中央警察大學 112 學年度碩士班入學考試試題

所　別：消防科學研究所
科　目：火災科學

作答注意事項：

1.本試題共 4 題，每題各占 25 分；共 2 頁。
2.不用抄題，可不按題目次序作答，但應書寫題號。
3.禁用鉛筆作答，違者不予計分。
4.不需使用計算機，可用中文答題。

一、Find the eigenvalues and eigenfunctions.

（一）$y''+\lambda y=0,\ y(0)=0,\ y(10)=0$　（12 分）

（二）$(y'/x)'+(\lambda+1)y/x^3=0,\ y(1)=0,\ y(e^{\pi})=0$　（13 分）

二、A sinusoidal voltage $Esin\omega t$, where t is time, is passed through a half-wave rectifier that clips the negative portion of the wave. Find the Fourier series of the resulting period function.

$$u(t)=\begin{cases}0 & if \quad -L<t<0\\ Esin\omega t & if \quad 0<t<L\end{cases} \quad p=2L=\frac{2\pi}{\omega}.$$

三、請以史帝芬－波茲曼（Stefan-Boltzmann）公式，說明幅射熱熱傳特性(10 分)，並針對設備測試、系統功能及性能設計方面，提出 3 種在防火工程（Fire Safety Engineering）上的運用情境（15 分）。

四、請針對以下火羽在溫度層化環境下（Plumes in Temperature - Stratified Ambients）的描述，解讀附圖的物理現象。

原文：When a buoyant, turbulent plume rises, it cools by entrainment of ambient air. If the ambient air increases in temperature with height, which is normal in buildings, and the fire source is weak, the temperature difference between the plume and the ambient, which gives the plume buoyancy, may vanish and actually reverse in sign. Eventually the plume ceases to rise.

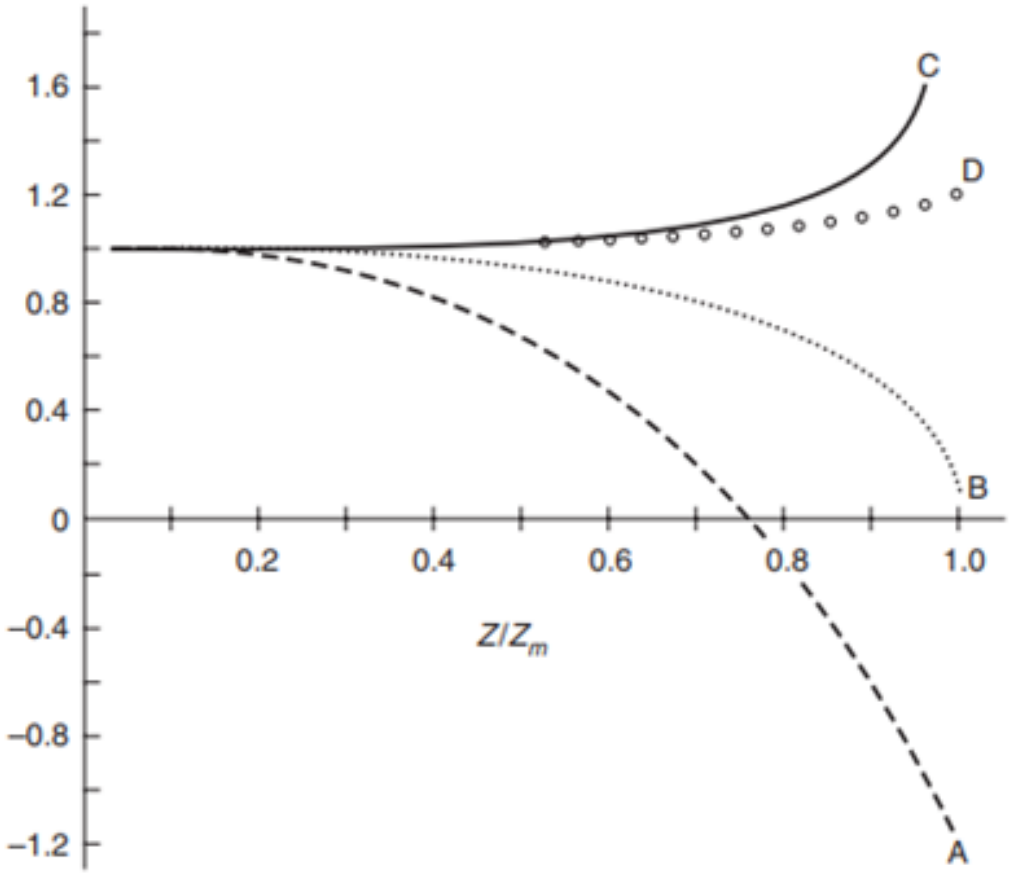

Figure: Theoretical behavior of centerline plume variables in linearly temperature-stratified ambients. Curve A: ratio of temperature rises (stratified versus unstratified), Curve B: ratio of axial velocities. Curve C: ratio of plume radii. Curve D: ratio of volumetric species concentrations. Where z: height above top of combustible (m) and Zm: maximum vertical penetration of plume fluid in stratified ambient (m)