

## 2002 Paper 8 Question 14

### Computer Systems Modelling

Consider an  $M/G/1$  queue.

- (a) What is the condition for the non-saturation of the server? [2 marks]
- (b) State the *Pollaczek–Khintchine* formula for the steady-state average number of customers in the system. [4 marks]
- (c) Suppose that Edward and Ursula are two applicants for a vacancy as a bank teller. It has been determined by empirical testing that Edward’s service times are exponentially distributed with mean 0.9 minutes, while Ursula’s are uniformly distributed between 0.8 and 1.2 minutes. It is known that customers arrive at the bank teller’s window with inter-arrival times which are exponentially distributed and at the rate of 50 per hour.
- (i) Can both applicants cope with the load?
- (ii) If so, which one should be employed so as to minimise the steady-state average number of customers present?

In both cases, justify your answer. [8 marks]

- (d) Given a sequence of pseudo-random numbers  $U_1, U_2, \dots$  distributed uniformly between 0 and 1 explain briefly how to construct pseudo-random sequences for the inter-arrival times of bank customers and for the service times of both Edward and Ursula. [3 marks]
- (e) Briefly compare the advantages and disadvantages of the analytical queueing theory and the discrete event simulation approaches to determining performance measures by the above bank employer. [3 marks]