# MULUNGUSHI UNIVERSITY

## SCHOOL OF NATURAL AND APPLIED SCIENCES

### DEPARTMENT OF MATHEMATICS AND STATISTICS

**EGM 211 - ENGINEERING MATHEMATICS I**

**Assignment 1**          **DUE DATE:** 7$^{th}$ November, 2024          **DUE TIME:** 11 : 00 AM

**Q 1.** For a hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ centered at $(0,0)$, show that at some point $(x_a, y_a)$, the equation of tangent line is $\frac{xx_a}{a^2} - \frac{yy_a}{b^2} = 1$.

**Q 2.**   (i) Evaluate

$$\lim_{x \to 0} \frac{\arctan 2x}{\arctan 3x} - \lim_{x \to \infty} \frac{\arctan 2x}{\arctan 3x} + \lim_{x \to 0}\left(\frac{1}{x} - \frac{1}{e^x - 1}\right) + \lim_{x \to 1^-} (x-1)^{\ln x}$$

(ii) Consider a long thin rod with heat diffusivity $k$ and coinciding with the $x$-axis. Suppose that at time $t = 0$ the temperature at $x$ is $A/2\varepsilon$ if $-\varepsilon \leqq x \leqq \varepsilon$ and is zero if $|x| > \varepsilon$. Then it turns out that the temperature $T(x, t)$ of the rod at the point $x$ at time $t > 0$ is given by

$$T(x, t) = \frac{A}{\varepsilon \sqrt{4\pi kt}} \int_0^\varepsilon \exp\left(-\frac{(x-u)^2}{4kt}\right) du.$$

Use L'Hôpital's rule to show that the temperature resulting from an initial "hot spot" at the origin is

$$\lim_{\varepsilon \to 0} T(x, t) = \frac{A}{\sqrt{4\pi kt}} \exp\left(-\frac{x^2}{4kt}\right).$$

(iii) Explain why

$$\lim_{x \to 0^+} (\ln x)^{1/x} \neq 0$$

(iv) Let $\alpha$ be a fixed real number.

(a) Evaluate (in terms of $\alpha$) the $0^0$ indeterminate form

$$\lim_{x \to 0}\left[\exp\left(-\frac{1}{x^2}\right)\right]^{\alpha x^2}$$

(Note that l'Hpital's rule is not needed.) Thus the indeterminate form $0^0$ may have as its limit any positive real number. Explain why.

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**Shasha Hu**

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*Advances in Mechanical Engineering, Materials and Mechanics II* Riadh Elleuch,Basma Ben Difallah,Ridha Mnif,Mouna Baklouti,Abdessattar Abdelkefi,Mohamed Kharrat,2025-05-12 This book reports on cutting edge research in the broad fields of mechanical engineering and mechanics It describes innovative applications and research findings in design and manufacturing applied and fluid mechanics dynamics and control thermal science and materials It also highlights several relevant advances in industrial applications All papers were carefully selected from contributions presented at the International Conference on Advances in Mechanical Engineering and Mechanics ICAMEM 2024 held on June 28 30 2024 in Sousse Tunisia and organized by the Laboratory of Electromechanical Systems LASEM at the National School of Engineers of Sfax ENIS and the Tunisian Scientific Society TSS in collaboration with a great number of national and international research institutions and laboratories    **Compressed Air** ,1927    **Parliamentary Debates (Hansard).** Great Britain. Parliament. House of Commons,2013    **Annual Index/abstracts of SAE Technical Papers** ,2006    **Compressed Air Magazine** ,1927    **HTFS Digest** ,1985    **English Mechanic and World of Science** ,1906    **White Paper on Science and Technology** ,2015    **English Mechanic and Mirror of Science and Art** ,1905    *Corrosion Abstracts* ,1965    **English Mechanic and Mirror of Science** ,1906    *Nuts & Volts* ,2005    **The Parliamentary Debates (Hansard).** Great Britain. Parliament. House of Lords,2008    [CERN Courier](#) ,2014    [The Boston Globe Index](#) ,1989

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