LIT
DEPARTMENT OF INFORMATION TECHNOLOGY

Semester: Semester 1 (Winter 2016/17)

Date/Time: Wednesday 14th December 2016, 2 PM – 4 PM

Programme: Bachelor of Science (Honours) in Computing (Games Design and Development)

Stage: Year 4

Module: GAME PHYSICS

> COMP 08030

Time Allowed: 2 hours

Instructions: Attempt any four (4) questions

Additional Attachments: Formula Sheet

External Examiners: Derek O'Reilly
Internal Examiners: Janice O'Connell, Eugene Kenny

Question No. 1 (25 Marks)

(a) In a soccer game, the player is attempting a penalty kick at a distance of 11 meters from the goal. The ball reaches the goal in a straight line after 1 second. What was the average acceleration of the ball? *(10 marks)*

(b) Suppose a NPC police officer sets up a speed trap on a straight section of a road. He times a player who covered 300 meters in 15 seconds. If the speed limit on that section is 90 km/h, will the player get a speeding ticket? *(15 marks)*

Suppose another player is driving a car and suddenly has to break. He is going at 50 km/h and the car can decelerate at a rate of -4.55 m/s. How much time does the player need to stop?

Question No. 2 (25 Marks)

(a) Why is it necessary to use numerical methods to solve certain physics equation? Name, describe and compare two techniques that are used to solve certain equations numerically. *(10 marks)*

(b) For a time dependent variable, x(t), satisfying the equation: *(15 marks)*

$$x(t) = 100t - 2t^2$$

and with x = 0 at t = 0 show how you would solve for x using the techniques you have described above.

Question No. 3 (25 Marks)

(a) *Spatial partitioning* data structures are commonly used to make the fast selection of models to test in a collision detection system. Outline in detail two such data structures. *(10 marks)*

(b) State the *Separating Axis Theorem* (SAT). Illustrate how it works for two polygon shapes such as a triangular object and a rectangular object. If one of the objects was curved would SAT be of any use? *(15 marks)*

Question No. 4 (25 Marks)

(a) Discuss the problem of how best to represent rigid bodies for the purpose *(10 marks)* of collision detection and describe the different approaches that may be taken to solve it.

(b) When your game program detects penetration of one rigid body object by *(10 marks)* another what technique would you use to work out the time of the actual collision?

(c) One unwelcome effect in modelling bodies that may collide is tunnelling. *(5 marks)* What does this refer to, why does it happen and how can it be avoided?

Question No. 5 (25 Marks)

(a) Describe a physics model that is sometimes used to represent cloth and *(10 marks)* other soft bodies.

(b) What are the advantages and disadvantages of doing games physics *(15 marks)* computations on the GPU such as with PhysX or on the CPU such as with Havok?