This assignment covers Modules 1–4. It is due on Thu, Feb 28, 2002.

Problem 1 (8 marks) Consider the following *graph colouring problem*: Given a graph $G = (V, E)$ with vertex set V and edge relation E, assign colours $c_1, c_2, \ldots, c_k$ to the vertices such that two vertices which are connected by an edge in E are never assigned the same colour.

(a) Show how this problem fits the definition of a combinatorial problem and state the different decision and optimisation variants as defined in Chapter 1, Section 1.

(b) Find and briefly summarise 2–3 references from the literature regarding the complexity of this problem.

Problem 2 (7 marks) Consider the following, alternative definition of a stochastic local search algorithm.

> Given a combinatorial problem Π, a stochastic local search algorithm for solving an arbitrary problem instance $\pi \in \Pi$ is defined by the following components:
>
> - a (directed) *search graph* $G(\pi) = (V, E)$, where the elements V are the candidate solutions of π and the arcs in E connect any candidate solution to those candidate solutions which can be reached in one search step;
> - an *evaluation function* f_π which assigns a numerical value $f_\pi(s)$ to each candidate solution s and whose global maxima correspond to the (optimal) solutions of π;
> - an *initialisation procedure* $init(\pi)$, which determines a candidate solution at which the search process is started;
> - a *iteration procedure* $iter(\pi)$, which for any candidate solution s selects a candidate solutions s' such that $(s, s') \in E$;
> - a *termination function* $terminate(\pi)$ which for a given candidate solution determines whether the search is to be terminated (this function can make use of a random number generator and a limited amount of memory on earlier events in the search process).

Is this definition equivalent to the one given in Chapter 1, Section 5, *i.e.*, does it cover the same class of algorithms? Briefly discuss the differences between the definitions and try to decide which one is better.

Problem 3 (5 marks) Which role do 2-exchange steps play in the Lin-Kernighan procedure for the TSP?

Problem 4 (5 marks) Discuss similarities and differences between Ant Colony Optimisation and Genetic Local Search.