THIS PAPER MUST NOT BE REMOVED FROM THE EXAMINATION ROOM

STUDENT NAME:
STUDENT NUMBER:

Internal Students Only

THE UNIVERSITY OF QUEENSLAND

School of Information Technology & Electrical Engineering

Second Class Test, October 2011

ENGG7302

ADVANCED COMPUTATIONAL TECHNIQUES IN ENGINEERING

(M.E.)

CLOSED BOOK

TIME: **FORTY** minutes for working

FIVE minutes for perusal before examination begins

ANSWER ALL QUESTIONS ON SHEET PROVIDED

QUESTIONS CARRY THE NUMBER OF MARKS INDICATED

EAIT approved and labelled calculators only.

ENGG7302 ADVANCED COMPUTATIONAL TECHNIQUES IN ENGINEERING
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Part A. (1 mark each)

1. In multiple objective optimisation, solution s_1 is incomparable with s_2 if:

(a) s_1 is worse than s_2 in some objectives and better in others.

(b) s_1 is better than s_2 in all objectives.

(c) s_1 is worse than s_2 in all objectives.

(d) s_1 is not worse than s_2 in all objectives and better than s_2 in at least one objective.

2. Which of the following **is not** a feature of the Max-Min Ant Systems Algorithm:

(a) Imposing a maximum and minimum bound on the pheromone values.

(b) Use of local search to improve the iteration best solution.

(c) The solution construction rule is modified to only select from the top 3 ranked solution components.

(d) Only one solution is used to update the pheromone per iteration.

3. Which of the following **is not** an accepted way to compare algorithm performance as discussed in lectures:

(a) Reliability

(b) Repeatability

(c) Ruggedness

(d) Robustness

4. The *A Posteriori* method for solving multiple objective optimisation problems consists of:

(a) Determining a mixing function ahead of time so that the problem reduces to a single objective optimisation problem, then solving as a single objective optimisation problem.

(b) Treating all objective function independently to generate a Pareto set and selecting a solution from this set at the end.

(c) Using a mixing function to reduce the problem to a single objective optimisation problem, but allowing the objective functions to be mixed differently differently during the optimisation process.

(d) None of the above.

5. Which of the following **is not** a major Evolutionary Computation algorithm:

(a) Genetic Algorithm
(b) Genetic Strategies
(c) Genetic Programming
(d) Evolutionary Strategies

6. Which of the following is the most legitimate reason to use a global optimisation technique:

(a) The search space is finite.
(b) The objective function is known.
(c) You can only evaluate the objective function 100 times.
(d) The objective function is non-differentiable.

7. If $f(\mathbf{x}) = 3x_1^2 + 2x_2^2 - 12x_1 + 16x_2$ and $\mathbf{x_0} = [1\ \ 1]^T$ then

(a) $\nabla f(\mathbf{x_0}) = [-9\ \ 18]^T$
(b) $\nabla f(\mathbf{x_0}) = [9\ \ 9]^T$
(c) $H_f(\mathbf{x_0}) = \begin{pmatrix} 1 & 6 \\ 4 & 1 \end{pmatrix}$
(d) $H_f(\mathbf{x_0}) = \begin{pmatrix} 6 & 0 \\ 0 & 4 \end{pmatrix}$

8. Given a one-dimensional minimisation problem where f is unimodal on $[0, 100]$. Golden section search identifies a subinterval containing the minimum using the value $\tau = (\sqrt{5} - 1)/2$. After 5 iterations, the length of this interval will be:

(a) Dependant on the functional form of f
(b) Greater than 1.43 but less than 2.09
(c) 5.57
(d) 9.01

Part B. (3 marks each)

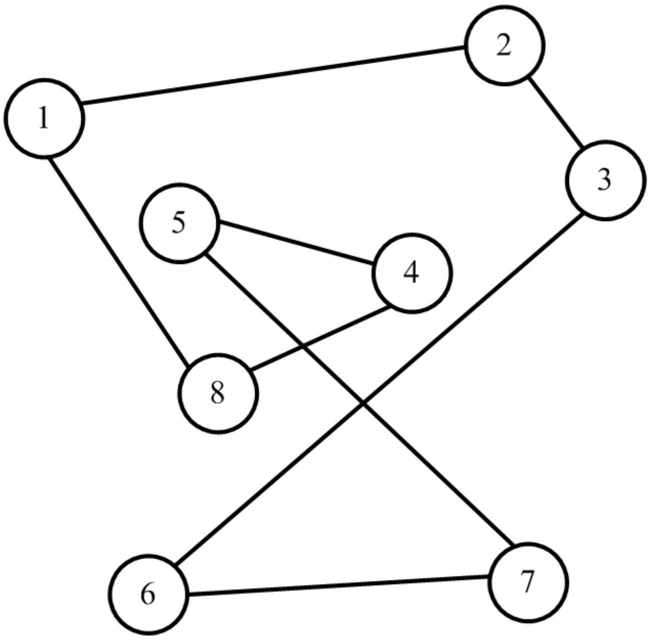

Figure 1: Travelling Salesman Problem

9. A 2-opt procedure is applied to the Travelling Salesman Problem in Figure. 1. The edges that are selected to be modified by the 2-opt routine are those that connect city 3 with city 6, and city 5 with city 7. What is the resultant tour after the application of the 2-opt routine:

(a) 1,2,3,7,6,5,4,8

(b) 1,2,3,6,7,5,4,8

(c) 1,2,3,7,6,4,5,8

(d) 1,2,3,6,7,4,5,8

10. Given the following two solutions to a Travelling Salesman Problem: $[1, 2, 4, 8, 5, 3, 6, 7]$ and $[4, 3, 2, 1, 6, 8, 5, 7]$. What are the resultant child individuals after performing a 1-point order permuting crossover between genes 3 and 4:

(a) $[1, 2, 4, 8, 5, 3, 6, 7]$ and $[4, 3, 2, 1, 6, 8, 5, 7]$

(b) $[1, 2, 4, 8, 3, 6, 5, 7]$ and $[4, 3, 2, 1, 8, 5, 6, 7]$

(c) $[1, 2, 4, 1, 6, 8, 5, 7]$ and $[4, 3, 2, 8, 5, 3, 6, 7]$

(d) $[1, 2, 4, 3, 6, 8, 5, 7]$ and $[4, 3, 2, 1, 8, 5, 6, 7]$

11. If a Simulated Annealing algorithm's current Solution (S) has Quality (S) $= 0.9$, and it produces a new solution (R) with slightly less quality (Quality (S) $= 0.8$), and the temperature $T = 2$, what is the probability that the new solution R will replace the current solution S:

(a) 100%

(b) 99%

(c) 95%

(d) 0%

12. Steepest descent tends to converge towards a local minimum given a suitable value for the step-size parameter α. However, assume α is set to a constant (non-negative) value, if $f(x) = x^2$ and $x_0 = 1$, then the algorithm will fail to converge when:

(a) $\alpha \geq 0.5$

(b) $\alpha \geq 1$

(c) $0 \leq \alpha \leq 2$

(d) $0 \leq \alpha \leq 1$

 END