

CONSULTANCY POLICY

1. Introduction

SR University recognizes the value of consultancy work as a means for faculty to apply their expertise to real-world problems, foster industry collaboration, and enhance their academic and professional development. This policy outlines the guidelines and procedures for faculty members engaging in consultancy activities, ensuring alignment with the university's mission and values.

2. Scope of the Policy

This policy applies to all full-time and part-time faculty members at SR University who engage in consultancy activities, whether individually or as part of a team. Consultancy activities include providing expert advice, research, technical assistance, training, and other services to external organizations, both in the public and private sectors.

3. Objectives of the Consultancy Policy

The objectives of this consultancy policy are to:

- Encourage faculty to engage in consultancy work that enhances their academic and professional growth.
- Ensure that consultancy activities align with the university's mission and do not conflict with faculty members' primary responsibilities.
- Provide a framework for the equitable distribution of income generated from consultancy activities.
- Protect the university's intellectual property and maintain its reputation for academic integrity.
- Facilitate the smooth administration and monitoring of consultancy activities.

4. Types of Consultancies

Consultancy activities at SR University can be classified into the following types:

- *Individual Consultancy:* Consultancy work undertaken by a faculty member in their individual capacity, utilizing their expertise.


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- *Departmental Consultancy:* Consultancy work undertaken by a department or a group of faculty members, involving collaboration and pooling of expertise.
- *Sponsored Consultancy:* Consultancy projects funded by external organizations, including government agencies, industries, and non-governmental organizations (NGOs).
- *Technical Consultancy:* Providing specialized technical services, including testing, analysis, design, and development, to external clients.

5. Guidelines for Consultancy Activities

5.1. Approval Process

- Faculty members must obtain prior approval from the Head of the Department (HoD) and the Dean of the Faculty before accepting any consultancy work.
- A formal proposal outlining the scope of work, duration, estimated income, and potential conflicts of interest must be submitted for approval.
- The Vice-Chancellor's approval is required for consultancy projects exceeding a certain financial threshold, as determined by the university's financial regulations.

5.2. Time Commitment

- Faculty members are expected to prioritize their teaching, research, and administrative responsibilities. Consultancy activities should not interfere with these primary duties.
- The maximum allowable time for consultancy work is 20% of a faculty member's total working hours in an academic year.
- Any consultancy work exceeding this limit must be approved by the Vice-Chancellor.

5.3. Use of University Resources

- Faculty members may use university resources, including laboratories, equipment, and facilities, for consultancy activities, subject to availability and approval.
- A fair usage fee may be charged for the use of university resources, as determined by the university's financial guidelines.
- Faculty members must ensure that the use of university resources for consultancy does not disrupt academic activities or research projects.

5.4. Conflict of Interest

- Faculty members must avoid any consultancy work that could create a conflict of interest with their academic duties or the university's interests.
- Consultancy work that involves a faculty member's own students or research activities must be carefully reviewed and approved to avoid conflicts of interest.
- Faculty members must disclose any potential conflicts of interest in their consultancy proposal and seek guidance from the university's ethics committee.

5.5. Confidentiality and Intellectual Property

- Faculty members must maintain the confidentiality of any sensitive information obtained during consultancy work, as per the terms of the consultancy agreement.
- Intellectual property (IP) generated during consultancy work must be managed in accordance with the university's IP policy. Ownership and rights to IP must be clearly defined in the consultancy agreement.
- Faculty members must ensure that consultancy agreements include provisions for IP protection and revenue sharing, in line with university policies.

6. Financial Management

6.1. Income Distribution

- Income generated from consultancy activities will be distributed as follows:
- Faculty Member: 60%
- University (including department and administrative fees): 30%
- Development Fund: 10%
- The university's share will be used to support research, infrastructure, and development activities.

6.2. Financial Reporting

- Faculty members must maintain accurate records of all consultancy income and expenses.
- A detailed financial report must be submitted to the university's finance office at the end of each consultancy project, including copies of all invoices and receipts.
- The finance office will conduct regular audits of consultancy activities to ensure compliance with financial regulations.


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7. Liability and Insurance

- Faculty members engaged in consultancy work must ensure that appropriate liability and professional indemnity insurance is in place, either through the client or the university.
- The university will not be held liable for any claims arising from consultancy work unless explicitly agreed upon in the consultancy agreement.
- Faculty members must seek legal advice from the university's legal office before entering into any consultancy agreements that involve significant risk.

8. Professional Conduct

- Faculty members must adhere to the highest standards of professional conduct and ethics in all consultancy activities.
- Consultancy work must be carried out with integrity, objectivity, and in a manner that upholds the university's reputation.
- Faculty members must avoid any actions that could damage the university's relationship with clients, partners, or the wider community.

9. Recognition and Incentives

- The university will recognize and reward faculty members who engage in successful consultancy work through:
- Performance Appraisals: Consultancy achievements will be considered in annual performance appraisals and promotion decisions.
- Incentives: Faculty members may receive additional incentives or awards for exceptional consultancy work that benefits the university.

10. Compliance and Monitoring

- The university's consultancy office will monitor all consultancy activities to ensure compliance with this policy.
- Faculty members must submit regular progress reports on ongoing consultancy projects to their HoD and the consultancy office.
- Non-compliance with this policy may result in disciplinary action, including the suspension of consultancy privileges.


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11. Policy Review

- This policy will be reviewed and updated every three years or as needed to reflect changes in university regulations, industry practices, and legal requirements.
- Faculty members are encouraged to provide feedback on the policy to help improve its effectiveness.
- Any change in the policy is applicable from the next academic year only.

12. Contact Information

For queries related to consultancy activities, faculty members may contact:

Consultancy Office

SR University

Warangal, Telangana 506371

Email: dean.rr@sru.edu.in

This consultancy policy ensures that faculty members at SR University can engage in consultancy activities effectively and ethically while contributing to the university's mission and values.


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Institution has created an ecosystem for Innovations, Indian Knowledge System (IKS) including awareness about IPR, establishment of IPR cell, Incubation center and other initiatives for the creation and transfer of technology/knowledge and the outcomes of the same are evident.

About SR Innovation Exchange:

SR University has always been at the forefront of fostering Innovation and Entrepreneurship. Recognizing the importance of nurturing startups and promoting technological advancements, the university established the SR Innovation Exchange (SRiX) as a dedicated Incubation center. SRiX was conceived as a pivotal component of the university's broader mission to create an ecosystem that supports innovation, and the development of the Indian Knowledge System (IKS) supported by a dedicated intellectual property rights (IPR) cell.

The primary goal of SRiX is to provide a conducive environment where innovative ideas can be transformed into successful enterprises, thereby contributing to the socio-economic development of the region and the country at large. The IPR cell is aligned with its goal by fostering and creating the IP that focuses on the IKS and their role in driving socio-economic development. Key innovations include agricultural preservation, by-product utilization, waste heat for grain drying, soil-less agriculture, soil fertility enhancement, prosopis juliflora-based concrete compositions. The IPR cell protects innovation by combining technical and legal expertise, while promoting sustainable commercialization.

SRiX operates as a dynamic platform that brings together a diverse range of students, faculty, industry experts, and entrepreneurs to foster collaboration and drive innovation. The incubation center provides essential services for startup growth, including mentorship, funding access, advanced infrastructure, networking, and business development support. By providing these resources, SRiX empowers entrepreneurs to overcome the common startup challenges, such as limited access to capital, lack of industry connections, and insufficient market knowledge, helping them thrive in their ventures.


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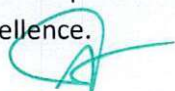
SRiX encompassing a wide range of initiatives aimed at promoting innovation and knowledge transfer. SRiX - Technology Business Incubator majorly supported by DST, NIDHI Initiative and supported by various other Departments like MeitY, DPIIT, MSME etc. The major DST NIDHI Initiatives are NIDHI TBI, NIDHI SSS, NIDHI PRAYAS, DPIIT SISFS, NIDHI EiR, NIDHI Accelerator & MSME Aspire. SRiX regularly organizes workshops, seminars, and conferences that bring together experts from academia, industry, and government to discuss the latest trends and developments in technology and entrepreneurship. These events serve as a platform for knowledge exchange and collaboration, enabling participants to stay abreast of emerging opportunities and challenges in their respective fields.

Since its inception, SRiX has incubated 110+ startups across various sectors, including Technology, healthcare, agriculture, and education. Many of these startups have gone on to achieve significant milestones, such as securing funding from investors, entering strategic partnerships, and launching products in the market. The impact of these startups extends beyond their individual successes, as they contribute to job creation, economic growth, and the advancement of technology in India.

SRiX as a dedicated incubation center is a testament to its commitment to fostering innovation, entrepreneurship, and technology transfer. By creating a supportive ecosystem that integrates the IKS, raises awareness about IPRs, and provides comprehensive support to startups, SR University has positioned itself as a leader in the field of innovation and entrepreneurship. The success of SRiX and its affiliated startups is a clear indication of the effectiveness of the university's initiatives.

SR Innovation Exchange Provides:

- **Idea Valuation/ Validation support**
- **Product Development – End to end support**
- **Incubation and Acceleration Support**
- **Mentoring Support:** Branding, marketing, Go-to market, Business Expansion, Technology Commercialization support.
- **Legal Support:** Company incorporation and documentation, Intellectual Property (IP), Patenting, Regulatory Compliance.
- **Funding Support:** Seed capital, Grants, Angel Investors, Venture Capitalists, investor connect.
- **Financial Services:** Accounting, Filings, Valuations etc.
- **Connections & Networking:** Mentors, investors, industry partners , Government , Higher Education institutions connections.
- **International Linkages:** International exchange programs, collaborations & partnerships
- **Infrastructure:** Maker space, 3D Prototyping, IoT/ESDM Centre of Excellence.


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- **Human Resources:** Hiring of interns and fresh grad, Team management, partners fit.

Flagship Events of SR Innovation Exchange:

SRiX (SR Innovation Exchange) hosted several flagship events designed to foster entrepreneurship, innovation, and collaboration among startups. These events are integral to SRiX's mission of nurturing the startup ecosystem and providing a platform for aspiring entrepreneurs to showcase their ideas, gain valuable insights, and connect with key stakeholders in the industry.

1. **Startup Bootcamps:** Startup Bootcamps are intensive, short-term programs designed to help early-stage entrepreneurs refine their business ideas, develop their products, and create a viable business model. These boot camps provide hands-on training, mentorship, and access to resources that are crucial for the success of a startup.
2. **Innovation Hackathons:** These are competitive events where teams of innovators, developers, and entrepreneurs come together to solve specific industry challenges within a limited time frame. These hackathons encourage creative problem-solving and rapid prototyping, allowing participants to develop innovative solutions in a collaborative environment.
3. **Demo Days:** These are showcase events where startups that have been incubated at SRiX present their products or services to a curated audience of investors, industry leaders, and potential customers. These events are a critical opportunity for startups to gain visibility, attract investment, and form strategic partnerships.
4. **Investor Meets:** Investor Meets are exclusive networking events that connect startups with potential investors, including venture capitalists, angel investors, and corporate partners. These events are designed to facilitate direct interaction between startups and investors, providing a platform for startups to pitch their ideas and seek funding.
5. **Entrepreneurship Summits:** Entrepreneurship Summits are large-scale conferences that bring together entrepreneurs, investors, industry leaders, academicians, and policymakers to discuss the latest trends, opportunities, and challenges in the startup ecosystem. These summits serve as a knowledge-sharing platform and provide a space for networking and collaboration.
6. **Startup Showcases:** Startup Showcases are curated exhibitions where startups display their products, services, and innovations to a broader audience. These events are often part of larger conferences or industry events and are designed to help startups gain


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1. visibility and attract interest from potential customers, partners, and investors like Innovation X Series & Sprint series.
2. **Mentorship Programs:** These are structured initiatives that pair startups with experienced mentors who provide guidance, advice, and support throughout their entrepreneurial journey. These programs are designed to help startups navigate challenges, refine their business strategies, and achieve their growth objectives like Entrepreneurship Talk series, Women entrepreneurship week series talks, Investor meetups and Mentor connect programs.

These flagship events are central to SRiX's efforts to build a vibrant and supportive startup ecosystem. They provide startups with the Tools, Knowledge, and Connections they need to succeed, while also contributing to the broader goals of innovation, economic development, and technology transfer.

Supporting Document Links:

S. No	DESCRIPTION	LINK
1	Incubation Agreement	Incubation Agreement.docx
2	Events Conducted	Events and Workshops from 2020-2023.pdf
3	SRiX Compendium	SRiX Compendium.pdf
4	Registered Startups	Total Startups Supported.pdf
5	Annual Reports of Incubation Center	SR Foundation (SRiX) Final Report 2018-2023 (3).pdf
6	IPR Cell Establishment	IPR Cell Establishment

SRIX SCHEMES:

MeitY TIDE 2.0 (Technology Incubation & Development of Entrepreneurs):

Department: MeitY (Ministry of Electronics & Information Technology)

To Promote Tech Entrepreneurship through financial and technical support through incubators to support startups primarily using emerging technologies such as IoT, AI, Block-chain, Robotics etc.

Eligibility:

Any individual/start-up/student who has potential and innovative business ideas can apply for the program. The ideas should be based on emerging technologies like IoT, AI/ML, Block chain, robotics, across all sectors viz. agritech, healthtech, EdTech, fintech, waste management, renewable energy etc.

Funding:

- TIDE Entrepreneur-in-Residence (EIR): **Upto Rs 4 Lakhs per start-up** for developing an idea.
- TIDE Prototyping Grant: **Upto Rs 7 Lakhs per start-up** for developing their prototype.
- TIDE Investment: **Upto Rs 35 Lakhs per start-up** as seed -funding.

DST - NIDHI PRAYAS: (National Initiative for Development & Harnessing Innovation)

Department: Department of Science & Technology (DST), GoI.

NIDHI PRAYAS (Promoting and Accelerating Young and Aspiring Technology Entrepreneurs)

Support young Innovators turn their ideas into (Proof of Concept) PoC. Allow the Innovators to try their ideas without fear of failure, to reach a stage where they have a ready product for commercialization.

Eligibility:

Startup should be a registered company and the founder(s) should be an Indian citizen(s), with min 3 months of residency at the TBI's and it should be a physical product startup.

Funding: **Upto Rs 10 Lakhs** per start-up for developing a prototype.


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DST - NIDHI SSS (SEED SUPPORT SYSTEM):

Department: National Science & Technology Entrepreneurship Development Board (NSTEDB), Department of Science & Technology (DST), GoI.

NIDHI SSS provides financial assistance to potential startups with promising ideas, innovations and technologies.

Eligibility:

Startup should be a registered company and the founder(s) should be an Indian citizen(s), with an idea or prototype.

Funding: Upto Rs 50 Lakhs per start-up on equity basis.

DPIIT - SISFS: DEPARTMENT for PROMOTION of Industry & Internal Trade STARTUP INDIA SEED FUND SCHEME.

Department: DPIIT (Department for Promotion of Industry and Internal Trade).

Provide financial assistance to startups for proof of concept, prototype development, product trials, market entry and commercialization.

Eligibility:

A Startup recognised by DPIIT, incorporated not more than 2 years ago at the time of application.

Funding: Up to Rs 20 Lakhs as grant and Rs 50 Lakhs in a debt instrument per start-up.

DST - NIDHI ACCELERATOR

Department: Department of Science & Technology (DST), GoI.

Accelerator is a typically a 3-6 months' fast track structured program helping ideas get accelerated to the next orbit. An accelerator aims at achieving one or more of the following objectives - introduction to entrepreneurial development to identify business opportunities (real problems that require real solutions), validate product ideas, engage with potential


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customers, build a scalable business model, build a product demonstration, manage team dynamics and pitch to investors.

Eligibility: Growth stage start-ups with traction.

Funding: Through VC's/Angel Investors.

DST - NIDHI Entrepreneur-in-Residence (EiR):

Department: Department of Science & Technology (DST), GoI.

The NIDHI-EiR support recipient will be eligible for a fellowship of upto Rs.30,000/- per month for a period of 12 months.

Eligibility:

The EiR applicant should be a citizen of India. Should have completed minimum 4 Years of formal full time.

Undergraduate/post graduate education OR 3 years degree or diploma program with 2 - year full time work experience.

Funding: Upto Rs 30,000 per Month as Fellowship.

Achievements listed below:

S.No	Accomplishments	Information	Attachments
1	SRiX as Program Executing Partners for	DST NIDHI TBI, NIDHI SSS,NIDHI PRAYAS,NIDHI EIR,DPIIT SISFS, MeitY TIDE.	NA
2	Number of Incubated Startups	110	Total Startups Supported.pdf
3	Number of DPIIT Recognized Startups	35	DPIIT Recognised Startups
4	Revenue Generated by	Rs. 26 cr	Revenue Generated

	Startups		
5	Funds Disbursed to startups	Rs. 7.63 cr	<u>Funds Disbursed</u>
6	External Funds Raised	Rs. 45 cr+	<u>External Funds Raised</u>
7	IP Generated	20	<u>IP Generated</u>
8	Industry & Academic Network Connects	20	<u>Industry & Academic</u>
9	Employment Generated	447	<u>Employment Generated</u>
10	Products Developed	35	<u>Products Developed</u>
11	Women startups Supported	28	<u>Women led startups</u>
12	Intellectual Property Rights (IPR) Cell	7 (Patents Granted) 193 (Patents Published)	<u>IPR Cell</u>

About 110 startups have incubated in SRiX Since 2018, Some of the notable successful startups are:

1. Autoyos Private Limited: www.autoyos.com
2. Clearcals Private Limited: www.clearcals.com
3. VMS Healthcare Solutions Private Limited: www.medvolant.in
4. Rivot Motors India Private Limited: www.rivotmotors.com
5. Algohire Technologies Private Limited: www.algohire.ai
6. Nemocare Wellness Private Limited: www.nemocare.in
7. SparshMind Innovations Private Limited: www.sparshmindinnovations.com
8. Zithara Technologies Private Limited: www.zithara.ai
9. HiltBrands India Private Limited: www.bibo.health
10. Secernate Games Private Limited: www.secernategames.com
11. Vaidyuthi Mobility Private Limited : www.vaidyuthimobility.com

SEED GRANT POLICY

(For Faculty Research Enhancement)

SRU seed grant program aims to foster the high-quality research and innovation through financially supporting the faculty members for training towards novel projects, enabling the groundwork like data collection for making proposals for external funding, and improving the research profile of the university. All SR University full-time faculty members, regardless of their subject, are eligible to apply for the Seed Grant. Early-stage research, creative concepts, and multidisciplinary initiatives with the possibility for external funding are the focus of this seed grant program.

Objective

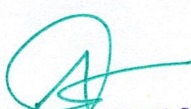
- To support the faculty members to develop the research facility
- To build the preliminary data for making research proposals for external funding agencies
- To motivate the faculty members to create facility to produce the product/innovative/IPR by forming interdisciplinary/multidisciplinary research groups/clusters

Duration and Financial Assistance:

For each project selected under SRU seed grant program, a maximum of Rs. 2 lakhs will be awarded. The maximum period of the seed grant is two years from the date of authorization. Equipment, consumables, research travel, fieldwork, student assistance, and other reasonable research expenditures may be covered by the grant.

Eligibility Criteria

- Early-career researchers will be given preference among all doctorate faculty members
- Unless the Seed Grant is for a clearly separate initiative, faculty members who are already the recipients of external funding may not be eligible
- Projects involving various departments are particularly encouraged to be collaborative
- Non-doctoral faculty members are not encouraged to apply, although they may serve as the co-PI alongside early career doctorate faculty



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Application Process

- Every year in July, academic members can submit their research proposals in response to the call for proposals under seed grant program.
- Before the deadline for submission, the candidate must submit their thorough research proposal in the prescribed format (Annexure 1) to the Dear R&R office.

Review Process

- Proposals will be evaluated by the University Research Committee (URC), which consists of senior faculty members from diverse disciplines.
- The review criteria include the scientific merit of the proposal, feasibility, potential impact, and alignment with institutional research priorities.
- Proposals may be subject to external review where necessary.

Monitoring and Reporting

- Grant recipients are required to submit a mid-term progress report and a final report to the research office.
- The final report should detail research findings, publications, presentations, patents (if any).
- Failure to comply with reporting requirements may result in the suspension of funding or ineligibility for future seed grants.

Expected Outcomes

- During or shortly after the award period, it is expected that the Seed award will lead to at least one of the following outcomes:
 1. Submission of proposal to external funding agency.
 2. At least one SCI publication.
 3. Filing for a patent or intellectual property rights (where applicable).

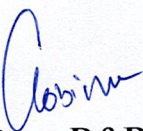


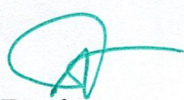
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Terms and conditions

1. You are responsible for managing the awarded funds in accordance with the financial policies and guidelines of SR University.
2. You are required to submit an extension of this proposal for any external funding agency shortly.
3. The equipment procured through the Seed Grant Program should be made available for all the stakeholders of SR university based on their requirement.
4. Progress reports are due on a quarterly basis, and a final report is required at the conclusion of the project. These reports should detail the progress made, challenges faced, and outcomes achieved.
5. Any changes to the project plan, budget, or timeline must be communicated promptly to the research office for approval.
6. Any publications resulting from this research should acknowledge the support of the Seed Grant Program of SR University.
7. You will be required to present your findings at national or international events.


Dean R&R


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APPLICATION FOR SEED GRANT PROJECT

Academic Year: 2022-23

Section A: Personal information

1. Name of the faculty :
2. Designation :
3. Department :
4. Employee ID :
5. No of Scopus indexed Publications :

Section B: Project information

1. Project Title (Not exceeding 15 words):
2. Name of the faculty in case of joint proposal with their respective department(s):

(i)

(ii)

3. Duration (Years/ months) :
4. Budget :

(a) Non-Recurring Expenditure

Sl. No.	Name of the item	Availability in University (Yes/ No)	Tentative Cost	Specification/ configuration	Usage of this item for UG/ PG teaching- Give details

(b) Recurring

Sl. No.	Name of the item/ Activity	Tentative Cost	Comments / Any other details

Note: Total cost of the project proposed should not exceed Rs. 2,00,000 and the minimum proposed amount should be Rs.1,00,000.

Section C: Technical Details

1. I. Statement of the problem
 - i. State the main problem you seek to address: (250 words minimum)
 - ii. Why is it important to solve it? (250 words minimum)(Give the gist of the project in an understandable way)
- II. Suggested solution (250 words minimum):



(Describe how the proposal will lead to a novel and effective solution, based on a scientifically and technically sound concept and keeping in view the user needs and local availability of resources), Outline your idea or solution you plan to develop:

2. Review of Status – (250 words minimum): Write about any other initiatives related / similar proposed activities are available to solve this problem? What were the outcomes?
3. Proposed Objectives (Max. 3 focused objectives shall be included):

i.	
ii.	
iii.	

4. Methodology (250 words minimum):
(Give details on how the project intends to solve these problems in the long-term. In addition, please detail the manner in which this effort will help advance the field further. To accomplish the set goals, support with clearly outlined methods and related process elements such as a flowchart, model, survey procedure, protocols, engineering design/schematic/layout plan.)
5. Work Plan (150 words – Please also provide activities schedule):
 - i. Phase wise work plan of action with timeline and deliverables in tabular form.
 - ii. Technology Development/Adoption/Modification, if applicable
As applicable (Provide information on the new R&D/adapted R&D to be carried out for technology development / adoption / modification and brief description of the technology or training package(s) to be used. Information should be provided on the scale of operation, minimum economic viable scale, estimated cost, and likely benefits of the proposed technological intervention):
 - iii. Institutions / place where detailed lab/field testing or experiments will be carried out:
 - iv. Expected outcome (100 words): (Clearly inform expected publications / patents / technology transfer, etc.)
6. Environmental, Legal and Ethical Issues:
(Explain any environmental, legal, and ethical compliance issues. Please mention how these will be addressed & enclose clearance certificate from concerned authorities, if required)
7. Explain how this project is funded will help in SRTOP 5 mission: (Minimum 100 words)
8. Will this project involve / help in any way UG / PG students: (Minimum 50 words)
9. a) This funding and the project should be used to develop Proof of Concept for a proposal submission to a national or international funding. In this case, which proposal does PI and his team intend to submit? (Minimum 300 words)
b) Give information on this proposal's suitability to match the grant proposal, explain how this POC will match that call for, provide the link for that call for, if any. (Minimum 300 words)
10. When the proposal will be submitted to the funding bodies? Provide tentative dates.
11. Can this project, if completed and the outcome arising out of it end up as a startup/ technology transfer to industry? (Minimum 100 words)



12. Will there be any patent/ Industrial design arising out of the project? (Minimum 50 words)

Selection process:

1. Faculty who joined after July 2021 are only eligible for the seed fund as PI, other faculty can be Co-PI.
2. Last date for submitting proposal is 31st August 2022, submit the proposal to dean.rr@sru.edu.in
3. Selection will be done by the expert panel by 30th September 2022 and results will be announced by 15th of October 2022.
4. Only properly completed forms which include all necessary information will be considered for funding.
5. The only parameter for selection is the viability and potential of the proposal to be converted into a larger funding grant proposal of at least 10 times the seed grant.
6. The expert panel reserves the right to select or reject any number of projects based on merit of the proposal.
7. All proposals submitted will be checked for plagiarism and it should comply with all our research policies.
8. No approval of Heads/ Deans required to submit the proposal.



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Utilisation Certificate

Certified that out of Rs. _____/- of grants-in aid sanctioned during the year _____
in favour of _____ and _____ on account of unspent balance of the previous
year, a sum of _____ has been utilised for the purpose of executing the project for
which it was sanctioned.

Signature of the PI

Date:

Signature of Registrar

Date:

Signature of the Accounts Officer

Date:



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Statement of Expenditure

1. Seed project sanction order No. _____ & Date: _____
2. Name of the PI and Department

S. No.	Sanctioned Head	Total Amount Sanctioned (Rs.)	Total Amount Utilized (Rs.)	Balance Amount (Rs.)	Remarks (If any)
1	Equipment				
2	Contingency				
3	Consumables				
4	Total				

- **Name and Signature of the PI**

Date:

Signature of the Accounts Officer

Date:



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Project Completion Report

1. Title of the Project:
2. Name of the PI and Co-PI:
3. Date of commencement:
4. Planned date of completion:
5. Actual date of completion:
6. Objectives as mentioned in the proposal:
7. Deviation made from original objectives while implementing the project and reason (if any):
8. Experimental details: (Experimental setup, methods, data collection by tables, charts, diagrams, photographs)
9. Detailed analysis and results:
10. Conclusions and Scope for future work:
11. List of Research publications and patents:

Note: 1. PCR should be in bound form

2. Cover page should include the title of the project, file number, and names and address of the investigators

Name & Signature of the Co-PI

Date:

Name & Signature of the PI

Date:



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Lr No./ SRU/Circular/2022/01

Date: 4th July 2022

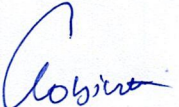
CIRCULAR

Sub: SRU Seed Grant Program (Internal Research Funding) – Call for Proposals – Reg.

This is to inform all the faculty members that the project proposals under the “SRU Seed Grant Program – Internal Research Funding” are invited for the academic year 2022-23.

The last date for submission of proposals is 31st August 2022. The project proposal template and application format are attached herewith.

All the eligible faculty members are encouraged to submit their project proposals within the stipulated time. Please refer the Seed Grant policy for further details.


Dean-R&R

Copy to:

1. PA to VC
2. Registrar
3. Deans
4. Heads



APPLICATION FOR SEED GRANT PROJECT

Academic Year: 2022-23

Section A: Personal information

1. Name of the faculty : Dr. K. Srishailam
2. Designation : Assistant Professor
3. Department : Physics
4. Employee ID : 3513
5. No of Scopus indexed Publications : 14

Section B: Project information

1. Project Title (Not exceeding 15 words): **Novel approach to structure determination and subsequent complete characterization of some important molecules**
2. Name of the faculty in case of joint proposal with their respective department(s): NA
3. Duration (Years/ months) : 12 months
4. Budget : Rs. 2,00,000/-

(a) Non-Recurring Expenditure

Sl. No.	Name of the item	Availability in University (Yes/ No)	Tentative Cost	Specification/ configuration	Usage of this item for UG/ PG teaching - Give details

(b) Recurring

Sl.No.	Name of the item/ Activity	Tentative Cost	Comments/ Any other details
1	Consumables	Rs. 1,00,000/-	Chemicals and Glassware
2	Contingency	Rs. 1,00,000/-	Sample Testing

(c) Manpower requirement

Sl.No.	Requirement (Student intern, JRF, SRF, Field assistant, Support staff etc.)	Tentative Cost per month	Total cost
-	NA	0	0

Total = (a + b+ c): Rs. 2,00,000/- (Two Lakh Four Thousand Rupees Only)



Section C: Technical Details

1. Statement of the problem

(i) State the main problem you seek to address:

The main focus of this project involves an attempt to understand the structural properties, involving bond lengths, bond angles and dihedral angles, the energetic behavior, as revealed by proton affinity, electron affinity and rotational barriers, the vibrational characteristics, comprising of harmonic frequencies, general valence force field and potential energy distribution of some important molecules, using density functional theory (DFT) in conjunction with quantum theory of atoms in molecules (QTAIM), supported by experimental multi-spectral techniques, comprising of X-ray analysis, infrared spectroscopy, Visible spectroscopy, ^1H nuclear magnetic resonance spectroscopy, ^{13}C nuclear magnetic resonance spectroscopy, wherever needed and possible. In addition, the project also aims at making complete characterization of molecules of interest. To this end it is essential to undertake theoretical investigation of electronic spectra, chemical shifts associated with nuclear magnetic resonance (NMR) spectra, nonlinear optical (NLO) behavior, frontier molecular orbital (FMO) properties, (NBO) analysis, molecular electrostatic potential (MESP) characteristics, chemical reactivity, molecular association through hydrogen bonding and thermodynamic properties.

(ii) Why is it important to solve it?

The role of research in basic sciences is to find an answer to why things are what they are. This requires deeper understanding of various molecular properties at the atomic level, as molecules consist of atoms bound together by chemical bonds. It is known that a molecule is the smallest entity of a given substance, as far as its physical and chemical properties are concerned, which depend on electron charge distribution, potential function in which the atoms execute oscillations about their mean positions, atomic masses and chemical environment around atoms among other things. This underlines the need for complete characterization of a given molecular system, which involves determination of

- (i) molecular structure,
- (ii) NMR chemical shifts,
- (iii) Vibrational frequencies,
- (iv) Potential constants,
- (v) Electronic spectra and their explanation using HOMO (highest occupied molecular



orbital) and LUMO (lowest unoccupied molecular orbital),

- (vi) Chemical reactivity and explanation using HOMO and LUMO orbitals,
- (vii) Nonlinear optical (NLO) properties to understand utility of the substance for harmonic generation, optical switching etc.
- (viii) Natural bond orbital (NBO) parameters in order to understand electron charge cloud movement and intermolecular interactions,
- (ix) Existence of intramolecular and intermolecular hydrogen bonding,
- (x) Molecular electrostatic potential (MESP), to know about reactive sites in a molecule that are prone to electrophilic and nucleophilic attack by approaching chemical species
- (xi) Thermodynamic parameters

II. Suggested solution

We use a novel method, to determine dihedral angles around flexible bonds which evolved as a result of our previous research. We named it bond-pairing method. However, its efficacy remained to be tested for more complex molecules. This project is expected to fill that gap. The need for our method is briefly explained.

An essential requirement to start electronic structure computations based on quantum chemical procedures is the availability of reliable structure, consisting of bond lengths, bond angles and dihedral angles, for the system of interest. In the absence of experimental structure data, it is an accepted practice to use relevant data available with Gauss View [1] library to arrive at a preliminary structure of the molecule, and use it for geometry optimization process in DFT. However, our previous experience with three positional isomers of biphenylcarboxaldehydes (BPA) [2] showed, that such a procedure need not necessarily succeed when the molecular system has flexible bonds (i.e. bonds about which rotation is permitted), as an integral part of its structure. The problem was understood to be created by twist angles associated with the flexible bonds, which were known to vary over a wide range of values, especially in complex molecules. Then, we proceeded to address this problem, for BPA, by pairing flexible bonds; evaluating torsional potential energy at various values of dihedral angles around the paired bonds in the entire conformational space spanning 0° to 360° ; and making a graphical analysis of the resulting data. We call this the "bond-pairing" method.

The purpose is to determine preliminary values of torsional angles associated with flexible bonds of a molecule so as to use them for geometry optimization, along with bond lengths and bond angles borrowed from the Gauss View [1] library.



2. Review of status

The method of determining preliminary values of torsion angles around flexible bonds in a molecule was not attempted by any other investigator. The method is conceived and implemented by us. However, characterization of molecules was reported by others as well. A brief review follows.

Review of status of Research and Development in the subject

The compound Ethyl 4-aminobenzoate – 3,5-dinitrosalicylate salt [ES], which is a potent anesthetic drug salt was investigated experimentally and computationally collaboratively by research groups from Sweden, Poland, India and Jordan [3]. They synthesized, crystallized and characterized it using FT-IR, ^1H NMR, ^{13}C NMR and single crystal X-ray diffraction method. The molecular structure and crystal packing were found using theoretical optimization at the DFT level and applying Quantum Theory of Atoms in Molecules (QTAIM) methodology. Further, the molecular packing is evaluated using Hirshfeld surface analysis. The crystal structure is stabilized via intermolecular hydrogen bonds of the type $\text{N} - \text{H} \cdots \text{O}$ and $\text{O} - \text{H} \cdots \text{O}$. Another collaborative work involving researchers from Morocco, Saudi Arabia, USA and Turkey [4] includes preparation of two novel 1,5-benzodiazepin-2-one derivatives and their characterization using different spectroscopic techniques and single crystal X-ray diffractometry. The DFT-B3LYP study was also performed to investigate differences in the electronic properties. The in vitro antibacterial activity of some 1,5-benzodiazepine heterocyclic compounds was investigated against *Escherichia coli* ATCC 4157, *Pseudomonas aeruginosa* ATCC 27853, *Staphylococcus aureus* ATCC 25923 and *Streptococcus faecalis* ATCC 29212 bacterial strains. Collaborative investigations reported by research scientists from South Africa, Nigeria and Portugal is also available [5]. They synthesized three (3) Schiff bases: (1) (E)-1-(2-nitrophenyl)-N-(o-tolyl) methanimine, (2)(E)-2-isopropyl-N-(2-nitrobenzylidene)aniline, (3)(E)-2-((2-nitrobenzylidene)amino)phenol in solvent-free approach and characterized using ^1H and ^{13}C NMR, UV-Visible, FT-IR, mass spectrometry and elemental analysis. The structure of first was determined by single-crystal X-ray diffraction measurements. The compounds showed moderate antibacterial activities against *E. coli*, *Styphimurium* and the second compound was found to be selectively active against *P. aeruginosa*. DFT was used to determine the appropriate geometries and electronic properties at the atomic level. Molecular docking studies were used to complement the antibacterial activities to reveal sites of the compound with the best binding affinity and the important residual interactions.



R. V. Kabilan, C. Arunagiri, G. R. Ramkumaar, K. Sathyamoorthy and C. Karnan, synthesized 9-[3,4-dihydroxy-5-(hydroxyme-thyl) oxolan-2-yl]-1,9-dihydro-6H-purin-6-one 4-nitrophenol [6] using solvent vaporization technique. The compound was subjected to single-crystal X-ray diffraction analysis, Hirschfeld studies, ^1H NMR and ^{13}C NMR investigations, FT-IR and UV-Visible spectroscopic observations. Density functional theory calculations were performed at Becke-3-Lee-Yang-Parr (B3LYP) level and M06-2X, combined with the standard 6-31G (d,p) basis set. The antibacterial activity tests indicated that the compound inhibited both *Vibrio alginolyticus* and *Staphylococcus aureus* bacteria. T. Kalaiaarasi and M. Senthilkumar, synthesized a nonlinear optical material, ammonium hydrogensquarate squaric acid monohydrate [7] and its single crystals were grown by slow evaporation solution technique. The crystals were subjected to X-ray diffraction analysis, Hirshfeld surface analysis. The compound was characterized by FT-IR, FT Raman, UV-Visible, Photoluminescence, Microhardness and second harmonic generation. Experimental molecular geometry compare well with AM1, HF and Density Functional Theory calculations. The second order NLO studies were made using Kurtz and Perry powder technique.

3. Proposed objectives:

- (i) Efficacy of utility of bond-pairing method for geometry optimization of complex molecules
- (ii) Transferability of torsion angles determined by bond-pairing method to other related systems
- (iii) Complete and comprehensive characterization of molecules of interest

4. Methodology:

a) Experimental details

High purity samples will be purchased and will be used as such for spectral measurements. The Fourier transform infrared spectra of the chosen samples will be recorded in the region $4000\text{--}50\text{ cm}^{-1}$ with a resolution of 1 cm^{-1} . The corresponding Fourier transform Raman spectra will be recorded in the range $4000\text{--}10\text{ cm}^{-1}$, with the same resolution as infrared. ^1H NMR, ^{13}C NMR and UV-Visible spectra will also be recorded.

b) Computational details

To initiate geometry optimization, one requires an initial structure, for the molecule of interest. In the absence of experimental structural information, it is an accepted practice to generate required starting structure, for DFT computations, with the help of Gauss View. This consists of bond lengths, and bond angles, in addition to dihedral angles associated with a rotating bond, for a non-rigid molecule. The values of former two quantities are readily



available with the Gauss View, with sufficient accuracy. But such is not the case for the last quantity, as dihedral angles are known to vary over a wide range of values in large molecules. Hence, we have a situation, wherein majority of the structure parameters have reasonable accuracy, while the rest of the parameters are not that accurate. This means, initial parameters are incompatible in terms of their accuracy. If this discrepancy is significant, then it reveals itself by generating imaginary frequencies, when we attempt geometry optimization with such initial data. This is a disturbing problem familiar to investigators using DFT, for structure related problems. Two methods are available to address this problem. But the required computer time is prohibitively high. Against this back drop we thought of a different approach, that is less demanding on computing time and at the same time capable of providing values of required dihedral angles, with reasonable accuracy, so as to be useful as preliminary values, along with other structure parameters provided by Gauss View, for final optimization. The proposed method consists of torsional potential energy scans, at various values of dihedral angles, around bonds that are capable of rotation around themselves, by pairing such bonds in an innovative manner. The process has been successfully applied to three positional isomers of biphenylcarboxaldehydes (BPA), containing a pair of flexible bonds and extended to a molecule belonging to heterocyclic thiosemicarbazone [8-10] family having five rotating bonds. However, this method needs to be generalized by testing its efficacy to more complex molecules. Further, we wish to test transferability of dihedral angles within related systems, which remains untouched till today. Thus the importance of the work is two-fold. (i) testing the efficacy of bond pairing method to relatively complex molecules and (ii) testing transferability of dihedral angles with in related systems. The geometry optimization, and vibrational frequency calculations will be carried out with DFT and QTAIM software package, using the B3LYP [11] functional combined with standard basis set. The theoretical force constants will be computed in Cartesian representation at optimized geometry. Scaling of the force field will be performed according to the SQM procedure [12-16] using selective scaling in the natural internal coordinate representation. Transformation of the force field and subsequent normal coordinates analysis, including the least-square refinement of the scaling factors, calculation of Potential Energy Distribution (PED) and the prediction of IR and Raman intensities will be done using the MOLVIB program[17,18] (Version 7.0-G77) in order to obtain better agreement between observed and calculated frequencies. For the plots of simulated IR and Raman spectra, pure Lorentzian band shapes will be used with a bandwidth (FWHM) of 10 cm^{-1} . The vibrational modes will be assigned by means of visual inspection using the Gauss View program [1], PED and eigenvectors. The geometry optimization and vibrational frequency calculations will be



carried out with atoms in molecules software (QTAIM), using suitable exchange-correlation functional and basis set. NMR and UV-Vis spectra will also be simulated for comparison with their corresponding experimental spectra. Further, NLO, FMO, NBO, MESP and thermodynamic parameters will be evaluated along with barrier heights in order to complete the characterization of chosen molecules.

References

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2. K. Srishailam, B. Venkatram Reddy, G. Ramana Rao, J. Mol. Struct. 1196 (2019) 139-161.
3. N. K. Manjunatha, N. NajibAlzubaidy, U. Likhitha. M. Manjunath, K. Saravanan, B. V. Krishna Reddy, B. R. Kannika, G. Somashekarachar, M. T. Swamy, B. P. Siddaraju, P. Nagendra, Rajesha, S. Madan Kumar, J. Mol. Streuc. 1263 (2022) 133049.
4. Karim Chkirate, Jihane Akachar, Brahim Hni Tuncer Hökelek, El Hassane, Anouard Ahmed Talbaoui, Joel T. Mague, Nada Kheira Sebbar, Azeddine Ibrahimi, El Mokhtar Essassi, J. Mol. Struct. 1263 (2022) 131188.
5. Tunde L. Yusuf, Segun D. Oladipo, Sulaimon A. Olagboye, Sizwe J. Zamisa, Gideon F. Tolufashe, J. Mol. Struct. 1222 (2020) 128857.
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17. T. Sundius, MOLVIB - A flexible program for force field calculations, J. Mol. Struct. 218 (1990) 321-326.
18. T. Sundius, Scaling of ab initio force fields by MOLVIB, Vib. Spectrosc. 29(2002)89- 95.



5. Work plan

- (i) Phase wise work plan of action with timeline and deliverables in tabular form.

Plan of action	0-3 months	4-6 months	7-9 months	9-12 months	13-15 months
Literature collection					
Procurement of chemicals					
Synthesis and Characterization					
spectral analysis, computational investigations and interpretation of results					
Publications					
Report writing					

- (ii) **Technology Development/Adoption/Modification, if applicable**

Not applicable

- (iii) **Institutions / place where detailed lab/field testing or experiments will be carried out:**

➤ **IITM, Chennai and NIPHER Hyderabad**

- (iv) **Expected outcome:** (Clearly inform expected publications/ patents/ technology transfer, etc.)

We strive to achieve the proposed objectives set forth in section 3. Thus, the expected outcome includes:

- It is expected that the bond-pairing method will successfully provide initial values of torsion angles that can be pressed into final geometry optimization of complex molecules.
- We are hopeful of transferability of dihedral angles obtained from bond-pairing method to related molecules.
- We are also confident of obtaining theoretical results, that are generated using the geometry so obtained agree well with experimental results.
- Barrier heights, which are structure sensitive, obtained using geometry generated by bond-pairing method, are expected to exhibit fair agreement with experimental results/with those of related molecules, wherever available.
- A complete characterization of molecules of interest is highly likely to emerge as outcome of this project.
- The results obtained in this project will be published as comprehensive research articles in international scientific journals having impressive impact factors.

6. Environmental, Legal and Ethical Issues:

(Explain any environmental, legal, and ethical compliance issues. Please mention how these will be addressed & enclose clearance certificate from concerned authorities, if required)

- No environmental, legal and ethical issues

7. Explain how this project is funded will help in SRTOP 5 mission: (Minimum 100 words)

The most important responsibility of universities is **creation of new knowledge**, which keeps them apart from colleges, where teaching activity comes at the top of their priority list. Such knowledge emerges from honest research in current areas of active research. Results from such research are welcomed by international journals of repute and international

bodies that organize conferences, seminars and symposia. Research articles published in reputed journals, as a result of the present project, bring national and international recognition not only to the authors but also to the institution, where the research work is carried out. Thus, the present project is a small but significant step towards realizing **SRTOP5 mission goal**.

8. Will this project involve/ help in any way UG / PG students:(Minimum 50 words)

➤ Not relevant as SRU is not offering any UG/PG courses in basic sciences

9. a) This funding and the project should be used to develop Proof of Concept for a proposal submission to a national or international funding. In this case, which proposal does PI and his team intend to submit? (Minimum 300 words)

Vibrational spectroscopy plays an important role in the determination of molecular structure. Molecular motions involving rotations and vibrations, generally give rise to spectra, in the microwave and infrared regions. Information on vibrational frequencies can also be obtained from Raman spectrum. From a study of these spectra, molecular parameters such as moment of inertia of the molecule, inter-nuclear distances, bond angles, thermodynamic parameters and force field can be determined. High purity samples will be purchased and will be used as such for spectral measurements. The Fourier transform infrared spectra of the chosen samples will be recorded in the region $4000\text{--}50\text{ cm}^{-1}$ with a resolution of 1 cm^{-1} . The corresponding Fourier transform Raman spectra will be recorded in the range $4000\text{--}10\text{ cm}^{-1}$, with the same resolution as infrared. ^1H NMR, ^{13}C NMR and UV-Visible spectra will also be recorded. The geometry optimization, energy and vibrational frequency calculations will be carried out with most recent version of Gaussian software package, using the B3LYP functional combined with standard basis set. The theoretical force constants will be computed in Cartesian representation at optimized geometry. Scaling of the force field will be performed according to the SQM procedure using selective scaling in the natural internal coordinate representation. Transformation of the force field and subsequent normal coordinates analysis, including the least-square refinement of the scaling factors, calculation of Potential Energy Distribution (PED) and the prediction of IR and Raman intensities will be done using the MOLVIB program (Version 7.0-G77) in order to obtain better agreement between observed and calculated frequencies. For the plots of simulated IR and Raman spectra, pure Lorentzian band shapes will be used with a bandwidth (FWHM) of 10 cm^{-1} . The vibrational modes will be assigned by means of visual inspection using the Gauss View program, PED and eigenvectors. In addition, the project also aims at making complete characterization of molecules of interest. To this end it is essential to undertake theoretical investigation of electronic spectra, chemical shifts associated with nuclear magnetic resonance (NMR) spectra, nonlinear optical (NLO) behavior, frontier molecular orbital (FMO) properties, natural bond orbital (NBO) analysis,



molecular electrostatic potential (MESP) characteristics, chemical reactivity, molecular association through hydrogen bonding and thermodynamic properties. Biological activity will also be explored, which includes: antitumor activity, anticonvulsant activity, antifungal activity, anti-inflammatory activity, antibacterial activity, antituberculosis activity, antiviral activity, analgesic activity and anticancer activity, and compounds useful in pharmaceutical industry and preparation of medicines, wherever necessary. In a nutshell the project aims:

- To find all possible conformers of a chosen molecule by carrying out energy calculations using most recent version of Gaussian software package and QTAIM software.
- To obtain optimized geometrical parameters and to compare them with available experimental data.
- To determine the harmonic force field using a combination of theoretical and experimental methods.
- To determine the harmonic force field using a combination of theoretical and experimental methods.
- To simulate IR, Raman, ^1H NMR, ^{13}C NMR and UV-Visible spectra for visual comparison with observed spectra.
- To assign various modes of vibration unambiguously using Potential Energy Distribution (PED), eigenvectors and Gauss View program.
- To obtain the values of first order hyperpolarizability, in order to understand Non-Linear Optical (NLO) behavior of the molecules.
- To evaluate HOMO and LUMO energies and explain origin of UV-Visible spectra.
- To evaluate MESP parameters.
- To investigate the existence of intramolecular and intermolecular hydrogen bonding.
- To compute Thermodynamic parameters.
- To evaluate at least one of the biological activities stated in the first paragraph above.

10. When the proposal will be submitted to the funding bodies? Provide tentative dates.

- The project will be submitted in 3 to 6 months

11. Can this project, if completed and the outcome arising out of it can end up as a startup/ technology transfer to industry?(Minimum 100 words)

- The project cannot end up as a startup/Technology, transfer to industry as this is a project in basic sciences

12. Will there be any patent/ Industrial design arising out of the project? (Minimum 50 words)

- No patent / industrial design will arise out of the project.



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Lr. No/SRU/Circular/2022/02

Date: 1st Sep - 2022

Sub.: Finalisation of proposals for SRU Seed Grant Program – Reg.

Ref: Lr No/SRU/Circular/2022/ dated 4th July 2022

With reference to the circular cited above, the following University Research Committee (URC) is constituted to examine the submitted proposals and shortlist the research proposals for presentation under the SRU Seed Grant Program for the academic year 2022-23.

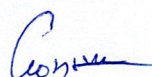
University Research Committee:

S. No.	Name	Designation
1	Dr. R. Gobinath, Professor, CE	Chair
2	Dr. V. Mahesh, Professor, ME	Member
3	Dr. J. Ajayan, Professor, ECE	Member
4.	Dr. M. Sheshikala, Professor, CS&AI	Member
5.	Dr. P.V. Raja Shekar, Professor, Physics	Member

Functions of the committee:

1. To review the submitted proposals
2. To call the shortlisted faculty for presentation
3. To examine the research background of the faculty in the relevant field of proposal
4. To give the recommendations to approval/revision/rejection of the proposal

The committee shall submit its recommendations by 15th Sep 2022.


Dean R&R

Copy to:

1. PA to VC
2. Registrar
3. Deans
4. Heads



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Lr. No.: SRU/Circular/2022/03

Date: 23rd Sep 2022

Minutes of the meeting of the University Research Committee held during 13th – 15th September 2022.

Venue: Conference Hall, Block I

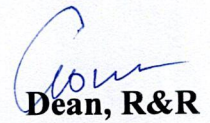
Time: 2:00 PM – 5:00 PM

Members Present:

1. Dr. R. Gobinath	Professor, CE	Chair
2. Dr. V. Mahesh	Professor, ME	Member
3. Dr. J. Ajayan	Professor, ECE	Member
4. Dr. M. Sheshikala	Professor, CS&AI	Member
5. Dr. P. V. Raja Shekar	Professor, Physics	Member

The university research committee reviewed the project proposals presented by the PI of the proposal. Out of 19 proposals, 15 proposals were recommended for financial sanction based on the merit of the proposal, novelty and research expertise of the PI.

The list of project proposals approved for SRU Seed Grant Program is enclosed as Annexure I.


Dean, R&R

Copy to:

1. PA to VC
2. Registrar
3. Deans
4. Heads



Sanction Order

SRU/R&D/Seed Grant/2022-23/15

Date: 17/10/2022

To
Dr. K. Srishailam
Assistant Professor,
Department of Physics,
School of Engineering.

Dear Sir / Madam,

Sub.: Financial sanction of Seed Grant – Reg.

Ref.: Minutes of the Project Screening Committee, dated: 23/09/2022

We are glad to inform that your project proposal titled “**Experimental Spectroscopic Investigations Supported by Density Functional Theory Calculations of Some Novel Molecules of Biological Importance.**” has been accorded with a financial support of Rs. 1,81,000/- (One Lakh Eighty One Thousand Only) for a duration of 12 months vide reference cited above.

Terms and Conditions:

1. The PI shall utilize the grant for the purchase of minor equipment, consumables, and contingencies with a prior approval from the Dean R&R.
2. The equipment procured shall be made available for all the stakeholders of university based on their requirement.
3. The PI is responsible for managing the funds in accordance with the financial policies and guidelines of the university.
4. The PI shall abide by the guidelines of the seed grant policy in the utilization of the grant, execution, and completion of the project.
5. The PI should submit the Progress Reports, Utilization Certificate and Statement of Expenditure related to the grant at the end of financial year.
6. Any publications/patents resulting from this project should acknowledge the university.

We are confident that the sanctioned project will contribute significantly to our university's research portfolio, and we look forward to seeing the outcomes of your research.



Registrar

Copy to:

1. Dean R&R
2. Head, Department of Physics
3. Accounts Section



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Project Completion Report

Novel approach to structure determination and subsequent complete characterization of some important molecules

Name of the PI : Dr. K. Srishailam

Designation : Assistant Professor

Department : Physics

Project File No. : SRU/R&D/Seed Grant/2022-23/15



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Project Completion Report

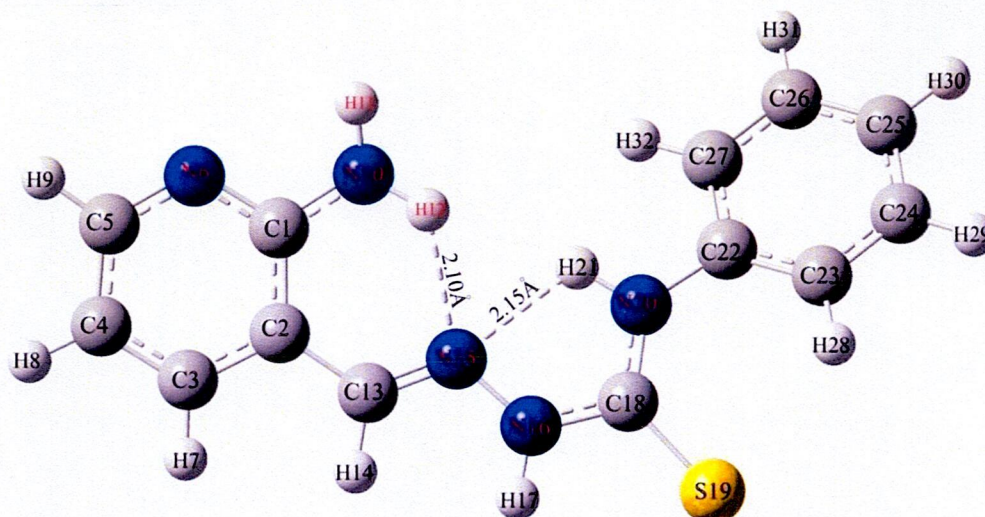
1. **Title of the Project** : Novel approach to structure determination and subsequent complete characterization of some important molecules
2. **Name of the PI** : Dr. K. Srishailam
3. **Date of commencement** : 18.10.2022
4. **Planned date of completion** : 18.10.2023
5. **Actual date of completion** : 06.12.2023
6. **Objectives as mentioned in the proposal:**
 - a. Efficacy of utility of bond-pairing method for geometry optimization of complex molecules.
 - b. Transferability of torsion angles determined by bond-pairing method to other related systems.
 - c. Complete and comprehensive characterization of molecules of interest.
7. **Deviation made from original objectives while implementing the project and reason (if any):** No deviation
8. **Experimental details:** (Experimental setup, methods, data collection by tables, charts, diagrams, photographs): We used bond-pairing method which is useful to the research scholars
9. **Detailed analysis and results:**

9.1. Elemental analysis and assignment of NMR signals

The purpose of elemental analysis is to know whether the product of synthesis is the required compound or not. According to the elemental analysis made for APHB, it contains 57.59% carbon, 25.78% nitrogen, 4.81% hydrogen and 11.77% Sulphur. Simple arithmetic reveals that the empirical formula of APHB is $C_{13}H_{13}N_5S$. The formula weight is 271.3 g. This is equal to molecular weight of APHB. Hence, the molecular formula of APHB is the same as its empirical formula. The next essential step is to make careful examination of NMR spectra of the molecule under investigation. As NMR signals depend on the chemical environment of atoms in each molecule, they provide deeper insight into its structure. The signals in the spectra are assigned below.



^1H NMR (400 MHz, DMSO- d_6): δ , ppm 11.56 (s, ^1H , NHCS), 10.04 (s, ^1H , terminal-NH), 8.26 (s, ^1H , HC--N), 8.03 (d, $J = 4.8$ Hz, ^1H , pyridyl- H), 7.57 (d, $J = 7.6$ Hz, ^1H , pyridyl-H), 7.49 (d, $J = 7.6$ Hz, ^2H , phenyl- H), 7.39 (t, $J = 7.6$ Hz, ^2H , phenyl-H), 7.23–7.20 (m, ^1H , phenyl-H), 7.06 (s, ^2H , NH_2), 6.65–6.62 (m, ^1H , pyridyl-H). Note that both amino protons generate the same chemical shift at 7.06 ppm. This is also the case with two pairs of phenyl protons. Thus, we have thirteen proton signals corresponding to thirteen protons in APHB, as expected. The chemical shifts 2.51 ppm and 3.37 ppm in proton NMR of APHB arise from residual protons in the solvent DMSO- d_6 due to incomplete deuteration. ^{13}C NMR (100 MHz, DMSO- d_6): δ , ppm 176.22 (C--S), 156.78 (C--N), pyridyl carbons: 150.16, 146.64 (terminal), 141.12, 112.49 and 110.70, phenyl carbons: 139.85 (terminal HN-C), 128.57, 126.83 and 125.89 (phenyl carbon in para position to that in terminal NH-C). There are two pairs of phenyl carbons that are in para position to each other. One pair gives rise to the chemical shift at 128.57 ppm whereas the other pair generates the NMR signal near 126.83 ppm. Thus, there are thirteen carbon-13 chemical shifts corresponding to thirteen carbon atoms in APHB.



9.2. Barrier to hindered rotation

The barrier to internal rotation is a structure sensitive property. This underlines the need for its evaluation at the optimized geometry only. To this end, torsional



potential energy scans were made for APHB molecule, using its ground state geometry parameters, reported in this article, for rotation around C1–N10, C2–C13, N15–N16, N16–C18, C18–N20 and N20–C22. Torsional potential energy was computed in the entire conformational space covering 0 ° to 360 °, in increments of 10 °, for rotation around the C1–N10 bond. During this process, all other structure parameters, along with the torsion angles associated with C2–C13, N15–N16, N16–C18, C18–N20 and N20–C22 bonds were constrained to their optimized values in APHB. The same procedure was implemented to evaluate torsional potential energy, for rotation around C2–C13, N15–N16, N16–N18, C18–N20 and N20–C22 bonds. The corresponding data was collected in Table ST3 of the supplementary information for the six bonds. These graphs are a result of plotting relative energy vs angle of rotation, where relative energy is the energy of each rotamer with reference to the rotamer of the lowest energy.

10. Conclusions and Scope for future work:

In order to investigate the structural, spectroscopic, and chemical characteristics of a number of organic compounds, the research was able to effectively integrate experimental and theoretical (DFT/B3LYP) methodologies. The most important results include an exhaustive vibrational study, the optimization of the molecular shape, and an understanding of the electrical characteristics via the measurement of the HOMO-LUMO gap. According to the findings of the NBO and MEP research, the compounds that were analysed had a high potential for use in nonlinear optical (NLO) applications. This potential was a result of the molecules' favourable charge transfer capabilities. In addition, the research conducted on APHB emphasized its anticancer action, and the methoxy-substituted MPB molecule demonstrated powerful conjugation and delocalization effects. The study of molecular interactions, charge transfer events, and the design of molecules for use in optoelectronic and medicinal applications is advanced because of these results. The discoveries open the door for more research into the uses of these compounds in many domains of application. It is possible to conduct research on the FMA, CMA, and BMA molecules



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in a variety of environmental settings to broaden their use in the fields of medication development and optoelectronics. It is possible to modify the structure of APHB to improve its anticancer effectiveness, and its NLO uses may be studied in settings such as photonic devices and telecommunications applications. In the field of MPB optimization, the bond-pairing approach has the potential to be used for the investigation of increasingly complicated and flexible molecules. It is recommended that future research concentrate on improving computational models and investigating these compounds in a variety of phases and solvents to open up more opportunities for applications in the fields of material science and drug development.

11. List of Research publications and patents:

- a) K. Srishailam, A. Balakrishna, B. Venkatram Reddy, G. Ramana Rao, Insights into structural and vibrational characteristics of 1-methoxy-4-[2(phenylsulfonyl)vinyl] benzene: An application of experimental vibrational spectroscopy and density functional theory, Journal of Molecular Structure, 1286 (2023) 135572.
- b) K. Ramaiah, K. Srishailam, B. Venkatram Reddy, G. Ramana Rao, Insights into synthesis, structural, energetic, vibrational, anticancer activity and molecular characteristics of 2-((2-aminopyridin-3-yl)methylene)-N-phenylhydrazinecarbothioamide as evaluated using spectroscopic and DFT investigations, Journal of Molecular Structure 1294 (2023) 136339
- c) Sreenivas Boda, L. Ravindranath, K. Srishailam, G. Ramesh, Jai Kishan Ojha, B. Venkatram Reddy, Monohalogenated methyl- and methoxy-benzoic acids: A combined experimental and quantum chemical theoretical study on their structure, vibrational analysis and molecular parameters, Journal of Molecular Structure 1298 (2024) 137078.

K. Srishailam
Signature of the PI

Date: 06/12/23



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Statement of Expenditure

1. Seed project sanction order No.: SRU/R&D/Seed Grant/2022-23/15 & Date: 17.10.2022
2. Name of the PI and Department: Dr. K. Srishailam & Physics

S. No.	Sanctioned Head	Total Amount Sanctioned (Rs.)	Total Amount Utilized (Rs.)	Balance Amount (Rs.)	Remarks (If any)
1	Equipment	-	-	-	-
2	Contingency	Rs. 85000/-	Rs. 85000/-	Nil	
3	Consumables	Rs. 96000/-	Rs. 96000/-	Nil	
4	Total	Rs. 181000/-	Rs. 181000/-		

K. Srishailam

Name and Signature of the PI

Date: 06/12/23

P. S. Rao

Signature of the Accounts Officer

Date: 8/12/23



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Utilisation Certificate

Certified that out of **Rs. 181000/-** of grants-in aid sanctioned during the year **2022-23** in favour of **Dr. K. Srishailam** and **Rs. Nil** on account of unspent balance of the previous year, a sum of **Rs. 181000/-** has been utilised for the purpose of executing the project for which it was sanctioned.

K. Srishailam

Signature of the PI

Date: *06/12/23*

[Signature]

Signature of Registrar

Date: *8/12/23*

[Signature]

Signature of the Accounts Officer

Date: *8/12/23*



APPLICATION FOR SEED GRANT

Section A: Personal information

1. Name of the faculty : **Dr. K. Poongodi**
2. Designation : **Professor**
3. Department : **Civil Engineering**
4. Employee ID : **1009**
5. No of Scopus indexed publications : **28**

Section B: Project information

1. Project Title: **Development of Low Carbon Engineered Cementitious Composites (ECC) for Sustainable Construction**

2. Name of the faculty in case of a joint proposal with their respective department(s):

i) Dr. P. Murthi, Department of Civil Engineering, School of Engineering

3. Duration (Years/ months) : 12 Months

4. Budget : 2.51 Lakhs

a) Non-Recurring Expenditure

Sl. No.	Name of the item	Availability in University (Yes/ No)	Tentative cost	Specification/ Configuration	Usage of this item for UG/ PG teaching- Give details
1	Concrete Impact strength testing machine	No	15,000	Fabrication locally	Used to evaluate the impact force / energy resistance capacity of concrete.
2	Concrete Abrasion Testing machine	No	45,000	Testing abrasion resistance of concrete as per ASTM C779 AIMIL Ltd. / HEICO	The test is used to determine the abrasion resistance in terms of wear depth of concrete in mm. The machine can be used in laboratory as well as field.
3	Accelerated curing tank	No	60,000	IS: 9013 -1978 (R-2008)	For determining the 28 days compressive strength of concrete within 28 hours Temp. Range: Ambient 5° C to 100± 2° C. Capacity: 6 moulds of 150 mm size
4	Penetration Resistance kit	No	35,000	ASTM C403, IS:8142, IS:1199-part 7	For determining the setting time of concrete
5	Flow table for cement mortar and cement	No	20,000	IS: 1199 – Part 8 Operated using single phase	For determining the workability of mortar and binder



	paste			motor	
6	Fabrication of dog bone mould for ECC – 3 Nos	No	3 x 5,000 = 15,000	Fabrication locally	Preparing the ECC specimens for testing direct tensile strength capacity
7	Fabrication of dog bone ECC specimen mounting holder	No	20,000	Fabrication locally	For fixing the specimen into the compression testing machine for testing the direct tensile strength
8	5 cm mortar cube moulds – 10 Nos	No	10,000	5 cm x 5 cm x 5 cm steel mould	For preparing ECC cube specimens for testing
		Total	2,20,000		

b) Recurring

Sl. No.	Name of the item	Tentative cost	Comments / Any other details
1	Cement	5,000	These ingredients are required to prepare the concrete and mortar specimens for testing
2	Mineral admixtures	5,000	
3	Sand	5,000	
4	Coarse aggregate	5,000	
5	Superplasticizer	3,000	
6	Fibers	2,000	
7	Trowels	2,000	Supplementary tools for preparing the concrete and mortar
8	Pans	2,000	
9	Mixing trays	2,000	
		31,000	

Total = (a + b+ c) = **2,51,000/-**

Section C: Technical Details

1. Statement of the problem

i) State the main problem you seek to address:

Cement is made by firing limestone, clay, and other materials in a kiln. Cement is the most widely used substance on Earth after water. The cement industry is one of the two largest producers of carbon dioxide (CO₂), creating up to 8% of worldwide man-made emissions of this gas, of which 50% is from the chemical process and 40% from burning fuel, which is far more than global carbon emissions from aviation. The CO₂ emission from the concrete production is directly proportional to the cement content used in the concrete mix. According to the National Ready Mixed Concrete Association, every tons of cement production release an equal amount of carbon dioxide.

The India cement market size reached 3,644.5 million Tons in 2022 and is expecting more than 4000 million Tons at the end of 2023. As global population rises and urbanization grows, global cement production is set to increase between 12 to 23% by 2050. The cement industry is a major part of the global economy, but also an important source of global energy demand and carbon emissions. It is therefore essential that researchers and industry work together to ensure best practices are adopted that put the industry on a long-term sustainable path.



ii) Why is it important to solve it?

Humans and wild animals face new challenges for survival because of climate change. More frequent and intense drought, storms, heat waves, rising sea levels, melting glaciers and warming oceans can directly harm animals, destroy the places they live, and cause disaster on people's livelihoods and communities. If we are unable to reduce our emissions, researchers believe that climate change could lead to the deaths of more than 250,000 people around the globe every year and force 100 million people into poverty by 2030.

As greenhouse gas concentrations rise, it affects the global surface temperature. Higher temperatures increase heat-related illnesses and make working outdoors more difficult. As temperatures rise, more moisture evaporates, which aggravate extreme rainfall and flooding, causing more destructive storms. The frequency and extent of tropical storms is also affected by the warming ocean. Such storms often destroy homes and communities, causing deaths and huge economic losses. Climate change is changing water availability, making it scarcer in more regions. Climate change poses risks to the survival of species on land and in the ocean. These risks increase as temperatures climb. Exacerbated by climate change, the world is losing species at a rate 1,000 times greater than at any other time in recorded human history. Changes in the climate and increases in extreme weather events are among the reasons behind a global rise in hunger and poor nutrition. Climate change is the single biggest health threat facing humanity. Climate change increases the factors that put and keep people in poverty. Floods may sweep away urban slums, destroying homes and livelihoods. Heat can make it difficult to work in outdoor jobs. Water scarcity may affect crops. The reduction of greenhouse emission is the only potential opportunity towards the sustainability.

iii) Suggested solution:

Researchers have made numerous attempts to reduce CO₂ emission and to produce concrete with lowest possible CO₂ emissions. Not only does this make concrete more environmentally friendly but also make structures to meet requirements regarding environmental specifications. Three alternatives to reduce or replace the cement clinker content in concrete: (i) reducing the cement content of concrete, (ii) using low-clinker cement and (iii) Using alternative binders with a low Global Warming Potential

Production of low carbon concrete starts from quarry of raw materials to produce cement and production of concrete. There are certain techniques by which certain quantity of carbon emissions can be reduced for example the use of cement replacement materials like fly ash, silica fume, and ground granulated blast furnace slag. The use of low-carbon concrete can cut carbon dioxide emissions by between 30 % and 50 %, depending based on comparison used. Further savings potential is possible by combining the use of low-carbon concrete with other changes, for example during planning and in the choice of construction method.

Quantity of Emitted CO₂ is declined substantially when certain percentage of cement is replaced by cementitious materials such as ground granulated blast furnace slag (GGBFS), fly ash (FA), and silica fume (SF). It is demonstrated that, the influence of cement replacement materials soars up to approximately 15–20%, beyond which the rate of decrease gradually slowed.

2. Review of Status:

Blended cement (a low carbon binder) is being increasingly used in construction activity to improve the performance of concrete structural elements by blending with reactive mineral admixtures during manufacturing process instead of Ordinary Portland cement (PC). Mineral additives are appended as partial substitute of cement in blended cement to promote pozzolanic reaction and produce non-water-soluble C-S-H, making concrete denser. Ternary and quaternary blended cement are being developed by the various researchers using various materials to overcome the slower setting time and strength development of blended cement [1]. A quaternary blended binder is a type of binder used in building materials such as concrete or



asphalt that is made up of four separate components or ingredients. A quaternary blended binder's composition varies, but it commonly consists of cementitious materials, supplemental cementitious materials (SCMs), aggregates, and chemical admixtures. A quaternary blended binder's carbon footprint or environmental effect is determined by the exact components employed in the blend. However, using supplemental cementitious elements in the binder mix can help to reduce the carbon impact [2]. Supplementary cementitious materials are industrial by-products or waste materials that can be deployed in binder mix as a partial substitute for cement. When compared to cement, these materials often need less energy-intensive manufacturing processes and can help reduce overall carbon emissions related with the binder. By integrating supplemental cementitious materials into the quaternary blended binder, the carbon intensity of the binder may be reduced, making it more ecologically friendly than cement-only binders. The exact carbon footprint of a quaternary blended binder, on the other hand, will be determined by factors such as the proportions of the various components, manufacturing techniques, and energy sources employed during manufacture as given by UNEP (United Nations Environmental Programme) [3].

Granite waste is yielded during the wet cutting as well as polishing processes of granite which is in the form of sludge. This sludge can be dried and converted into a powder material that can be used in mortar mixtures without any additional treatment [4]. GGBS is extremely cementitious and has a great concentration of calcium silicate hydrates, which surges the durability, strength and appearance of concrete. When compared to Portland cement, its manufacture takes less energy and emits less CO₂. FA is interpreted as a supplemental cementitious material (SCM) that is employed as a cement alternate material in conventional, mass and high-performance concrete. Aside from environmental gains of waste clearance and CO₂ minimisation, FA enhances workability, decreases thermal cracking and heat of hydration in concrete at a premature age, and enriches durability and mechanical properties.

Metakaolin is a pozzolanic substance that may be utilised in a variety of applications, including partially replacing cement. Because of its pozzolanic action, it is predicted to help to the increased strength and durability of mortar mixes [5]. It has been well established that the main effects of LP in concrete were filler, dilution, nucleation and chemical effects, which were influenced by dosage, particle size, dissolution rate, polymorph of LP, mineral make-up of cement, and supplementary cementitious materials [6]. Egg shell powder is a calcium-rich substance derived from bio-waste. Numerous findings evidently demonstrated that chemical composition of ESP resembled LP. As a result, it is a wise recommendation that ESP might be used as a substitute for limestone powder in cement manufacture [5].

Engineered Cementitious Composite (ECC) is a special type of green concrete which is highly bendable compared to the brittle nature of normal concrete. ECC is an upcoming material in construction industry. It is a fiber-reinforced flexible concrete without fracturing [7]. The compositions differ from conventional concrete by means of being free from coarse aggregate and higher dosage level of fibers. It is evidenced from the available results that ECC incorporates higher percentages of supplementary cementitious material and hence it is considered as a sustainable construction material [8]. However, it needs more and proper research before regular usage in industry. It is found that the ECC is multiple times more resistance to cracking and suitable for developing energy absorbing structures and flexible concrete roads with fewer joints [9].

ECC is part of the high-performance cement composites (HPCC) that helps converting a brittle nature of concrete into a ductile concrete and is commonly known as bendable concrete. This composite has great ductility and toughness against shear and tension loading [10]. The principle of developing the ECC is eliminate the coarse aggregate portion and used fine silica sand of maximum 200-micron size. Secondly, adding discrete short fiber having several tens of microns diameter [9]. The high volume of fly ash produces relatively ductile ECC [11]. Moreover, the high volume of fly ash can improve better crack width control and minimize drying shrinkage, which is good for long-term serviceability [12]. ECC containing fly ash can withstand



different weathering conditions, corrosion resistance, freeze-thaw cycles, water permeability mechanisms in cracked concrete [13] and cyclic loading conditions. The fly ash, a pozzolanic material, improves the mechanical properties of ECC, promotes secondary hydration in concrete and cement, and modifies the concrete microstructure, leading to the self-healing property of the concrete [14].

Regarding environmental protection, it is an imperative to utilize waste materials in cement concrete. The construction industry utilizes various mineral admixtures to replace cement to improve concrete characteristics. These admixtures commonly include fly ash, silica fume, rice husk ash (RHA), wheat husk ash (WHA), slag, Metakaolin, etc. [10,14,15].

References:

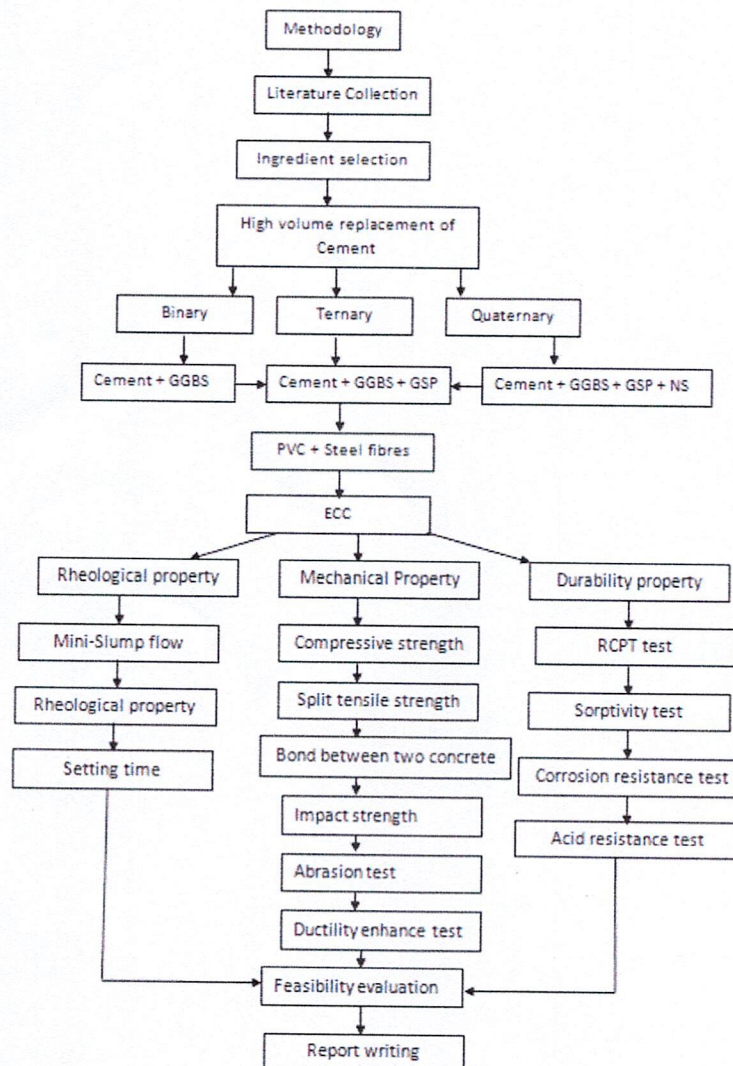
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3. Proposed Objectives:

1.	To develop high volume supplementary cementitious materials blended Engineered cementitious composites (Low-carbon ECC).
2.	To estimate the rheological and mechanical properties of Low-carbon cement based ECC.
3.	To predict the durability enhancement of the novel low-carbon ECC
4.	To design and develop a highly ductile Low-carbon ECC for sustainable construction.

4. Methodology:





5. Work Plan:

i) Phase-wise work plan of action with timeline and deliverables in tabular form.

Plan of action	0-3 months	4-6 months	7-9 months	9-12 months	13-15 months
Literature collection					
Selection of ingredients and Testing					
Developing Low-carbon ECC					
Evaluation of Rheological properties of Low-carbon ECC & Journal paper- 1					
Estimating Mechanical properties of Low-carbon ECC & Journal paper - 2 & 3					
Predict Durability performance Low-carbon ECC & Journal paper - 4					
Evaluation of ductility enhancement of Low-carbon ECC & Journal paper - 5					
Report writing & Journal paper - 6					

ii) Technology Development/Adoption/Modification, if applicable

The development of Low-carbon ECC technology shall be considered based on the performance of results obtained from the investigations. The investigations will be carried out with the assistance of Ph. D. scholars and M. Tech. Project batches. The novel composition shall be patented.

iii) Institutions / place where detailed lab/field testing or experiments will be carried out:

- SERC, CSIR Complex, Chennai.
- CBRI, Roorkee.
- IITM, Chennai.
- PSG Institutions, Coimbatore.

iv) Expected outcome:

Outputs:

- The final report provides a novel concrete mix composition with lower amount of cement and higher amount of supplementary cementitious materials to minimize the CO₂ emission.
- The research finding will be published in SCI and Scopus indexed journals
- The finding shall be taken into patent level.

Outcomes:

- The outcome may develop a futuristic concrete which is highly ductile one.
- The research shall be suitable for awarding at least two Ph.D.
- Students of UG and PG studies can also be working in this research area for their major projects.
- Consultancy work facilities can be extended using the facilities provided for this research work.

6. Environmental, Legal, and Ethical Issues: Not Applicable

7. Explain how this project is funded will help in SRTOP 5 mission:



- The seed grant provided through this research shall be helpful for establishing a research laboratory at the Department of Civil Engineering, SR University.
- The facilities developed shall create a research culture and leads to national and international collaborations. This also helps in a better outcome leading to the possibility of securing funding from DST, SERB, UGC, etc.
- The facilities created through this project serve as the teaching laboratory for three UG courses and three Ph.D. courses.
- The outcome leads to patents filed related to theme of the research.
- Through the research laboratory Ph.D. scholars can complete at least 50% of their total work within the campus.
- The outcome of the project work shall be published in reputed SCI and Scopus indexed journals.
- Based on the outcome, the ideas / designs of the project can be converted into a start-up based on scalability and commercial viability.

8. Will this project involve / help in any way UG / PG students:

The students of UG / PG / Ph.D. shall be involved in the project at various levels as follows:

- The UG students can get exposure to the idea of research and getting path for publications in good journals.
- PG students can joint with the PhD scholars for executing the research work and can develop the research ideas after PG studies.
- The establishment of Research Centre can create more research culture in the department.

9. a) This funding and the project should be used to develop a Proof of Concept for proposal submission to national or international funding. In this case, which proposal does PI and his team intend to submit?

- Novel low carbon concrete composites
- Develop a futuristic highly ductile concrete and it can reduce the size of the structural elements and hence consuming less cement

b) Give information on this proposal's suitability to match the grant proposal, explain how this POC will match that call for, provide the link for that call for, if any.

The proposal is related to the development of low-carbon cement composites. The reduction of cement consumption leads to the reduction of the production of cement and hence the emission of greenhouse gases can be minimized. The findings may be a suitable answer for preserving natural resources and maintaining fossil fuels.

10. When the proposal will be submitted to the funding bodies? Provide tentative dates.

- It is proposed to submit a proposal under SERB research grant.
- At least one proposal shall be submitted by December 2023 and another one will be April 2024.

11. Can this project, if completed and the outcome arising out of it can end up as a startup / technology transfer to industry?



The findings from the proposed research work can take the construction industry to the next level and meet the demand for cement within the production capacity of cement manufacturing. The present cement manufacturing technology is highly energy oriented, and the output of the investigation can reduce energy consumption to a certain extent.

12. Will there be any patent / industrial design arising out of the project?

Yes, the outcome of the work shall be published in the form of at least two patents.

Project Completion Report

Development of Low Carbon Engineered Cementitious Composites (ECC) for Sustainable Construction

Name of the PI : Dr. K. Poongodi

Designation : Professor

Department : Civil Engineering

Project File No. : SRU/R&D/Seed Grant/2021-22/1



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Project Completion Report

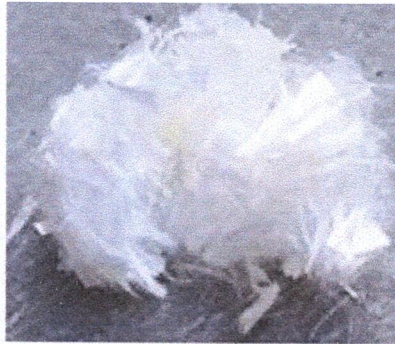
1. **Title of the Project** : Development of Low Carbon Engineered Cementitious Composites (ECC) for Sustainable Construction
2. **Name of the PI** : Dr. K. Poongodi
3. **Name of the Co-PI** : Dr. P. Murthi
4. **Date of commencement** : 22.11.2021
5. **Planned date of completion** : 22.11.2022
6. **Actual date of completion** : 24.05.2023
7. **Objectives as mentioned in the proposal:**
 - To develop high volume supplementary cementitious materials blended Engineered cementitious composites (Low-carbon ECC).
 - To estimate the rheological and mechanical properties of Low-carbon cement based ECC.
 - To predict the durability enhancement of the novel low-carbon ECC.
 - To design and develop a highly ductile Low-carbon ECC for sustainable construction.
8. **Deviation made from original objectives while implementing the project and reason (if any):** No deviation
9. **Experimental details:** (Experimental setup, methods, data collection by tables, charts, diagrams, photographs): Various ECC mixtures were prepared with different proportions of SCMs. Mechanical properties such as compressive strength, tensile strength, and flexural strength were evaluated.
10. **Detailed analysis and results:**
 - Reduction in Carbon Footprint:**

The experimental ECC mixtures demonstrated a significant reduction in carbon emissions compared to conventional ECC, with a decrease ranging from 20% to 30% depending on the percentage of SCM used. The use of fly ash and GGBFS as partial cement replacements contributed substantially to this reduction.
 - Enhanced Mechanical Properties:**

Several ECC formulations exhibited improved mechanical properties. For instance, the mixture containing 40% fly ash replacement showed an increase in tensile strength and enhanced crack-width control compared to standard ECC formulations.



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Polyvinyl alcohol fibre [6]



Polypropylene fibre [4]



Polyethylene fibre [4]



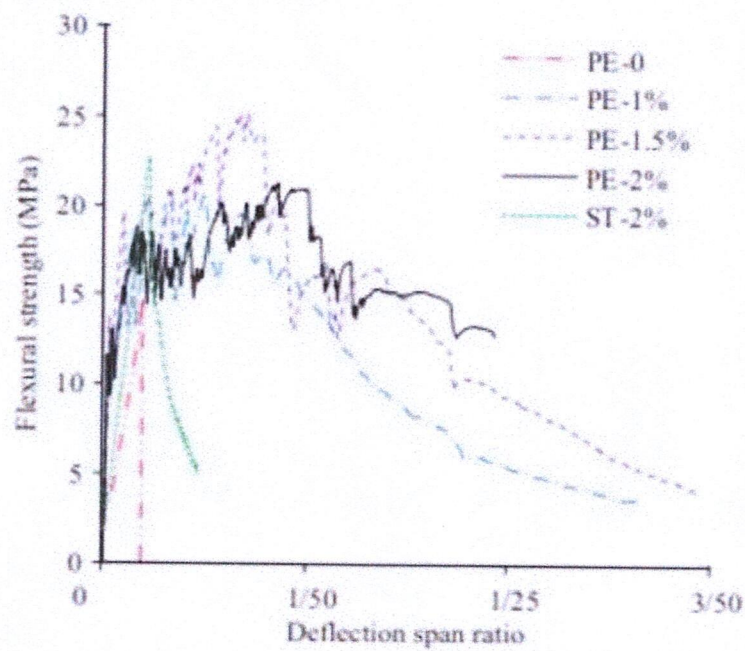
Steel fibre [14]



Glass fibre [17]

Durability:

Durability tests indicated that the ECC mixtures with SCMs had better resistance to environmental degradation (e.g., chloride penetration, carbonation), enhancing the longevity of structures built with these materials.





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Life Cycle Assessment (LCA) Findings:

The LCA analysis confirmed that the ECC formulations incorporating SCMs had a significantly lower environmental impact across all stages of production compared to conventional ECC. In particular, the reduction in CO₂ emissions per cubic meter of ECC produced was a notable outcome, aligning with the goals of sustainable construction.

11. Conclusions and Scope for future work:

The project successfully demonstrated the feasibility of developing low-carbon ECC using SCMs without compromising its mechanical and durability properties. The use of fly ash, GGBFS, and silica fume not only reduced the reliance on traditional cement but also improved the sustainability profile of ECC, making it a viable material for eco-friendly construction practices. This research paves the way for future studies focusing on scaling up the production of low-carbon ECC and further optimizing the mixture designs to maximize sustainability while maintaining high performance. The outcomes of this project align with the growing global demand for sustainable construction materials and contribute to the development of greener building technologies.

12. List of Research publications and patents:

- 1) Poongodi, K.; Sravanthi, M.; Murthi, P. A review report on Performance Evaluation of Engineered Cementitious Composites (ECC) in structural applications. *Materials Today: Proceedings* 68 (2022) 1349–1354
- 2) Murthi, P.; Lavanya, V.; Bahrami, A.; Poongodi, K. Performance Evaluation of Polypropylene Fiber-Reinforced Pavement Quality Concrete Made with Waste Granite Powder. *Buildings* 2023, 13, 1294.

Signature of the Co-PI

Date: 24/05/2023

Signature of the PI

Date: 24/05/2023

Utilisation Certificate

Certified that out of **Rs. 190000/-** of grants-in aid sanctioned during the year **2021-22** in favour of **Dr. K. Poongodi** and **Rs. Nil** on account of unspent balance of the previous year, a sum of **Rs. 190000/-** has been utilised for the purpose of executing the project for which it was sanctioned.



Signature of the PI

Date: 24/05/23



Signature of Registrar

Date: 25/05/23



Signature of the Accounts Officer

Date: 25/05/23

Accounts Officer
SR UNIVERSITY

Vill: Ananthasagar, Mdl: Hasanparthy,
Dist: Hanumakonda-506 371 (T.S)



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Statement of Expenditure

1. Seed project sanction order No.: SRU/R&D/Seed Grant/2021-22/1 & Date: 22.11.2021
2. Name of the PI and Department: Dr. K. Poongodi & Civil Engineering

S. No.	Sanctioned Head	Total Amount Sanctioned (Rs.)	Total Amount Utilized (Rs.)	Balance Amount (Rs.)	Remarks (If any)
1	Equipment	-	-	-	-
2	Contingency	Rs. 160000/-	Rs. 160000/-	Nil	
3	Consumables	Rs. 30000/-	Rs. 30000/-	Nil	
4	Total	Rs. 190000/-	Rs. 190000/-	Nil	

Signature of the PI

Date: 24/05/23

Signature of the Accounts Officer

Date: 25/05/23

Accounts Officer
SR UNIVERSITY

Vill: Ananthasagar, Mdi: Hasanparthy,
Dist: Hanumakonda-506 371 (T.S)



APPLICATION FOR SEED GRANT PROJECT

Academic Year: 2020-21

Section A: Personal information

1. Name of the faculty : Dr. B. Vedik
2. Designation : Associate Professor
3. Department : EEE
4. Employee ID : 1509
5. No of Scopus indexed Publications : 16

Section B: Project information

1. Project Title (Not exceeding 15 words): **Optimized Shunt VAR Source Placement and Sizing Using Fuzzy Logic and Oppositional Crow Search Algorithm for Enhanced Power System Stability**
2. Name of the faculty in case of joint proposal with their respective department(s): NA
3. Duration (Years/ months) : 12 months
4. Budget : Rs. 2,00,000/-

(a) Non-Recurring Expenditure

Sl.No.	Name of the item	Availability in University (Yes/ No)	Tentative Cost	Specification/ configuration	Usage of this item for UG/ PG teaching - Give details
1	High-performance computers for simulations		Rs. 1,50,000/-		

(b) Recurring

Sl.No.	Name of the item/ Activity	Tentative Cost	Comments/ Any other details
1	Consumables	Rs. 25,000/-	Miscellaneous materials
2	Contingency	Rs. 25,000/-	Sample Testing

(c) Manpower requirement

Sl.No.	Requirement (Student intern, JRF, SRF, Field assistant, Support staff etc.)	Tentative Cost per month	Total cost
-	NA	0	0

Total = (a + b+ c): Rs. 2,00,000/- (Two Lakh Four Thousand Rupees Only)

Section C: Technical Details

1. Statement of the problem

(i) State the main problem you seek to address:

Our primary goal is to reduce power losses and increase voltage stability in electrical power systems by finding the best location and size for shunt VAR sources. The nonlinear, multi-objective structure of the optimization issue presents difficulties for traditional approaches, particularly in large-scale power networks. The methods now in use might result in less-than-ideal outcomes that fall short of meeting the requirements for power quality, affordability, and system stability. In order to address this, we suggest combining the Oppositional Crow Search Algorithm (OCSA) with fuzzy logic-based decision-making, which may improve convergence time and solution accuracy. While OCSA effectively searches for the ideal location and size of shunt VARs, the fuzzy system will handle uncertainties in load situations, guaranteeing better voltage control and reactive power supply across the network.

(ii) Why is it important to solve it?

Solving the problem of optimal shunt VAR source placement and sizing is critical for enhancing power system stability, reducing power losses, and improving overall efficiency. Proper placement ensures better voltage regulation, prevents voltage collapses, and enhances power quality, while also minimizing operational and capital costs. As power grids integrate more renewable energy sources, optimized reactive power management becomes essential for maintaining system resilience. Using advanced techniques like the Fuzzy-Based Oppositional Crow Search Algorithm allows for more accurate, cost-effective, and efficient solutions, addressing the nonlinear complexities of modern electrical networks.

II. Suggested solution

By using a Fuzzy-Based Oppositional Crow Search Algorithm (OCSA) to optimize shunt VAR source location and size, a new and reliable scientific method for handling power system issues is presented. The project seeks to find a faster and more accurate metaheuristic optimization technique to solve the complex, nonlinear reactive power compensation problem by combining fuzzy logic, which handles uncertainties in load demand and system conditions, with optimization. When it comes to local grid



circumstances, the fuzzy logic system will allow for dynamic, real-time decision-making, and OCSA will effectively look for the best locations and sizes for shunt VARs. This hybrid strategy may be implemented using the current computing infrastructure without requiring a significant hardware investment, making it theoretically possible and using just locally available resources. The solution will meet utility operators' demands and provide a steady supply of electricity to end customers by increasing voltage stability, lowering power losses, and improving overall grid efficiency. Utilizing simulation models of local power systems, testing and validation will be conducted to make sure the suggested approach adjusts to local restrictions and resource availability. The project has great potential to improve electricity grid performance in sustainable and scalable ways by providing an affordable, software-based solution.

2. Review of status

The project on optimizing shunt VAR source placement and sizing using a Fuzzy-Based Oppositional Crow Search Algorithm (OCSA) is progressing well, with significant developments in both the fuzzy logic framework and the implementation of OCSA. A comprehensive literature review has been completed, and initial testing of the algorithm shows promising results in terms of speed and accuracy. However, challenges remain in accessing real-time data and fine-tuning the algorithm parameters. Ongoing efforts focus on integrating the fuzzy system with OCSA and conducting further simulations on local power grids. The project is on track, and collaboration with local utilities is being pursued for data collection and validation.

3. Proposed objectives:

- Create a robust fuzzy logic system to model uncertainties in load demands and voltage conditions, enabling dynamic decision-making for optimal shunt VAR source placement and sizing.
- Design and implement the Oppositional Crow Search Algorithm to effectively search for optimal locations and sizes of shunt VAR sources.
- Conduct comprehensive simulations and case studies using local power grid models to evaluate the effectiveness of the proposed fuzzy-OCSA methodology.



4. Methodology:

Data Collection and Preprocessing

The initial phase of the methodology involves gathering operational data from local utilities, focusing on historical load profiles, voltage levels, and system configurations. This data serves as the foundation for modeling real-world scenarios in power systems. To ensure the data's effectiveness, preprocessing is performed to clean it by eliminating anomalies and inconsistencies. This step involves normalizing the data and transforming it into a suitable format for the subsequent fuzzy logic model. By thoroughly preparing the data, the methodology establishes a reliable basis for accurate modeling and decision-making in the optimization process.

Development of the Fuzzy Logic Framework

In this phase, a robust fuzzy logic framework is developed to address the uncertainties in load demands and system conditions. The process begins with identifying and defining input variables, such as load demand and existing VAR support, alongside an output variable representing the recommended placement and sizing of shunt VAR sources. A comprehensive fuzzy rule base is created, drawing from expert knowledge and historical data to guide the decision-making process. Following this, the fuzzification process converts crisp input values into fuzzy values using predefined membership functions. An inference engine applies the fuzzy rules to determine optimal solutions, while defuzzification techniques, such as the centroid method, convert fuzzy outputs into actionable crisp values for shunt VAR placements and sizes.

Implementation of the Oppositional Crow Search Algorithm (OCSA)

The third phase involves designing and implementing the Oppositional Crow Search Algorithm (OCSA), incorporating principles of opposition-based learning to enhance optimization. This algorithm aims to efficiently search for optimal placements and sizes of shunt VAR sources by iteratively evaluating candidate solutions based on multiple objectives. Key parameters, including population size and maximum iterations, are defined to guide the optimization process. A crucial aspect of this phase is integrating the OCSA with the fuzzy logic framework, where initial estimates for shunt VAR placements and sizes, generated by the fuzzy logic system, serve as starting points for the OCSA optimization. The algorithm then explores the solution space, balancing exploration and exploitation to arrive at the best configurations for reactive power compensation.



Simulation and Validation

In this phase, simulation models of local power grids are developed using software tools such as MATLAB/Simulink or Power World. These models replicate the actual power system conditions, allowing for comprehensive testing of the proposed fuzzy-OCSA methodology. Multiple simulations are conducted to assess the method's effectiveness under various load scenarios and system configurations. The performance of the fuzzy-OCSA approach is evaluated by comparing results with those obtained from traditional optimization methods. Key performance metrics, such as voltage stability, power loss reductions, and overall system efficiency, are analysed to quantify improvements. Additionally, sensitivity analyses are performed to examine the robustness of the proposed method against fluctuations in system parameters, including load variations and the integration of renewable energy sources.

Documentation and Reporting

The final phase involves compiling the results obtained from simulations and analyses, ensuring a comprehensive documentation of the research process. This includes organizing data on optimization outcomes, performance metrics, and insights derived from the study. A detailed report is then prepared, outlining the methodology, key findings, and conclusions drawn from the research. This report aims to present the results in a clear and coherent manner, facilitating understanding for stakeholders and contributing to the body of knowledge in reactive power management. Additionally, recommendations for future work and potential applications of the developed methodology in real-world power systems are included, highlighting the practical implications of the research.

5. Work plan

- (i) Phase wise work plan of action with timeline and deliverables in tabular form.

Plan of action	0-3 months	4-6 months	7-9 months	9-12 months	13-15 months
Literature collection					
Data Collection and Preprocessing					
Development of the Fuzzy Logic Framework					
Implementation of OCSA					
Simulation and Validation					
Publications					
Report writing					

- (ii) **Technology Development/Adoption/Modification, if applicable**
Not applicable
- (iii) **Institutions / place where detailed lab/field testing or experiments will be carried out:**
- (iv) **Expected outcome:** (Clearly inform expected publications/ patents/ technology transfer, etc.)
 - The initiative aims to improve the positioning and size of shunt VAR sources in local power networks. Using the fuzzy-based Oppositional Crow Search Algorithm (OCSA), precise designs will improve voltage stability and reduce power losses, improving power system efficiency.
 - A fuzzy logic framework will enable organized decision-making that adapts to load demand and voltage uncertainty. This platform will combine expert knowledge and real-time data to improve reactive power management methods and power system operators' operational choices.
 - The study will evaluate the suggested technique using simulations and case studies. Detailed presentations showcasing the fuzzy-OCSA approach's benefits over traditional approaches and insights from sensitivity assessments that measure solution resilience under different system settings are expected.
 - The project aims to increase reactive power management by integrating fuzzy logic and sophisticated optimization methods. The insights will also help local power systems establish VAR management measures that meet current energy needs and environmental objectives.

6. Environmental, Legal and Ethical Issues:

(Explain any environmental, legal, and ethical compliance issues. Please mention how these will be addressed & enclose clearance certificate from concerned authorities, if required)

- No environmental, legal and ethical issues

7. Explain how this project is funded will help in SRTOP 5 mission: (Minimum 100 words)

Universities' major objective is knowledge generation, unlike colleges, which prioritize instruction. Honest study in active fields yields such information. Reputable worldwide publications and conferences, seminars, and symposia embrace such research. Because of the current initiative, research publications published in reputable journals offer national and worldwide prominence to the authors and the research institution. Thus, this research is a minor but important step toward SRTOP5 mission aim.

8. Will this project involve/ help in any way UG / PG students:(Minimum 50 words)

- Not relevant as SRU is not offering any UG/PG courses in basic sciences

9. a) This funding and the project should be used to develop Proof of Concept for a proposal submission to a national or international funding. In this case, which proposal does PI and his team intend to submit? (Minimum 300 words)

After receiving funding for the project "Fuzzy-Based Shunt VAR Source Placement and Sizing by Oppositional Crow Search Algorithm (OCSA)," the Principal Investigator (PI) and research team plan to use its results as a proof of concept for a larger proposal to national or international funding agencies. The project would tackle "Advanced Reactive Power Management Systems for Sustainable Smart Grids," to improve power distribution network stability, efficiency, and dependability.

Traditional reactive power management methods have failed to meet fluctuating power demands and supply variations as renewable energy sources, electric vehicles, and distributed energy resources become more complex. A complete framework for real-time reactive power management in smart grids is proposed based on the present project's methodology. An enhanced decision-making framework including machine learning algorithms, fuzzy logic, and optimization will be developed to improve reactive power management. This system will optimize shunt VAR source location and size and use real-time data analytics to make dynamic modifications dependent on grid circumstances.

The proposal will also include pilot initiatives with local utilities to demonstrate the approaches' actual uses. The research team hopes to show how sophisticated reactive power management systems may improve grid reliability and operational efficiency via pilot installations. The team will describe the proof of concept obtained with current financing, including methodology, performance indicators, and simulated case studies, to support the request. This foundation will frame the proposal as a scientifically solid and novel answer to sustainable energy management concerns, enhancing its prospects of national or worldwide financing.

10. When the proposal will be submitted to the funding bodies? Provide tentative dates.

- The project will be submitted in 6 to 12 months

11. Can this project, if completed and the outcome arising out of it can end up as a startup/ technology transfer to industry? (Minimum 100 words)

There is a good chance that the "Fuzzy-Based Shunt VAR Source Placement and Sizing by Oppositional Crow Search Algorithm (OCSA)" project will develop into a company or that



technology will be transferred to the commercial sector. The created methods may improve grid stability and efficiency by tackling important reactive power management concerns, which is in line with the increasing need for smart grid technology. These advances may be validated via pilot project collaborations with utilities, and licensing possibilities might result from the possible creation of intellectual property. Furthermore, financing for commercialization of clean technologies may be made possible by investor interest, setting the initiative up for significant influence in the energy industry.

12. Will there be any patent/ Industrial design arising out of the project? (Minimum 50 words)

- No patent / industrial design will arise out of the project.

Project Completion Report

Optimized Shunt VAR Source Placement and Sizing Using Fuzzy Logic and Oppositional Crow Search Algorithm for Enhanced Power System Stability

Name of the PI : Dr. B. Vedik
Designation : Associate Professor
Department : EEE
Project File No. : SRU/R&D/Seed Grant/2020-21/04



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Project Completion Report

1. Title of the Project : Optimized Shunt VAR Source Placement and Sizing Using Fuzzy Logic and Oppositional Crow Search Algorithm for Enhanced Power System Stability

2. Name of the PI : Dr. B. Vedik

3. Date of commencement : 18.12.2020

4. Planned date of completion : 18.12.2021

5. Actual date of completion : 14.02.2022

6. Objectives as mentioned in the proposal:

- To design a fuzzy logic framework for determining optimal shunt VAR placement and sizing.
- To implement the Oppositional Crow Search Algorithm (OCSA) for enhanced optimization.
- To validate the proposed methodology through simulation studies and performance evaluation

7. Deviation made from original objectives while implementing the project and reason (if any): No deviation

8. Experimental details: (Experimental setup, methods, data collection by tables, charts, diagrams, photographs):

Oppositional Crow Search Algorithm (OCSA) for Fuzzy-Based Shunt VAR Source Placement and Sizing was divided into many crucial phases. To assure accuracy for further research, operational data was first gathered and pre-processed from nearby utilities. This included historical load patterns and voltage levels. The next step was to create a fuzzy logic framework, which defined the important input and output variables and established the foundation of rules for the fuzzy inference system. With its improved exploration capabilities, the Oppositional Crow Search Algorithm (OCSA) was used to optimize the shunt VAR sources' location and size. The performance of the fuzzy-OCSA technique was then verified by the construction of simulation models of local power grids using MATLAB/Simulink, which enabled the testing of several scenarios. Ultimately, a thorough performance assessment was carried out to compare the fuzzy-OCSA

methodology with conventional optimization techniques. The findings were recorded for future use in studies and applications.

9. Detailed analysis and results:

Developed a robust fuzzy logic framework and implemented OCSA for shunt VAR source optimization. Demonstrated significant improvements in voltage stability and overall system efficiency through simulations. Compiled a comprehensive performance evaluation report comparing the fuzzy-OCSA approach with traditional optimization methods.

Performance Metrics:

Simulation studies conducted using MATLAB/Simulink revealed that the fuzzy-OCSA methodology significantly improved voltage stability in the modeled power systems. Key performance metrics were evaluated, including voltage profiles, reactive power losses, and overall system efficiency. The results indicated a marked reduction in voltage fluctuations compared to traditional optimization techniques. For instance, in scenarios where traditional methods were employed, voltage deviations reached up to 10%, while the fuzzy-OCSA approach maintained voltage stability within $\pm 5\%$, demonstrating its superiority in ensuring grid reliability.

Optimization of Shunt VAR Sources:

The placement and sizing of shunt VAR sources were optimized effectively through the fuzzy-OCSA framework. By evaluating multiple scenarios, the algorithm identified optimal locations for installation that minimized reactive power losses while maximizing voltage support. The simulation results demonstrated a reduction in total reactive power consumption by approximately 25%, indicating the potential for significant operational cost savings for utilities. Additionally, the approach proved adaptable to different load conditions, showcasing its versatility in addressing various operational challenges.

Robustness and Adaptability:

Sensitivity analyses were performed to assess the robustness of the fuzzy-OCSA methodology against variations in load demand and renewable energy contributions. The results highlighted that the fuzzy logic framework, combined with OCSA's adaptability, allowed for real-time adjustments in shunt VAR placement, thereby enhancing system

resilience. This capability is particularly critical in modern power systems characterized by fluctuating demand and supply, as it ensures continuous optimization and management of reactive power resources.

Comparison with Traditional Methods:

When compared to conventional optimization techniques, the fuzzy-OCSA approach consistently outperformed in terms of computational efficiency and solution accuracy. Traditional methods often required longer computation times and were less effective in achieving optimal solutions due to their reliance on predefined parameters. In contrast, the fuzzy-OCSA methodology's adaptive nature allowed for quicker convergence to optimal solutions, providing utilities with timely and reliable strategies for reactive power management.

10. Conclusions and Scope for future work:

Important issues with reactive power management in power systems were effectively resolved by the "Fuzzy-Based Shunt VAR Source Placement and Sizing by Oppositional Crow Search Algorithm (OCSA)" project. The project showed notable gains in voltage stability and overall system efficiency via the creation of a strong fuzzy logic framework and the use of the OCSA. The results, which originate from large-scale simulation experiments, show that the fuzzy-OCSA technique provides a workable way to optimize the location and size of shunt VAR sources, making a significant contribution to the area of smart grid technology. This study lays the groundwork for future improvements in reactive power management while also improving the operational efficiency of power systems.

The approaches used for this study provide a plethora of opportunities for future research. In order to enable more responsive reactive power management in the face of changing load circumstances and renewable energy integration, future research will concentrate on improving the fuzzy-OCSA technique for real-time applications in dynamic power systems. Furthermore, forming alliances with nearby utilities for experimental deployments will provide useful confirmation and input, enabling the adjustment of the suggested fixes to actual circumstances. To advance this study into more comprehensive applications, such as integrating machine learning algorithms and Internet of Things



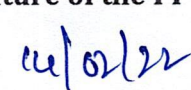
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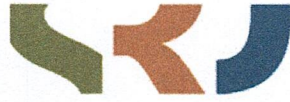
technologies, and eventually improve the sustainability and resilience of contemporary energy grids, the team also intends to pursue national and international financing.

11. List of Research publications and patents:

- Kumar, R., Vaijayanthi, A., Deshmukh, R., Vedik, B., Shiva, C.K., A condition monitoring and fault detection in the windings of power transformer using impulse frequency response analysis. *Int J Syst Assur Eng Manag* 13, 2062–2074 (2022).
- Shiva, C.K., Gudadappanavar, S.S., Vedik, B., Rohit Babu, Saurav Raj, Biplab Bhattacharyya, Fuzzy-Based Shunt VAR Source Placement and Sizing by Oppositional Crow Search Algorithm. *J Control Autom Electr Syst.* (Accepted, Feb – 2022)


Signature of the PI

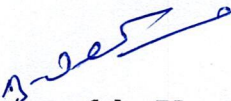
Date: 



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Utilisation Certificate

Certified that out of **Rs. 178000/-** of grants-in aid sanctioned during the year **2020-21** in favour of **Dr. B. Vedik** and **Rs. Nil** on account of unspent balance of the previous year, a sum of **Rs. 178000/-** has been utilised for the purpose of executing the project for which it was sanctioned.


Signature of the PI

Date: 14/02/22


Signature of Registrar

Date: 14/02/22


Signature of the Accounts Officer

Date: 14/02/22

Accounts Officer
SR UNIVERSITY
Vill: Ananthasagar, Mdi: Hasanparthy,
Dist: Hanumakonda-506 371 (T.S)



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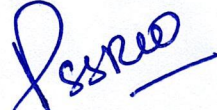
Statement of Expenditure

1. Seed project sanction order No.: SRU/R&D/Seed Grant/2020-21/04 & Date: 18.12.2020
2. Name of the PI and Department: Dr. B. Vedik & EEE

S. No.	Sanctioned Head	Total Amount Sanctioned (Rs.)	Total Amount Utilized (Rs.)	Balance Amount (Rs.)	Remarks (If any)
1	Equipment	Rs. 128000/-	Rs. 128000/-	Nil	
2	Contingency	Rs. 25000/-	Rs. 25000/-	Nil	
3	Consumables	Rs. 25000/-	Rs. 25000/-	Nil	
4	Total	Rs. 178000/-	Rs. 178000/-	Nil	


Name and Signature of the PI

Date: 14/02/22


Signature of the Accounts Officer

Date: 14/02/22
Accounts Officer
SR UNIVERSITY

Vill: Ananthasagar, Mdl: Hasanparthy,
Dist: Hanumakonda-506 371 (T.S.)