

# Declaration

I declare that the thesis entitled **A Study on Bianchi Type-V Cosmological Models in Lyra's Geometry**, being submitted by me in partial fulfillment for the award of the degree of Doctor of Philosophy in Mathematics to Bodoland University, is my own work carried out under the supervision and guidance of Dr. Mukunda Dewri, Assistant Professor, Department of Mathematical Sciences, Bodoland University. Some parts of the thesis has been published in International Journals. This work described in the thesis is original and has not been submitted, in part or full, for any other degree or diploma, to this or any other university.

Place : Kokrajhar

Bishnu Prasad Brahma  
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Place : Kokrajhar

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# Certificate

This is to certify that the thesis entitled **A Study on Bianchi Type-V Cosmological Models in Lyra's Geometry** being submitted by Bishnu Prasad Brahma for the award of the Degree of Doctor of Philosophy in Mathematics to Bodoland University, Kokrajhar, Assam, India, is a record of bonafide research work carried out by him under my supervision in the Department of Mathematical Sciences, Bodoland University, Kokrajhar.

The thesis satisfies the requirements of the regulation relating to the degree. Also, considerable parts of the thesis are published in International Journals. The work reported in the thesis is original and has not been submitted in any other university or institute for the award of any degree or diploma.

Place : Kokrajhar

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# Abbreviations

BAO : Baryon Acoustic Oscillations  
CDM : Cold Dark Matter  
CMB : Cosmic Microwave Background  
DE : Dark Energy  
DEC : Dominant Energy Condition  
DM : Dark Matter  
DP : Deceleration Parameter  
EC : Energy Condition  
EFE : Einstein Field Equations  
EHA : Einstein Hilbert Action  
EMT : Energy-Momentum Tensor  
EOS : Equation of State  
FRW : Friedmann Robertson–Walker  
GR : General Relativity  
HDE : Holographic Dark Energy  
HEL : Hybrid Expansion Law  
HP : Hubble Parameter  
LRS : locally Rotationally Symmetric  
LSS : Large Scale Structures  
NEC : Null Energy Condition  
RG : Riemannian Geometry.  
SC : Supernova Cosmology Project  
SEC : Strong Energy Condition  
SNeIa : Type Ia Supernova  
WEC : Weak Energy Condition  
WMAP : Wilkinson Microwave Anisotropy Probe

# Symbols

Some important standard symbols used in this thesis are given below:

$S$ : Einstein Hilbert action	$\theta$ : Scalar expansion
$\mathcal{G}$ : Gauss Bonnet invariant	$\tilde{R}$ : Function of Ricci scalar
$t$ : Cosmic time	$\xi$ : Co-efficient of Bulk viscosity
$\mathcal{T}$ : Torsion scalar	$a(t)$ : Scale factor
$T$ : Trace of energy momentum tensor	$A_m$ or $\Delta$ : Anistropy parameter
$\nabla_i$ : Covariant derivative	$c$ : Speed of Light
$T_{ij}$ : Strees energy momentum tensor	$ds^2$ : Space time line element
$\bar{p}$ : Total pressure	$G$ : Newton's Gravitational constant
$V$ : Spatial volume	$g_{ij}$ : Metric potential
$\rho$ : Energy density	$H$ : Hubble's parameter
$q$ : Deceleration parameter	$h$ : Heat conduction
$\sigma^2$ : Shear scalar	$L_m$ : Matter Lagrangian
$R$ : Ricci scalar	$p$ : Pressure
$\beta$ : Displacement vector field	$R_{ij}$ : Ricci tensor
$\square$ : Four dimensional covariant Laplacian	

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