hrs	/ /19		Exams Office Use Only

University of the Witwatersrand, Johannesburg

Course or topic No(s)	ELEN7015
Course or topic name(s) Paper Number & title	Teletraffic Engineering
Examination/Test* to be held during month(s) of (*delete as applicable)	September 2009
Year of Study (Art & Sciences leave blank)	Postgraduate
Degrees/Diplomas for which this course is prescribed (BSc (Eng) should indicate which branch)	MSc(Eng) and MEng
Faculty/ies presenting candidates	Engineering
Internal examiners and telephone number(s)	Professor H.E. Hanrahan Ext 77243
External examiner(s)	
Special materials required (graph/music/drawing paper) maps, diagrams, tables, computer cards, etc)	Question and Answer Form for Part I

Time allowance

Course Nos	ELEN7015	Hours	3 hours

Instructions to candidates (Examiners may wish to use this space to indicate, inter alia, the contribution made by this examination or test towards the year mark, if appropriate)	See page 1

Internal Examiners or Heads of Department are requested to sign the declaration overleaf

Instructions

(a) This examination is three hours long and is divided into two Parts and periods:

   i. **Part I** is Closed Book. No information be brought into the examination for this period. Answer Part 1 on the Form provided. The maximum time for Part I is 45 minutes. The answer form for Part 1 must be handed in not later than 45 minutes after the start of the examination. The student may then leave the examination room for up to five minutesor proceed directly to Part II.

   ii. **Part II** is Open Book. A student must commence Part 2 not later than 50 minutes after the start of the examination. The issued course notes, not personal handwritten ones must be brought to the examination. No other reference material may be used. In Part II the logic behind the answer to each question must be explained. For this part of the examination you may use computational aids, for example a scientific or programmable calculator or a laptop computer with Octave installed. You should be equipped to perform Erlang B and Erlang C calculations as well as general mathematical formulas.

(b) All questions may be attempted. The total available marks for Parts I and II is 120. One hundred marks = 100%.

(c) This examination tests the following outcomes:

   i. Display literacy in the basic concepts and principles of telecommunications.

   ii. Use standard abstractions, tools and techniques.

   iii. Apply the fundamental concepts and principles to solve problems in Intelligent Networks.

   iv. Apply a selection of standards described in the course text to the solution of problems.

Part I

Answer the short questions on the form provided. All parts carry credit proportional to the amount of information requested. Hand in the form to the Invigilator before proceeding to Part II.

[Total Marks 20]

Part II

Answer the following questions in the answer book provided.

[Total Marks 100]

Question 1

A phone company's target grade of service for the initial concentration of traffic is 0.5% when operating at the designed level of traffic. When the traffic is 10% over the design value, the blocking probability must not increase to more than 2%. A particular type of remote concentrator uses a 30-channel PCM link to the local exchange. How many subscribers can be connected if each offers 0.1 Erl of traffic? (20 marks)

Question 2

a. A source of messages produces packets at random instants with a negative exponential distribution of packet lengths. The packets are accumulated in a buffer before being output on to a single output line. Show that the performance of this system can be modelled using a familiar queueing model.

b. A finite M/M/1/N queue can accommodate N packets in a queue. Determine the required value of N to achieve blocking probability that does not exceed 0.1% with design value of $\rho = 0.5$. What is the blocking probability if the load exceeds the design value by 50%.

(20 marks)

Question 3

A small call centre has six agents at peak times. The PBX serving the centre is configured with a queue with ten places. Calls are distributed toagents as they become free. The average holding time for calls to agents is 5 minutes. At peak time, calls arrive with an average gap of 80 seconds.

Set up a model for the call centre and identify the standard distribution that best describes the call centre operation. State assumptions neing made.

With the above level of traffic, what is the probability of an incoming call being queued?

(20 marks)

Question 4

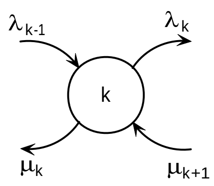
A link delivers an average of 1000 pure chance packets per second to a queueing system. The service time averages 0.33 ms and has a standard deviation of 0.1 ms. Determine the average delay in the queue. What is the magnitude of the error that would be made by assuming an M/M/1 model?

(20 marks)

Question 5

a. Explain the difference between time-based simulation and even-based simulation as applied to phenomena such as queueing systems.

b. One state in a general Markov model as encountered in teletraffic problems is shown with general birth-death rate parameters shown.



In an event-based simulator, assume that the simulation has just arrived at the current state k and the current time is t. What algorithm would allow the decision to be made whether to transition to state $k+1$ or to state $k-1$ and determine the time when this event will take place?

(20 marks)