



**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS**

Name of the Student : S. Arun

Roll Number : 126103030

Programme of Study : Ph.D.

Thesis Title : Design, development and testing of user friendly, light weight and inexpensive artificial limb for trans-femoral amputees

Name of Thesis Supervisor(s) : Dr. S. Kanagaraj

Thesis Submitted to the Department/ Center : Mechanical Engineering

Date of completion of Thesis Viva-Voce Exam : 7/6/2016

Key words for description of Thesis Work : Trans-femoral amputee; leg prosthesis; Rehabilitation; socket; polymer composites.

---

**SHORT ABSTRACT**

The trans-femoral amputation is a surgical interference that severs the thigh segment between the hip and knee joint. Though many prosthetic devices are available in the market, each one of them has inherent limitations. Thus, an attempt was made to design and develop a light weight and user friendly artificial limb having improved functionality with affordability in addition to the development of new materials for the socket and knee joint. The knee joint was designed based on the Grashof's criterion, stance phase stability, and extension bias. Based on the static and dynamic analysis, the knee joint was fabricated using nylon and it was fixed for 9 trans-femoral amputees. It is confirmed from the rehabilitation studies that the performance of prosthesis and the health related quality of life of the patients were observed to be significantly improved. The poly (methyl methacrylate) PMMA/MWCNT was selected as a material for the knee joint and the epoxy based sandwich composites along with MWCNT reinforcement was proposed to be used as a material for the socket. Based on the mechanical characteristics, PMMA/0.25 wt.% MWCNT was suggested to make a knee joint, which was also found to be suitable to reduce the aging degradation, where the modified Halpin-Tsai model and Pukanszky model are used to predict the mechanical properties of PMMA/MWCNT composites. It was observed that the increase in mechanical and thermal properties of 0.3 wt. % MWCNT reinforced epoxy/glass fabric/stockinet layer sandwich composite, which is suggested to be make a socket, led to reduce the (i) weight of the socket; (ii) temperature gradient across the thickness of the socket; (iii) temperature raise inside the socket; (iv) metabolic cost of an amputee. It is also anticipated that the newly developed light weight, durable and user-friendly knee joint is expected to make huge impact in locomotive disabled people community due to its function, performance, affordability and near sound leg gait pattern and thus it is expected to increase the comfort level of trans-femoral amputees and decrease their metabolic cost.