Visvesvaraya National Institute of Technology, Nagpur
Department of Mathematics
I Semester B.Tech. First Sessional Examinations
Mathematics (MAL 101)

Max Marks: 15 Date:8 – 9 – 2014
Duration: 1 hour(9.00 AM – 10.00 AM)
Note: Answer any FIVE questions. All questions carry equal marks.
Calculators are not permitted.

1. Show that the function f defined by $f(x) = x - [x]$ where $[x]$ denotes the integral part of x is discontinuous for all integral values of x and continuous for all others.
2. A twice differentiable function $f(x)$ defined on $[a, b]$, such that $f(a) = f(b) = 0$, $f(c) > 0$ for all $a < c < b$, prove that there exist at least one value ϵ in (a, b) such that $f''(\epsilon) < 0$.
3. Using Taylor's theorem prove that $1 - \frac{x^2}{2} \leq \cos x \leq 1 - \frac{x^2}{2} + \frac{x^4}{24}$, for any x.
4. Evaluate $\underset{x\to 0}{Lim} \left(\frac{\sin x}{x}\right)^{\frac{1}{x^2}}$.
5. Determine the radius of curvature of the curve $r^n = a^n \sin n\theta$ at any point (r, θ).
6. Trace the curve $y^2(a - x) = x^3$.

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