



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 2 Examination in Engineering: March 2014

Module Number: ME 2201

Module Name: Engineering Mechanics

[Three Hours]

[Answer all questions, each question carries ten marks]

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- Q1. a) What is the difference between classical mechanics and the quantum mechanics? [1 Mark]
- b) What are the three branches of the classical mechanics? [1 Mark]
- c) Define the terms; *Configuration Space*, *Co-ordinates*, and *Degrees of Freedom*. [3 Marks]
- d) What is defined as the *Ortho-normal frame of reference*? [1 Mark]
- e) Briefly explain the difference between *holonomic* constraints and *non-holonomic* constraints. [2 Marks]
- f) How you could relate the *holonomic constraints* and the *Degrees of Freedom* of a given mechanical system? [2 Marks]
- Q2. Consider a particle P constrained to move on a sphere of radius r (refer to Figure Q2). The representation of P using an ortho-normal frame e fixed at the center of the sphere can be expressed using the polar co-ordinates (θ, φ) as;
- $$x_1 = r \sin \varphi \cos \theta$$
- $$x_2 = r \sin \varphi \sin \theta$$
- $$x_3 = r \cos \varphi$$
- a) Express the velocity in the e frame using polar co-ordinates. [5 Marks]
- b) Express the acceleration in the e frame using polar co-ordinates. [5 Marks]
- Q3. Explain why a person standing on a scale inside an elevator sees his or her weight doubled as the elevator accelerates up at a rate g and sees the weight reduced to zero if the elevator decelerates at a rate of g . Also show that if, for some reason, the gravitational force field vanished and the elevator was moving up at an acceleration of g then the scale would still show the correct weight of the person. [10 Marks]
- Q4. Explain mathematically that a Hurricane formed in the Northern hemisphere has a counter clockwise rotation and a Hurricane formed in the Southern hemisphere has a clockwise rotation. [10 Marks]
- Q5. The two links or elements of a machine, when in contact with each other, are said to form a pair. If the relative motion between them is completely or successfully constrained, the pair is known as *kinematic pair*.

a) What are the types of constrained motions that a pair can take? Briefly explain them with neat sketches. [4 Marks]

b) Briefly explain with neat sketches the classification of kinematic pairs in relation to the type of ;
 i. relative motion between the elements,
 ii. contact between the elements, and
 iii. closure. [6 Marks]

Q6. Obtain the differential equations derived by mathematical modeling of the mechanical system shown in Figure Q6 with usual notations. [10 Marks]

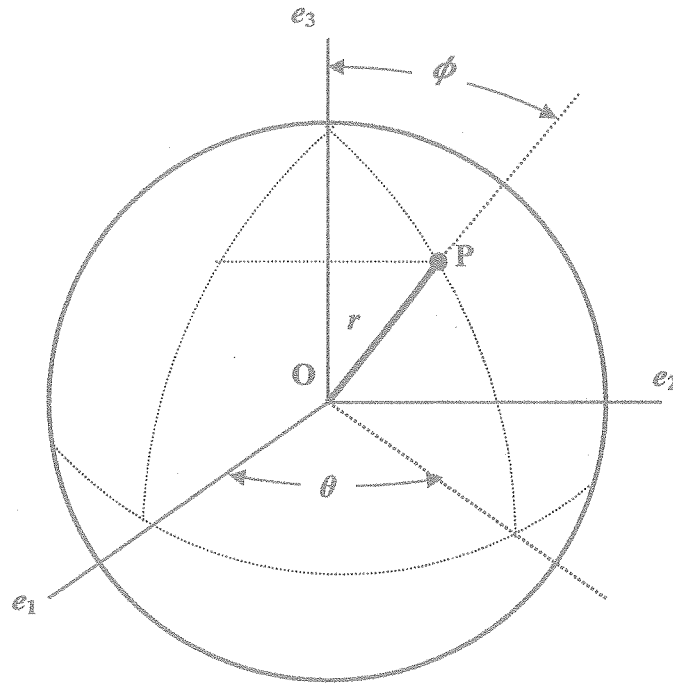


Figure Q2

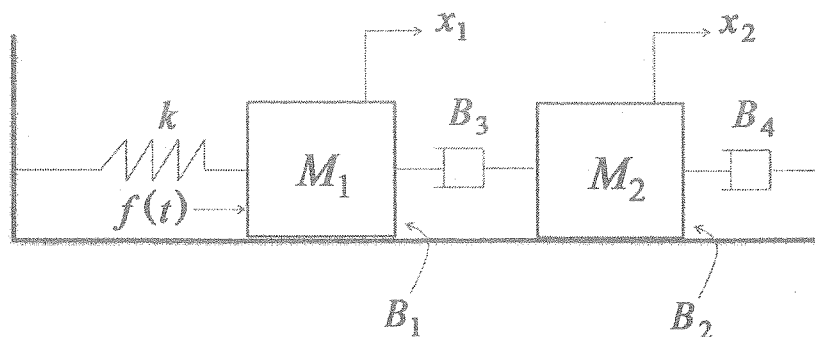


Figure Q6