國立中山大學113學年度
碩士班暨碩士在職專班招生考試試題

科目名稱：離散數學與演算法【資工系資安碩班碩士班】

—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。
- 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，唯不得攜帶書籍、紙張（應考證不得做計算紙書寫）、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。
- 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。

國立中山大學113學年度碩士班暨碩士在職專班招生考試試題

科目名稱：離散數學與演算法【資工系資安碩班碩士班】　　題號：485001

※本科目依簡章規定「不可以」使用計算機(問答申論題)　　

There are 9 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%] In how many ways can Richard assign 22 students in four classrooms so that there are at least three students in a classroom? (a student assigned different seats is considered as different cases in a classroom)

2. [10%] How many positive integers up to 188,071 that are relatively prime to 188,071?

3. (a) [10%] In how many ways can Peter select n candies from a large supply of four different kinds of candies (all of the same size) if the selection must include an even number of one specific type of candies?
   (b) [10%] In how many ways can Peter select n candies from a large supply of three different kinds of candies (all of the same size) if the selection must include odd numbers of two specific types of candies?

4. (10%) Find the generating function for the sequence 1, 2, 3, 4, 5, 5, 5, ….

5. A ship carries 60 food cans, 15 of each the chicken, beef, pork, and fish. Fifteen of these cans are placed to a lifeboat in order to supply foods for the rescue event.
   (a) [5%] How many possible choices that contains an even number of beef cans and an odd number of chicken cans?
   (b) [5%] How many possible choices that contains at least three pork cans or no pork cans at all?

6. [10%] An alphabet Σ consists of the five numeric characters 1, 2, 3, 4, 5, and the six alphabetic characters a, b, c, d, e, f. Find and solve a recurrence relation for the number of words of length n (in Σ^*), where there is no consecutive (identical or distinct) alphabetic characters.

7. (Algorithm points) [10%] Please express the algorithm of Quick Sort and analyze its time complexity in detail.

8. (Algorithm points) [10%] Please express the algorithm of Huffman coding and analyze its time complexity in detail.

9. (Algorithm points) [10%] Let T be a complete n-ary tree of height h with m leaves. Prove that $m \leq n^h$ and $h \geq \lceil \log_n m \rceil$.