compulsory for candidates of both geology and physical chemistry streams)

Part II A 5 questions 70 marks (to be answered by geology stream candidates only)

Part II B 7 questions 70 marks (to be answered by physical chemistry stream candidatesonly)

ALL ROUGH WORK MUST BE DONE ON THE TEST BOOKLET AND/OR ANSWER BOOKLET. YOU ARE NOT ALLOWED TO USE CALCULATORS

Final answers to some of the problems may involve computing long arithmetic expressions. Candidates need not spend time in numerically simplifying these expressions.

STOP! WAIT FOR SIGNAL TO START

TEST CODE GM

Sample Questions
PART – I
Compulsory for candidates of geology

Select the right answer from the given alternatives for each of the following questions.

1. The equation of the circle whose diameter is the line segment joining the origin and the point $\left(a^3, \frac{1}{a^3}\right)$ is

   i) $a^3x^2 + \frac{y^2}{a^3} - x - y = 0$

   ii) $a^3x^2 + \frac{y^2}{a^3} + x - y = 0$

   iii) $x^2 + y^2 - a^3x - \frac{y}{a^3} = 0$

   iv) $x^2 + y^2 + a^3x - \frac{y}{a^3} = 0$

2. If $f(x) = \frac{1-x}{1+x}$, the value of $f\left(f\left(\frac{1}{x}\right)\right)$, $x \neq 0, -1, 1$ is

   i) $\frac{1}{x}$

   ii) $\frac{1}{1+x}$

   iii) $\frac{1}{1-x}$

   iv) $\frac{1}{1-x^2}$

3. The minimum value of $x^4 + 4x^3 + 8x^2 + 8$, where x is real , is

   i) 8

   ii) 3

   iii) 0

iv) 6

4. The value of $\lim_{x \to 0} \left(\cos x\right)^{\frac{1}{x}}$ is

i) 0

ii) 1

iii) 1

iv) 2

5. If $y = e^{\sin^{-1} x}$, then the value of

$$\left(1 - x^2\right)\frac{d^2y}{dx^2} - x\frac{dy}{dx} - y \text{ is}$$

i) 0

ii) 1

iii) –1

iv) 3

6. If $x_r = \cos\frac{\pi}{2^r} + i\sin\frac{\pi}{2^r}$, then $x_1 x_2$ …..to infinity is

i) 1

ii) i

iii) –1

iv) $-i$

7. $\int_{-2}^{2} \left|1 - x^2\right| dx$ is equal to

i) 2

ii) 3

iii) 4

iv) 5

8. The area of the region bounded by the curves $y^2 = 4ax$ and $x^2 = 4ay$ is

i) $\frac{8a^2}{3}$

ii) $\frac{16a^2}{3}$

iii) $\frac{32a^2}{3}$

iv) $\frac{64a^2}{3}$

9. The values of λ and μ for which the equations

$$x + y + z = 6$$
$$x + 2y + 3z = 10$$
$$x + 2y + \lambda z = \mu$$

have an infinite number of solutions are

i) $\lambda = 3$ and

ii) $\lambda = 3$ and $\mu \neq 10$

iii) $\lambda \neq 3$ and μ may have any value

iv) $\lambda = 6$ and $\mu = 5$

10. If $A = \begin{bmatrix} 1 & 1 & -1 \\ 2 & -3 & 4 \\ 3 & -2 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & -2 & -1 \\ 6 & 12 & 6 \\ 5 & 10 & 5 \end{bmatrix}$,
which of the following statements is true ?

i) AB = BA

ii) Rank(AB) = Rank(BA)

iii) Rank(AB) = 0 , Rank(BA) = 1

iv) Rank(BA) = 0 , Rank(AB) = 1

TEST CODE: GM

Sample Questions

PART – II A
To be answered by geology stream candidates

11. A ship started its journey from an island lying at 30° N latitude and 120° E latitude. It travelled west along the same latitude for 1 degree of longitude and then turned north and followed that longitude to a location at 31° N and 119° E. Find out how many kilometers that ship travelled considering a spherical Earth of radius R kilometers.

12. Superposition of two strain increments can be modeled using matrix algebra. A rectangular section of a rock body undergoes pure shear whereby width of the section is halved. This is followed by right handed shear strain of √3 parallel to length of the rectangular section. Construct strain matrices for the two increments of strain assuming X-coordinate axis parallel to the length of the rectangular section. Find the total strain matrix.

13. In stereographic projection, the polar co-ordinates of the pole to a plane is given by (r, θ) where $\theta = \alpha + \pi/2$; α is the azimuth of the strike of the plane; $r = R \tan \beta/2$; R is the radius of the projection circle and β is the dip of the plane.
    i) Find the locus of the poles to planes with $\pi/4 \leq \alpha \leq 3\pi/4$ and $\beta = \pi/2$.

ii) Show that rate of decrease in r in the interval $\pi/6 \leq \beta \leq \pi/3$ *is lesser than that in the interval* $\pi/3 \leq \beta \leq \pi/2$. [cos $\pi/12$ =0.06698*;* cos $\pi/8$ = 0.25*;* cos $\pi/6$ = 0.5]

14. The sample data on salinity measurements (in parts per thousand) from two different water bodies are given below:

Water body 1 : 46,37, 62, 59, 40

Water body 2 : 35, 49, 48, 39, 36

Assuming that the population variability in the salinity level of the two water bodies are approximately the same, compute an approximate statistic to test whether the mean salinity level of water body 1 is larger than the Water body 2 at 5% level of significance.

(t_8 (0.05)) = 1.86, (t_9 (0.05)) = 1.83, (t_{10} (0.05)) = 1.81)