

## Investigations of warped product manifolds admitting $W^*$ -curvature tensor with applications

By UDAY CHAND DE (Calcutta), SAMEH SHENAWY (Maadi),  
ABDALLAH ABDELHAMEED SYIED (Zagazig),  
KRISHNENDU DE (Burdwan) and NASSER BIN TURKI (Riyadh)

**Abstract.** One significant geometric invariant with relativistic consequences is the  $W^*$ -curvature tensor. This article examines the  $W^*$ -curvature tensor on warped product manifolds  $N = \bar{N} \times_F \tilde{N}$ . In a  $W^*$ -curvature flat warped product manifold, it is shown that  $\tilde{N}$  is Einstein and the  $W^*$ -curvature tensor vanishes on  $\tilde{N}$ . Also, necessary and sufficient conditions are given to guarantee that  $\bar{N}$  is of constant curvature. The form of the Riemann and Ricci tensors of  $\bar{N}$ ,  $\tilde{N}$  are stated. The Ricci tensor of the fiber manifold is of Codazzi type if the  $W^*$ -curvature tensor is divergence-free, whereas the base manifold's Ricci tensor is of Codazzi type if the Hessian of the warping function is of Codazzi type. In a  $W^*$ -symmetric warped product manifold, many characterizations of Cartan-symmetry of the factor manifolds are obtained. Finally, many relativistic applications are discussed.

UDAY CHAND DE  
DEPARTMENT OF PURE MATHEMATICS  
UNIVERSITY OF CALCUTTA  
WEST BENGAL  
INDIA

SAMEH SHENAWY  
MODERN ACADEMY FOR ENGINEERING  
AND TECHNOLOGY  
MAADI  
EGYPT

ABDALLAH ABDELHAMEED SYIED  
DEPARTMENT OF MATHEMATICS  
FACULTY OF SCIENCE  
ZAGAZIG UNIVERSITY  
ZAGAZIG  
EGYPT

KRISHNENDU DE  
DEPARTMENT OF MATHEMATICS  
KABI SUKANTA MAHAVIDYALAYA  
UNIVERSITY OF BURDWAN  
P. O.-ANGUS, HOOGHLY  
PIN 712221, WEST BENGAL  
INDIA

NASSER BIN TURKI  
DEPARTMENT OF MATHEMATICS  
COLLEGE OF SCIENCE  
KING SAUD UNIVERSITY  
P. O. BOX 2455  
RIYADH 11451  
SAUDI ARABIA

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