

國立中山大學 112 學年度 碩士班暨碩士在職專班招生考試試題

科目名稱：離散數學【資工系碩士班甲組】

—作答注意事項—

考試時間：100 分鐘

- 考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答(不得另攜帶紙張，亦不得使用應考證空白處作為計算紙使用)。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

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題號：434004

※本科目依簡章規定「不可以」使用計算機(問答申論題)

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*There are 8 problems in this test. Note that you should write down **detailed steps** for the solution to each problem; otherwise, no credits for that problem will be given.*

1. [10%] What is the coefficient of $ab^6c^8d^5$ in the expansion of $(3a - b + 5c + 3d - 8)^{25}$?
2. [10%] Prove that for any $n \in \mathbb{Z}^+$, $12n+17$ and $8n+11$ are co-prime.
3. [10%] There are 25 warehouses in a company for storing the products and the space of each warehouse is different. Assume that no two warehouses have the same size. How many warehouses at least can be used to consist of a sequence of consecutive logistics collection points, where a previous collection point need to have a larger space than the next one?
4. [10%] Let $\Sigma = \{t, v, w, x, y, z\}$ and $A = \bigcup_{n=1}^{11} \Sigma^n$. How many strings in A have xyz as a proper prefix?
5. [10%] Find a formula for the convolution of the following sequences,
 $a_n = (-1)^n, b_n = (-1)^n, c_n = 1^n$, for all $n \in \mathbb{N}$.
6. A ship carries 60 flags, 15 each of the colors red, white, blue, and black. Fifteen of these flags are placed on a vertical pole in order to communicate a signal to other ships.
 - (a) [10%] How many of these signals use an odd number of black flags and an even number of red flags?
 - (b) [10%] How many of the signals have at least five white flags or no blue flags at all?
7.
 - (a) [10%] Find and solve a recurrence relation for the number of ways to park motorcycles and cars in a row of n spaces if each cycle requires one space and each car needs three.
 - (b) [10%] Find and solve a recurrence relation for the number of ways to park motorcycles and cars in a row of n spaces if each cycle requires one space, each car needs three, and the cars come in four different colors.
8. [10%] For $a, b, n \in \mathbb{Z}^+$ and $n > 1$, prove that $a \equiv b \pmod{n} \Rightarrow \gcd(a, n) = \gcd(b, n)$.