Bharath
INSTITUTE OF HIGHER EDUCATION AND RESEARCH
(Declared as Deemed-to-be University under section 3 of UGC Act, 1956)
(Vide Notification No. F.9-5/2000 - U.3, Ministry of Human Resource Development, Govt. of India, dated 4th July 2002)
Accredited by NAAC
NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL
Phone : 044-22290742 / 22290125 . Telefax : 044-22293886
Website : www.bharathuniv.ac.in
173, Agaram Road, Selaiyur, Tambaram,
Chennai - 600 073. Tamil Nadu.

Ref No.SMS-2018-O-09

Date: 17/04/2019

BHARATH INSTITUTE OF HIGHER EDUCATION & RESEARCH (Declared as Deemed to be University U/S 3 of UGC Act 1956) 17 APR 2019 OFFICE OF THE DEAN-RESEARCH Selaiyur, Chennai-600 073. INDIA

TO

Mr. K. Sathish Kumar,

Asst. Professor/Mechanical,

BIHER.

Thro: Concern Head of the Department

Greetings!!!

We are happy to announce that the Research Advisory Committee has approved your proposal for Seed Money Scheme-2018 which was presented by you. You are requested to complete the proposal and send the progress report to the Dean Research in the prescribed time period.

Title of the Project: Design and Simulation of composite materials based leaf spring

Seed Money Amount: Rs.1, 00,000/- (Rupees One Lakh Only)

Approved on: 17/04/2019

Payment details:

Voucher No.09 **Dated: 19/04/2019**

With Regards

Dean-Research

Bharath University

SELAIYUR, CHENNAI - 600 073, TAMIL NADU, INDIA.

CASH / PAYMENT VOUCHER

Date 19/04/19

V.No. 09

Debit _____ Amount

Rs. 1,00,000/-

PAID TO Mr. K. Sathish kumar

RUPEES One Lakh only

TOWARDS Seed Money Scheme.

BHARATH UNIVERSITY CHENNAI 600 073. INDIA.

Authorised by **Finance Manager** **Cashier/Accountant** **Payee's Signature**

PROPOSAL SUBMISSION

1. Details of principal Investigator

Name	: K.Sathish Kumar
Designation	: Assistant Professor
Highest Qualifications	: M.E
Department	: Mechanical Engineering
E-mail	: pkskumar88@gmail.com
Contact no	: 9790156350
Date of Joining	: 11/02/2016

2. Details of Co- principal Investigator

Name	: Dr. R. Venkatesh Babu
Designation	: Professor
Highest Qualifications	: Ph.D
Department	: Mechanical Engineering
E-mail	: rvbaboo76@gmail.com
Contact no	: 9962598499
Date of Joining	: 05-Dec-1997

Technical details

1. Introduction:

The springs are provided between wheels and the chassis frame to provide satisfactory comfort and also the shocks from bumps in the road surface must not be transmitted to the superstructure. Mostly the leaf spring applications are comprised of multi-leaf system found primary in rear suspensions. The purposes of this research are to analyze, develop and validate finite element models of multi-leaf spring. The introduction of better material, design optimization and better manufacturing processes provides weight reduction which has been the main focus to conserve natural resources and economize energy. This also achieves the vehicle with more fuel efficiency and improved riding qualities.

The introduction of composite materials this is made possible to reduce the weight of leaf spring without any reduction on load carrying capacity and stiffness. Since, the composite materials have more elastic strain energy storage capacity and high strength to weight ratio as compared with those of steel, multi-leaf steel springs are being replaced by mono-leaf composite springs. According to the studies made a material with maximum strength and minimum modulus of elasticity in the longitudinal direction is the most suitable material for a leaf spring. Fortunately, composites have these characteristics. The automobile components are subjected to variety of fatigue loads like shocks caused due to road irregularities traced by the road wheels, the sudden loads due to the wheel traveling over the bumps etc. The leaf springs are more affected due to fatigue loads, as they are a part of the unstrung mass of the automobile. This relation is simplified by strain failure criterion for practical application. In the present work, a seven-leaf steel spring used in passenger cars is replaced with a composite multi leaf spring made of glass/epoxy composites. The dimensions and the number of leaves for both steel leaf spring and composite leaf springs are considered to be the same. The primary objective is to compare their load carrying capacity, stiffness and weight savings of composite leaf spring. Finally, fatigue life of steel and composite leaf spring is also predicted using life data.

2. Review of status of Research and Development in the subject

- Fatigue Design of Leaf Springs for New Generation Trucks, International Journals of Structure Integrity,Vol 161, 2016, pp. 1-9.

  E Giannakis, M Malikoutsakis, G Savaidis

- Composite leaf spring in the early 60 failed to yield the production facility because of inconsistent fatigue performance and absence of strong need for mass reduction. Emphasis of vehicles weight reduction in 1978 justified taking a new look at composite springs. Studies are made to demonstrate viability and potential of FRP in automotive structural application. The development of a lit flex suspension leaf spring is first achieved. Based on consideration of chipping resistance base part resistance and fatigue resistance, a carbon glass fiber hybrid laminated spring is constructed. A general discussion on analysis and design of constant width, variable thickness, and composite leaf spring is presented. The fundamental characteristics of the double tapered FRP beam are evaluated for leaf spring application. Recent developments have been achieved in the field of materials improvement and quality assured for composite leaf springs based on microstructure mechanism. All these literature report that the cost of composite; leaf spring is higher than that of steel leaf spring. Hence an attempt has been made to fabricate the composite leaf spring with the same cost as that of steel leaf spring.

- Engineering Mechanics of Composite Materials", Second Edition, pp. 377.

  Isaac M. Daneil, OriIshai

Material properties and design of composite structures are reported in many literatures. Very little information is available in connection with finite element analysis of leaf spring in the literature, that too in 2D analysis of leaf spring. At the same time, the literature available regarding experimental stress analysis more. The experimental procedures are described in national and international standards. Recent emphasis on mass reduction and developments in materials synthesis and processing technology has led to proven production worthy vehicle equipment.

- "Simulation of Parabolic Leaf Spring for Heavy Commercial Vehicle Using FEA", International Journal of Engineering Sciences and Research Technology, Vol 4, June 2015, pp. 1077-1081.

SuwarnaTorgal, Shashank Jain,

- Design and Analysis of Fiber Reinforce Polymer (FRP) Leaf Spring. The main issue in automobile industries are weight reduction can be achieved primarily by the introduction of better material, design optimization and better manufacturing processes. The introduction of FRP material has made this possible without any reduction on load carrying capacity. The achievement of weight reduction with adequate improvement of mechanical properties has made composite a very good replacement material for conventional steel. Selection of material is based on cost and strength of material. The composite materials have more elastic strain energy storage capacity and high strength to weight ratio as compared with those of steel, so multi-leaf steel springs are being replaced by mono-leaf composite springs. The paper gives the brief look on the suitability of composite leaf spring on vehicles and their advantages. The objective of the present work is design, analysis and fabrication of mono composite leaf spring. The design constraints are stress and deflections. The finite element analysis is done using ANSYS software. The attempt has been made to fabricate the FRP leaf spring economically than that of conventional leaf spring

2.1 International Status: NIL

2.2 National Status: NIL

3. Progress/achievement so far,

a) Reference papers was collected.

b) Literature survey was studied.

c) Proposal work started in the Banyan and Neem fiber-based composite materials leaf spring is prepared through the hand lay-up method.

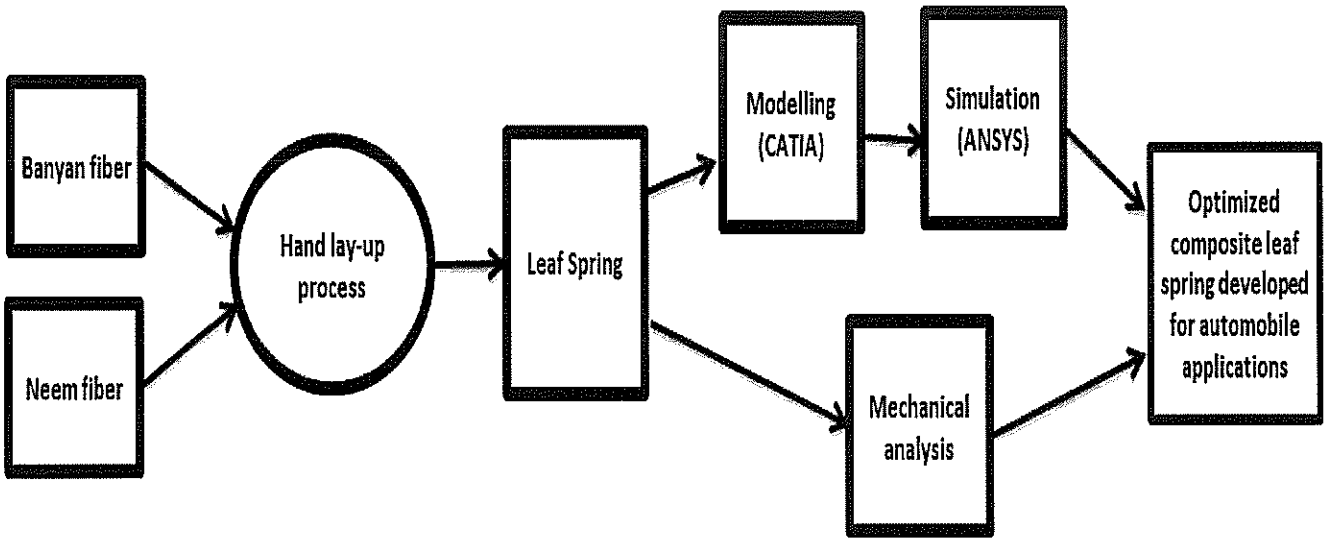
4. Work Plan

4.1 Methodology

The main objectives of the Banyan/Neem composites are as follows,

- To exact the natural fibres from plants and to prepare the wire form of fibres.
- To fabricate the leaf spring interply layer composites through the hand lay-up method.
- To examine the mechanical and vibration analysis of composites through a UTM machine.
- To analysis the performances of composites through novel fatigue, damping, and tensile testing method
- To identify the leaf spring's resistance capability through simulation software and find the optimized materials for automobile applications.

Block Diagram



Design and Simulation analysis through development of optimized leaf spring for automobile applications

Specification of composite leaf spring

Total span length (eye to eye)	1450mm
No. of full-length leaves	02
Length of full-length leaves (L-1 and L-2)	1450mm (each)
Width	70mm
Thickness	12mm
No. of graduated length leaves	07

Units specifications

Unit System	Metric (mm, t, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Analysis specifications

Object Name	Static Structural (A5)
State	Solved
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	ANSYS Mechanical
Environment Temperature	22. °C
Generate Input Only	No

SOFTWARE USED

CATIA – Computer Aided Three-Dimensional Interactive Application.

CATIA (version: V5 R18), developed by Dassault Systems a is one of the world's leading CAD/CAM/CAF Packages. Being a solid modeling tool, it unites the 3D parametric features with 2D tools and also addresses every design through manufacturing process. Besides providing an insight into the design content, the package promotes collaboration between companies and provides them an edge over their competitors.

Catia workbenches

I. Part design workbenches
II. Wire frame and Surface Design Workbench
III. Assembly Design workbench
IV. Drafting workbench
V. Generative Sheetmetal Design workbench
VI. DMU Kinematics workbench

Parametric modeling

The parametric nature of a software package is defined as its ability to use the standard properties or parameters in defining the shape and size of a geometry. The main function of this property is to transform the selected geometry to a new size or shape without considering its original dimensions. We can change or modify the shape and size of the any feature at any stage of design process. This property makes the designing process very easy.

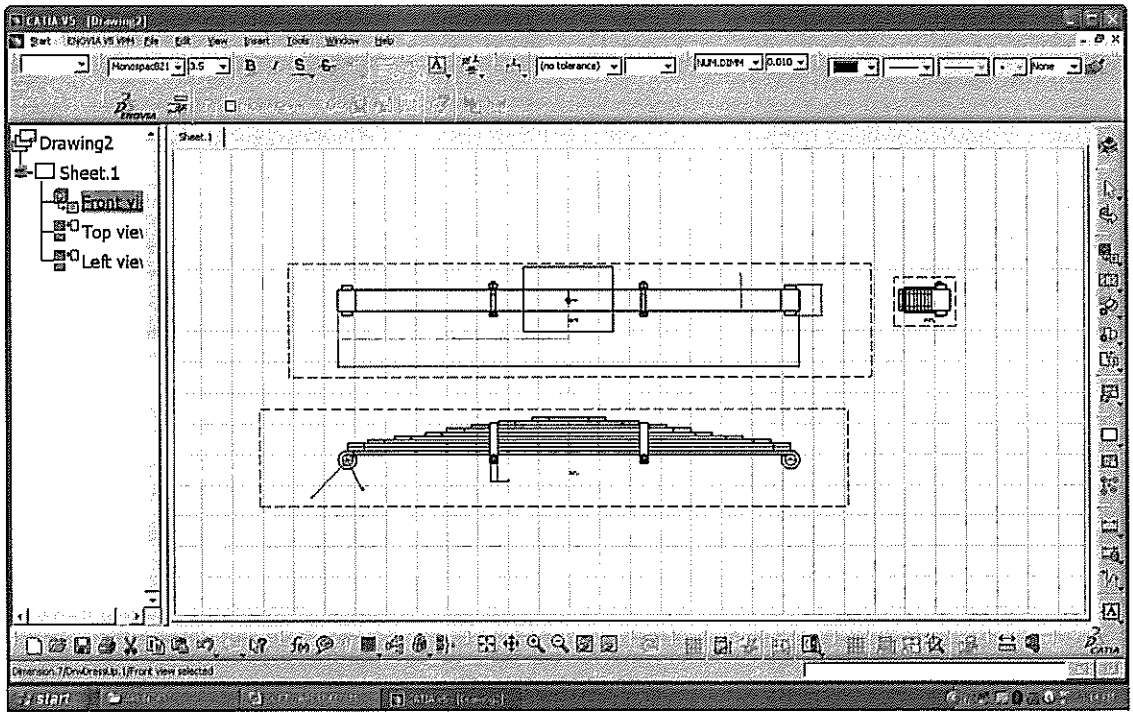
Constraints

Constraints are the logical operations that are performed on the selected element to define its size and location with respect to the other elements or reference geometries. The geometric constraints are:

- Distance
- Length
- Angle

- Radius / Diameter
- Semi major axis
- Semi minor axis
- Symmetry
- Mid-point
- Equidistant point
- Fix
- Coincidence
- Concentricity
- Tangency
- Parallelism
- Perpendicular
- Horizontal
- Vertical

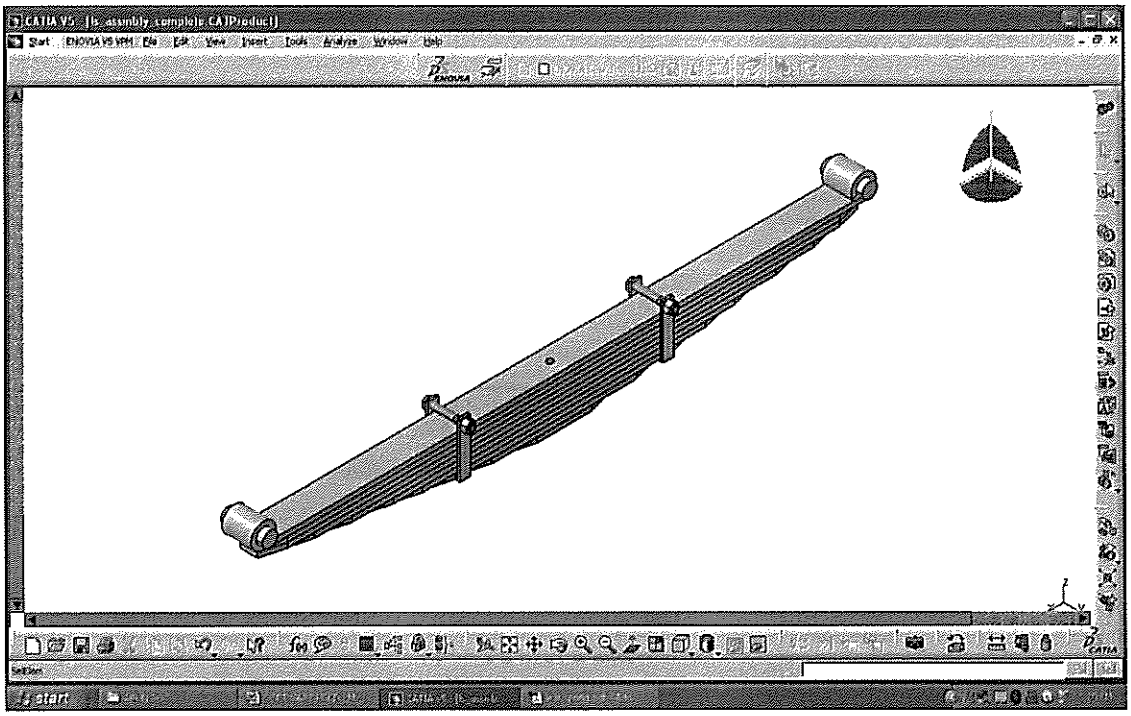
Detailed drawing of composite leaf spring



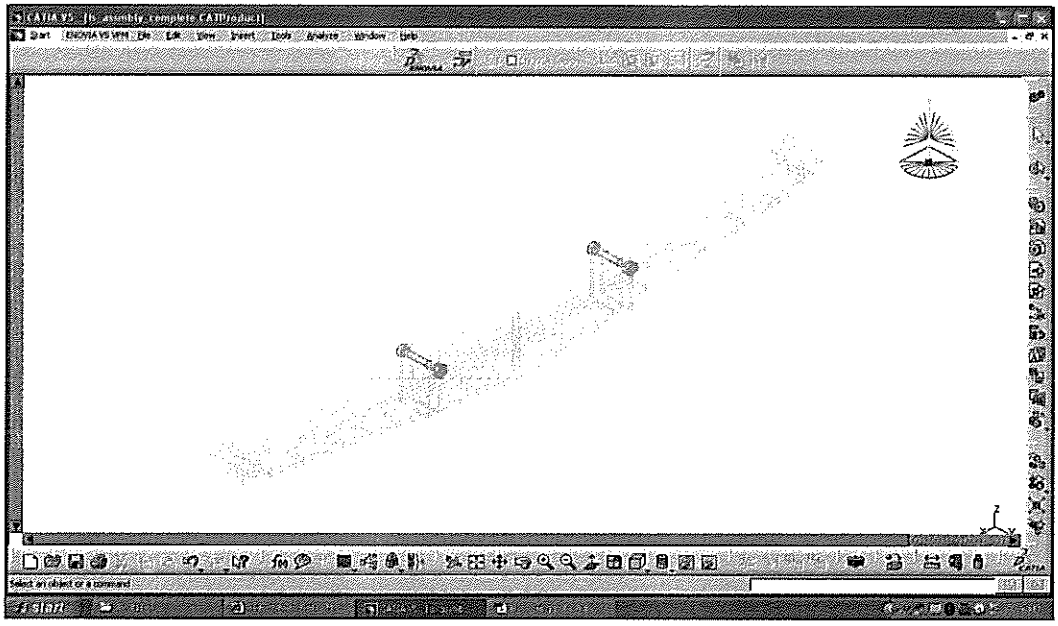
Detailed drawing of composite leaf spring

Design parameters of the Composite leaf spring

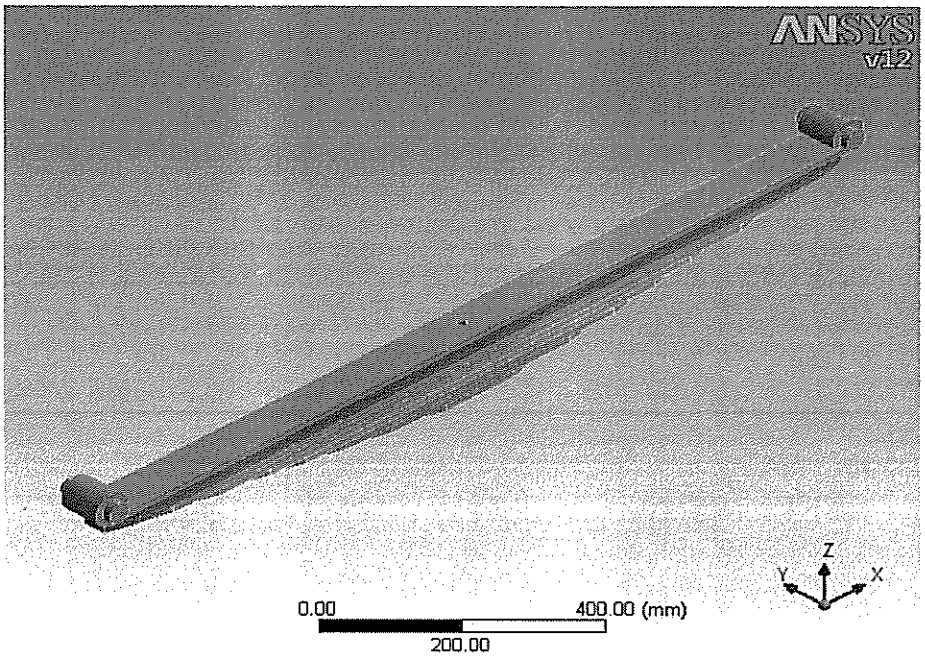
Total span length (eye to eye)	1450mm
Number of full-length leaves	02
Length of full-length leaves (L-1 and L-2)	1450mm (each)
Width of all leaves	70mm
Thickness of all leaves	12mm
Number of graduated length leaves	07
Length of graduated length leaves (L-3, L-4, L-5, L-6, L-7, L-8 and L-9)	1320mm,1140mm,940mm,800mm, 640mm, 464mm & 244mm resp.



Shade mode view of composite leaf spring



Wireframe view of composite leaf spring

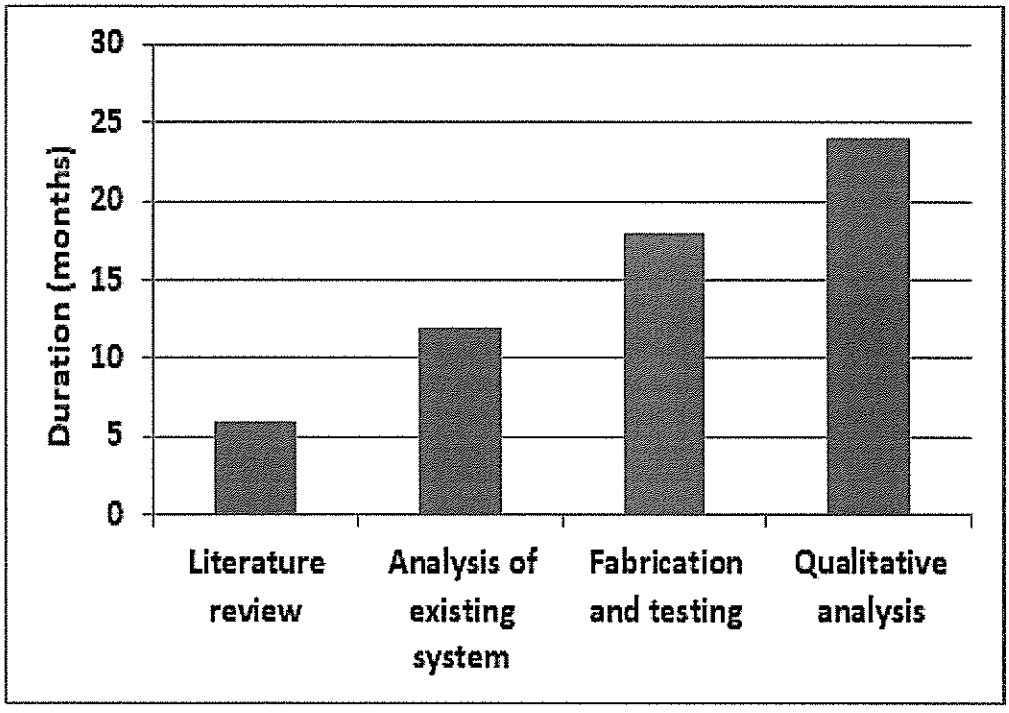


Leaf spring 3D modeling

4.2 Time Schedule of activities giving milestones through Bar diagram.

Work plan (including detailed methodology and time schedule)

Sl. No	Activity/Milestone	1st Year		2nd Year	
1	Literature review	1-6			
2	Analysis of existing system		7-12		
3	Fabrication and testing			13-18	
4	Qualitative analysis				19-24



4.3 Expected outcome within the time period of Seed Money Scheme

a) Prototype Hardware design can be implemented within the time period of Seed money Scheme.

b) For a real time composite leaf spring development field work can be done within the time period of Seed money Scheme.

5. Suggested Plan of action stating the name of funding agency where the project will be communicated for financial support within the time period of project.

Nil

6. Bibliography: Nil

7. List of Projects submitted/implemented by the investigators (Separate for Pi and Co-PI) : Nil

7.1 Details of Projects submitted to various funding agencies:

Sl. No	Title	Cost in lakhs	Month of submission	Role as PI/ Co-PI	Agency	Status
	NA	NA	NA	NA	NA	NA

7.2 Details of Projects under implementation

Sl. No	Title	Cost in lakhs	Duration	Role as PI/ Co-PI	Agency
	NA	NA	NA	NA	NA

7.3 Details of Projects completed during the last 5 years

Sl. No	Title	Cost in lakhs	Duration	Role as PI/ Co-PI	Agency
	NA	NA	NA	NA	NA

8. List of publications published by the Investigators, if any:

a) Co - Principal Investigator

S.No	Author names	Title of paper	Name of Journal	Vol (issue)	Page no.	Year
1.	Dr.K.P.Ashok, Dr.R. Venkatesh Babu,	A study of heat transfer in porous media on a stretching sheet	International Journal of Mechanical Engineering and Technology	Volume 9, No. 8 (2018)	241-246	2018
2.	Dr.K.P.Ashok, Dr.R. Venkatesh Babu,	Knowledge structure of computational mechanics: Heat mass transfer	International Journal of Mechanical Engineering and Technology	Volume 9, No. 8 (2018)	247-252	2018
3.	Dr.K.P.Ashok, Dr.R. Venkatesh Babu, Dr.V.Balambica	A review of heat transfer in compression ignition engine by applying various injection pressure	International Journal of Mechanical Engineering and Technology	Volume 9, No. 11 (2018)	604-607	2018
4.	Dr.K.P.Ashok, Dr.R. Venkatesh Babu, Dr.V.Balambica	A study on diesel engine performance depends on BP and BSFC by applying different injection pressure	International Journal of Mechanical Engineering and Technology	Volume 9, No. 11 (2018)	599-603	2018
5.	G.Balakrishnan, D. Sastikumar, P. Kuppusami, Dr.R. Venkatesh Babu Dr.J.I.Song	Microstructural and mechanical properties of Al2O3/ZrO2 nanomultilayer thin films prepared by pulsed laser deposition	International Journal of Mechanical Engineering and Technology	Volume 124, No. 2 (2018)	158	2018
6.	Dr. G.Balakrishnana Dr.R. Venkatesh Babu Dr.K.S.Shinc Dr.J.I.Song	Growth of highly oriented γ- and α-Al2O3 thin films by pulsed laser deposition	Optics & Laser Technology	Volume 56, (2014)	317-321	2014

9. Budget

SI.No	Equipments	Quantity	Amount in INR
1	Microscope and testing setup	1	50,000
2	Consumables (Like Fibers, Resins, Wetting particles, Roller, Plastics sheet, etc.,)	As per requirement	40,000
3	Travel support for the purpose of research work	----	5000
4	Contingency	----	3000
5	Others	----	2000
	Total		1,00,000

10. Name of at least two subject experts from the Institute and one from the outside Institute with their contact details:

a) Dr.S.Prakash – Associate Professor, Department of Mechanical Engineering, AVIT Kancheepuram, Chennai – 603 104.

b) Dr.C.M.Meenakshi – Associate Professor, Department of Mechanical Engineering, BIHER, Chennai - 600073.

CERTIFICATE FROM THE INVESTIGATOR

Project Title – Design and Simulation of composite materials based leaf spring

It is certified that

1. I do hereby agree to submit a complete proposal for financial support to the external funding agency within the time period of SMS-2018.
2. I undertake that spare time on equipment procured in the project will be made available to other users.
3. I agree to submit a certificate from institutional Biosafety Committee, if the project involves the utilization of genetically engineered organisms. I also declare that while conducting experiments, the Biosafety Guidelines of Department of Mechanical Engineering, GOI would be followed in to.
4. I agree to submit ethical clearance certificate from the concerned ethical committee, if the project involves field trials/ experiments/exchanges of specimens, human & animal materials etc.
5. I agree to abide by the terms and conditions of SMS-2018, BIHER, and Chennai.

Name and signature of
Principal investigator
(K. Sathish Kumar)

Name and signature of
Co-Principal Investigator

Date: 15/03/2019
Place: Chennai – 73

Forwarded by Head of the Department

Signature of the Head

PROJECT EVALUATION FORMAT

Name of the Principal investigator	K. Sathish Kumar
Name of the Co-Principal investigator	Dr. R. Venkatesh Babu
Name of the Department	Mechanical Engineering
Recommendation of the evaluation committee	Recommended
Financial allocation recommended	Rs. 1,00,000/- One lakh only

SI.No	Equipments	Quantity	Amount in INR
1	Microscope and testing setup	1	50,000
2	Consumables (Like Fibers, Resins, Wetting particles, Roller, Plastics sheet, etc.,)	As per requirement	40,000
3	Travel support for the purpose of research work	----	5000
4	Contingency	----	3000
5	Others	----	2000
	Total		1,00,000

Name and Signature of the Research Advisory Committee members with date

(Dr. P. Navaneethakrishnan)