

MATHEMATICS ENTRANCE EXAM
TOPICS

College of Engineering and College of SIS:

Students applying for the HCA entrance exam must acquire the full and detailed information about the following subjects:

I- Complex numbers:

- Modulus and argument of a complex number.
- Rectangular, Trigonometric and Exponential representation of a complex number.
- Adding, Subtraction, multiplication and division of complex numbers.
- Reduction of complex numbers.
- Solving quadratic equations with complex coefficients and roots.
- Graphical representation of a complex number.

II- Study of functions:

- Find the domain of definition of a certain function
- Continuity of a function over its domain
- Study the limits of a function
- Determine the asymptotes and asymptotic directions of a certain function
- Study the derivative of a function
- Draw the table of variation of a function
- Graphical representation
- Study the intersection of two functions analatically and graphicly.

III- Trigonometric Equations and Formulas

- Trigonometric circle
- Representation in polar coordinates
- Elementary trigonometric functions
- Inverse Trigonometric functions
- Fundamental trigonometric relations.(introduced later)
- Solution of elementary trigonometric equations

IV- Geometry:

- Equation of circle, and sphere .
- Notation of vectors and coordinate system in space
- Calculations of vectors(Dot, cross and mixed product, addition and subtraction)
- Implementing equations of plane and straight line in three dimensional systems
- Relative position of planes and straight lines
- Calculating distance from a point to both a plane and a straight line, between planes and straight lines

V-Derivatives, Integrals and Differential equations:

- Derivative of function at a point
- Operations on derivatives
- Solving first order and linear second order differential equations
- Finding the general solution of special differential equations
- Finding a particular solution for differential equations
- Differentiation and definite integrals
- Special integration methods(separation of variables, rational functions,.....)
- Finding the area and volume bounded using definite integration.

VI-Statistics:

- Calculating the mode, mean, range, variance and standard deviation of statistical data.
- Grouping data in classes and continuous variables.
- Applying median, median class, mode, modal class, variance and standard deviation to continuous variables
- Graphical representation and determination of median of statistical distribution.
- Frequency, cumulative frequency and relative frequency.

VII-Probability:

- Combinations
- Permutations with and without repetition
- Events and operations on events
- Equiprobable spaces
- Conditional probability and independent events
- Rules of total probability
- Discrete random variables and their probability distribution
- Distribution functions and calculation of mean, variance and standard deviation.

VIII-Sets:

- Equality and writing of a set
- Different kinds of sets
- Subsets of a set
- Operations on sets

IX-Sequences:

- Arithmetic and geometric sequences
- Determining the sum and the general term of a sequence
- Studying the sense of variation of a sequence
- Studying the convergence of a sequence
- Finding the limit of a sequence.

MATHEMATICAL FORMULAS

Trigonometric formulas:

$$\cos 2a = \cos^2 a - \sin^2 a = 2 \cos^2 a - 1$$

$$\sin 2a = 2 \sin a \cos a$$

$$\tan 2a = \frac{2 \tan a}{1 - \tan^2 a}$$

$$\sin(\alpha \pm \beta) = \sin \alpha \cos \beta \pm \cos \alpha \sin \beta$$

$$\tan(\alpha \pm \beta) = \frac{\tan \alpha \pm \tan \beta}{1 \mp \tan \alpha \tan \beta}$$

$$\sin \frac{\theta}{2} = \pm \sqrt{\frac{1 - \cos \theta}{2}}$$

$$\cos a + \cos b = 2 \cos \frac{a+b}{2} \cdot \cos \frac{a-b}{2}$$

$$\cos a - \cos b = -2 \sin \frac{a+b}{2} \cdot \sin \frac{a-b}{2}$$

$$\sin a + \sin b = 2 \sin \frac{a+b}{2} \cdot \cos \frac{a-b}{2}$$

$$\sin a - \sin b = 2 \cos \frac{a+b}{2} \cdot \sin \frac{a-b}{2}$$

$$\cos a \cdot \cos b = \frac{1}{2} [\cos(a+b) + \cos(a-b)]$$

$$\sin a \cdot \sin b = \frac{1}{2} [\cos(a-b) - \cos(a+b)]$$

$$\sin a \cdot \cos b = \frac{1}{2} [\sin(a+b) + \sin(a-b)]$$

$$\cos a = \cos^2 \frac{a}{2} - \sin^2 \frac{a}{2}$$

$$\sin a = 2 \sin \frac{a}{2} \cdot \cos \frac{a}{2}$$

$$\tan a = \frac{2 \tan \frac{a}{2}}{1 - \tan^2 \frac{a}{2}}$$

$$\cos(\alpha \pm \beta) = \cos \alpha \cos \beta \mp \sin \alpha \sin \beta$$

$$\tan \frac{\theta}{2} = \pm \sqrt{\frac{1 - \cos \theta}{1 + \cos \theta}}$$

$$\cos \frac{\theta}{2} = \pm \sqrt{\frac{1 + \cos \theta}{2}}$$

$$\cos^2 a = \frac{1 + \cos 2a}{2}$$

$$\sin^2 a = \frac{1 - \cos 2a}{2}$$

$$\tan^2 a = \frac{1 - \cos 2a}{1 + \cos 2a}$$

$$\cos 12a = 1 + \cos 2a$$

ab22

$$\frac{\sin \alpha}{a} = \frac{\sin \beta}{b} = \frac{\sin \gamma}{c}$$

SERIES:

$$(a+b)^n = C_m^0 a^m b^0 + C_m^1 a^{m-1} b^1 + \dots + C_m^m a^0 b^m$$

$$n(n+1)/2 = 1 + 2 + 3 + \dots + n$$

$$n(n+1)(2n+1)/6 = 1^2 + 2^2 + \dots$$

$$(n(n+1)/2)^2 = 1^3 + 2^3 + 3^3 + \dots$$

$$\cos x = 1 - x^2/2! + x^4/4! - x^6/6! + \dots$$

$$\sin x = x - x^3/3! + x^5/5! - x^7/7! + \dots$$

$$e^x = 1 + x/1! + x^2/2! + x^3/3! + \dots$$

$$\tan x = x + x^3/3 + 2x^5/15 + \dots$$

SETS:

$$P(E \cup F) = P(E) + P(F) - P(E \cap F)$$

$$P(E^C \cup F^C) = (E \cap F)^C$$

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

$$P(A) = \sum_{\text{all } i} P(A|B_i) \cdot P(B_i)$$

$$P(B_k | A) = \frac{P(A|B_k) \cdot P(B_k)}{\sum_{\text{all } i} P(A|B_i) \cdot P(B_i)}$$

$$P(E^C) = 1 - P(E)$$

$$E^C \cap F^C = (E \cup F)^C$$

$$F = P \cdot \left(1 + \frac{r}{n}\right)^{nt}$$

$$F = P \cdot e^{rt}$$

$$y = \left(1 + \frac{r}{n}\right)^n - 1$$

$$y = e^r - 1$$

$$E(X) = \sum_{\text{all } x} x \cdot P(X = x)$$

$$f_x(x) = \begin{cases} 0 & \text{if } x \leq 0 \\ 1/u & \text{if } 0 < x < u \\ 0 & \text{if } u \leq x \end{cases}$$

$$F_x(x) = \begin{cases} 0 & \text{if } x \leq 0 \\ x/u & \text{if } 0 < x < u \\ 1 & \text{if } u \leq x \end{cases}$$