PAPER CODE	EXAMINER	DEPARTMENT	TEL
INT102	Wenjin Lu	Intelligent Science	1505

2nd SEMESTER 2021/22 EXAMINATIONS (Final Open Book)

BACHELOR DEGREE – Year 2

ALGORITHMIC FOUNDATIONS AND PROBLEM SOLVING

TIME ALLOWED: 2 Hours

INSTRUCTIONS TO CANDIDATES

READ THE FOLLOWING CAREFULLY:

1. The paper consists of Part A and Part B. Answer all questions in both parts. Total marks available are 100. Marks for this examination account for 80% of the total credit for INT102.
2. In Part A, each of the questions comprises 5 statements, for which you should select the one most appropriate answer.
3. Answers to questions in Part B should be written in the answer script.
4. This is an OPEN BOOK examination. You can reference textbooks and notes but discuss with other students in any way is not allowed.
5. The time of the exam is strictly limited to 2 hours.
6. At the end of the online examination, be absolutely sure to submit your answer via Learning Mall. The time for submission of your answer via Learning Mall is strictly limited to 15 minutes. Once the time is over, the submission link will be closed.
7. All answers must be in English.

PART B (40 marks)

Question 1(27 marks)
Consider the following problem. Given an array A consisting of n distinct integers A[1], … A[n]. It is known that there is a position p (1≤ p ≤n), such that A[1], .., A[p] is in increasing order and A[p], A[p+1], …, A[n] is in decreasing order.

1. Write a brute force algorithm to find the position p. What is the time complexity of your algorithm? **5**

2. Devise a "divide and conquer" algorithm to find the position p. **8**

3. Set up a recurrence relation for the number of comparisons made by your algorithm and explain it. **7**

4. Based on the recurrence relation, show the complexity of your algorithm in big-O notation and prove it using either the iterative method or the substitution method, i.e., Mathematical Induction (for simplicity, you can assume that $n = 2^k$). **7**

Question II (13 marks)

1. Briefly describe the idea of the polynomial time reduction. Explain how to use it to prove a problem is NP-complete. **5**

2. 4-SAT Problem: for a Boolean formula in CNF in which each clause has exactly 4 literals, determine if there is an assignment of Boolean value to its variables so that the formula evaluates to true? (i.e., the formula is satisfiable). Prove 4-SAT Problem is NP-Complete. **8**

END OF THE PAPER