## MCL261 Minor 2

## Part (A)

Max marks: 13

Date: 6th October 2017

## Instructions:

- The method used is very important and clearly state all the assumptions made
- Please return the question paper with the answer sheet
- Part (A) and (B) should be attempted on separate answer sheets.
   Please clearly specify Part (A) / (B) on the answer sheet
- 1. Consider the following transportation problem:

	Destination 1	Destination 2	Destination 3	Destination 4	Destination 5	Supply
Factory A	7	5	4	3	2	20
Factory B	6	5	3	5	4	40
Factory C	2	7	4	6	3	80
Demand .	10	20	10	40	60	

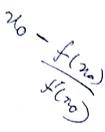
The cost of transportation from Factory to Destinations is given in each cell above, and the demands and supplies for each Destination and Factory are also given.

- (a) Use the Vogel's Method to get an initial BFS for the above problem. (2)
- (b) Obtain the optimal solution for the problem, using the solution from Vogel's method. (5)
- 2. Consider a single server queueing system, with at most 2 people in the <u>queue</u>. The service time is an exponential distribution with parameter  $\mu$ . In addition, some people may also leave the queue without being serviced. This has been observed to follow an exponential distribution with parameter  $\xi$ . The arrival rate follows an exponential distribution with parameter  $= \lambda/(n+1)$ , where n denotes the number of people currently in the system.

Find the stationary distribution for the system using first principles only.

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Nonlinear Optimization: Minor 2 Exam for MCL261

October 6, 2017

Total marks: 7



The marks) Consider the following function:  $f(x) = (x-2)^4 + (x-2)^5 \quad f'(\alpha) = (\alpha,2)^4 + (\alpha-1)(\alpha-2)^4$ (a) What are the roots of this function?  $f'(\alpha,\beta) = (\alpha,2)^4 + (\alpha-1)(\alpha-2)^4$ (b) Comment on the rates at which Newton's method is likely to converge to the different roots of this function.

(c) Starting at  $x_0 = 1.5$ , which rest

(c) Starting at  $x_0 = 1.5$ , which root will Newton's method converge to?

(4 marks) Consider the following problem:

minimize  $f(\mathbf{x}) = (x_1 - x_2)^2 + x_1^3 + x_2^2$ 



Here  $\mathbf{x} \in \mathbb{R}^2$ . Answer the following questions:

- (a) Find the stationary point(s) of f(x).
- (b) Is the second-order necessary condition for a local minimizer satisfied at the stationary point(s) identified? Show your work to prove yes/no.
- (c) Are any of the stationary point(s) local optima? Show your work to prove
- (d) Are any of the stationary point(s) global optima? Show your work to prove yes/no.

3. (1 mark) (a) Using the first-order necessary condition for (local) optimality, derive the second-order necessary condition for (local) optimality for an unconstrained nonlinear maximization problem.

(b) Also show how the second-order sufficient condition for optimality guarantees that a stationary point is a local maximizer for an unconstrained nonlinear maximization problem.

