

**UNIVERSITI TEKNOLOGI MARA**

**HYPERELASTIC CONSTITUTIVE  
ANALYSIS OF SILICONE SHEET AS  
SKIN SUBSTITUTE**

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Thesis submitted in fulfillment  
of the requirements for the degree of  
**Master of Science**

**Faculty of Mechanical Engineering**

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## CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 26th February 2015 to conduct the final examination of Siti Noor Azizzati Binti Mohd Noor on her Master of Science thesis entitled “ Hyperelastic Constitutive Analysis of Silicone Sheet as Skin Substitute” in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

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## AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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## ABSTRACT

Silicone Rubber is a potential skin substitute material, whereby its mechanical behaviour is also difficult to characterize. This study pioneers in its attempt to investigate the mechanical properties of Silicone Rubber materials via the integration of experimental, numerical and analytical approaches adapting hyperelastic constitutive equations. Initially, uniaxial tensile test is performed to measure the stress-stretch response of two types of Silicone Rubber based materials (i.e. Normal Grade and Food Grade) employing two testing standards (i.e. ASTM D2209 and ASTM D412). Three hyperelastic constitutive models (i.e. neo-Hookean, Mooney-Rivlin and Ogden) have been adopted to represent the materials behaviour and properties in terms of material constants for each Silicone Rubber which have been determined via numerical and analytical approaches. Engineering stress-stretch ( $\sigma_E - \lambda$ ) curve plot from numerical and analytical approach has been fitted to the experimental data. Results indicate that numerical approach provides better results than analytical approach in fitting the experimental data whereby the Mooney-Rivlin model gives the most accurate results to the experimental data compared to neo-Hookean and Ogden models. Therefore it can be concluded that numerical approach using the Mooney-Rivlin model is the closely hyperelastic constitutive model in representing the mechanical properties of Silicone Rubber materials.

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