			EXAMS OFFICE USE ONLY

University of the Witwatersrand, Johannesburg

Course or topic No(s)	ELEN7027
Course or topic name(s) Paper Number & Title	CONTROL II
Examination to be held during month(s) of	JUNE 2012
Year of Study (Art & Science leave blank)	MSc and MEng
Degrees/Diplomas for which this course is prescribed (Bsc (Eng.) should indicate which branch)	Post Grad (Eng) ELECTRICAL & INFORMATION ENGINEERING (MSc & MEng)
Faculty/ies presenting candidates	ENGINEERING & THE BUILT ENVIRONMENT
Internal examiner(s) and telephone extension number(s)	MR. NYANDORO O.T.C x77245
External examiner(s)	Dr Pedro J.O
Special materials required (graph/ music/ drawing paper/ maps/ diagrams/ tables/ computer cards, etc)	Matlab/Simulink provided on a Computer Lab environment. Open-book type exam
Time allowance	Course No ELEN7027 Submit by Monday 0800hrs 4th June 2012 At Electrical Engineering Reception Red Box
Instructions to candidates	Examination Type: ANSWER ALL QUESTIONS (Total Marks = 100: Full Marks = 100)

Instructions: ***The following are design and discussion type questions and require detailed analysis and critical evaluation of the various numerical answers, arguments and discussion points. The emphasis of the answers should therefore clearly justify assumptions made, and also discuss the limitations of the solutions to the various applied methodologies and/or techniques.***

A quarter car model represents a car decelerating from 120km/hr to rest on a dry asphalt road surface (λ_0=0.2 μ_0=0.8). Typical forces applicable to its deceleration are:

- the aero-dynamic drag proportional to the square of the longitudinal velocity with constant of proportionality 0.9.
- wheel bearing friction slowing down the car together with the aero dynamic drag in 150seconds when no braking torque is applied

Other parameters are:

- Mass of quarter car may be assumed to be any value between 350-500kg
- Mass of wheel may be assumed to be any value between 25-50kg
- Magnitude of moment of inertia of wheel is a value between 1-2 proportionally increasing with wheel mass
- Radius of the wheel is 0.3m

Key analysis points should include (classification/s of model, best performance, worst performance, control effort).

You are required to write a paper for presentation in a journal. The Paper should typically be no more than 14pages. The typical ABS in [1] [2] without suspension is to be utilised in conjunction with the above specifications. You are to motivate and demonstrate the viability of multi-rate quasi-sliding mode (MRQSM) control technique for real-time scheduling and slip control of ABS. You may assume four independent controllers implemented on one embedded CPU for four separately controlled car wheels. Your paper must typically have literature review for embedded control and scheduling developments, modelling and results analysis comparing results to typical approaches. In addition the superiority of the MRQSM approach must be thoroughly critiqued. Other issues to be discussed are the control torques, response times, and schedules for the controls. **[100marks]**

References:

1. J. Pedro, O. Nyandoro, and S. John, “Neural network based feedback linearisation slip control of an anti-lock braking system,” in Proc. of the 7th Asian Control Conference, Hong Kong, China, Sep 2009, pp. 1251–125
2. Nyandoro, O.T.C.; Pedro, J.O.; Dahunsi, O.; Dwolatzky, B, "Linear slip control formulation for anti-lock braking system with suspension effects," *International Federation of Automatic Control World Congress, 2011. IFAC World Congress. 18th* , pp.1251-1257, 28 Aug- 2Sep. 2011.