國立中山大學114學年度
碩士班考試入學招生考試試題

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。
- 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。**

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※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%] What is the value of *sum* after the following program segment is executed. (Here *i, j, k, increment,* and *sum* are integer variables.)

```
increment = 0
sum = 0
for i = 1 to 12 do
   for j = 1 to i do
      for k = 1 to j do
      begin
         increment = increment + 1
         sum = sum + increment
      end
```

2. [10%] Please prove the principle of mathematical induction by the well-ordering principle.

3. Let A= {1,2,3,4,5,6,7,8,9} and B={a,b,c,d,e,f,g,h}. Determine the number of functions f: A→B, where
   (a) [5%] f(A)={a,b,c}
   (b) [5%] |f(A)|=3

4. [10%] Find a sequence of ten distinct real numbers with no decreasing or increasing subsequence of length 3.

5. [10%] Construct a state diagram for a finite state machine with I = O = {0,1} that recognizes all strings in the language $\{0,0\}^*\{1,0\}\cup\{0,1\}^*\{00\}$.

6. (a) [10%] Find and solve a recurrence relation for the number of ways to perform two programs P1 and P2 sequently for n seconds if each process of P1 requires one second and P2 needs four seconds.

   (b) [10%] Find and solve a recurrence relation for the number of ways to perform two programs P1 and P2 for n seconds if each process of P1 requires one second and P2 needs four seconds, where the process of P2 for four different tasks and each P2 process with a different task is considered as a different process.

7. [10%] In how many ways, can Alice buy n boxes of meat from a supermarket that sells pork, chicken, and beef (each kind of meat is of the same brand and size) if the selection must an even number of beef boxes (beef can buy one and get one free)?

8. [10%] If a 28-digital octal (0,1,2,3,4,5,6,7) sequence is randomly generated, what is the probability that it has an even number of 3's and even number of 7's?

9. [10%] Solve the following recurrence relation. $a_{n+2}^2 - 7a_{n+1}^2 + 12a_n^2 = 9n, n \geq 0, a_0 = a_1 = 1.$