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University of the Witwatersrand, Johannesburg

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| Course or topic No(s) | ELEN7015 |
| Course or topic name(s)<br>Paper Number & title | Teletraffic Engineering |
| Examination/Test* to be held during month(s) of<br>(*delete as applicable) | SAMPLE PAPER 2009 |
| Year of Study<br>(Art & Sciences leave blank) | Postgraduate |
| Degrees/Diplomas for which this course is prescribed<br>(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<br>(graph/music/drawing paper)<br>maps, diagrams, tables, computer cards, etc) | Question and Answer Form for Part I |

Time allowance

| Course Nos | ELEN7015 | Hours | 3 hours |
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| Instructions to candidates<br>(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**

# Note: This is a SAMPLE PAPER that has not been subjected to the normal quality controls

(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 teletraffiv.

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## 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]

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QQ1

QQ2

# Part II

Answer the following questions in the answer book provided. All references to figures not contained in the paper refer to figures in the issued class notes.

[Total Marks 90]

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## Question 1

A phone company is considering alternative billing proposals.

(a) One unit every 30 seconds;

(b) One unit for the first 30 seconds and 1/30 unit per second therafter;

(c) Pure per second billing: 1/30

Given a negative exponential holding time with mean of 100 seconds, what is the average revenue that will be earneds for each of the three schemes.

(20 marks)

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## Question 2

Define the throughput of a finite M/M/... queue as $\gamma = \lambda(1-P_B)$, where $P_b$ is the blocking probability. Also define $\gamma/\mu$ as the normalised throughput. Explain the significance of these throughput measures. Express both measures as a function of $\rho = \lambda/\mu$. (20 marks)

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## Question 3

a. A subscriber line concentrator is designed for 256 users and is connected to a local exchange by a PCM 30 time division multiplex. What is the maximum traffic per user if the blocking probability is not to exceed 0.2%.

b. What is the blocking probability if there is a sudden peak of traffic and the offered traffic doubles?

(20 marks)

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## Question 4

A switching system in a SCN has $N$ servers and a queue with capacity $Q$. The offered traffic is $A = 0.6N$ The holding time has a negative exponential distribution with mean 100 s Determine the probability of being delayed and the probability of being blocked.

(20 marks)

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## Question 5

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

b. A general Markov model has rate parameters $\lambda_k$ and $\mu_k$. Show that the various rate parameters are related by

$$(\lambda_k + \mu_k)p_k = \lambda_{k-1}p_{n-1} + \mu_{n+1}p_{n+1}$$

(20 marks)