Appendix Vlll

Approved Programme

National Programme On Differential Equations: Theory, Computation & Applications

(NPDE-TCA)

CONTENTS

ABOUT NPDE-TCA

National Programme On Differential Equations: Theory, Computation & Applications

(NPDE-TCA)

Contents

National Programme On
Differential Equations: Theory, Computation & Applications

A. Preamble

The National Programme on Differential Equations: Theory, Computation & Applications (NPDE-TCA) was initiated in the year 2012 as a DST project with the **mission**

" To Create Human Resource and Knowledge Generation in Academia and Industry on Differential Equations: Theory, Computation & Applications."

The major **objectives** of this programme were to

- ⇨ To attract young talented students to study and to pursue research in the area.
- ⇨ To create a pool of trained mathematicians to support the advancement of science and technology in general and reap its benefits for the development of society.
- ⇨ To promote fruitful interaction between academia and industry.
- ⇨ To provide a platform for academic interaction and collaborative research amongst mathematicians and scientists in the country.
- ⇨ To expand and strengthen existing expertise in the area at various institutions / universities in the country.

Justification for Extension

The programme has been successful in achieving the objectives mentioned above. The detailed description of the programmes and their impact/ outcome will be given in this proposal. The stupendous success of the programme is self-evident from the feedback received from various sources, the amount of collaborative research which has been initiated and the high-quality research publications. The reason for this success can be attributed to the active collaboration of many Mathematicians from India and abroad since the last five years.

However, any such activity to bear fruit in the long run requires a more consistent contribution over a period of time. With an increase in the number of IITs, IISERs, NITs and other national institutes, there is a severe dearth of quality Mathematicians working in the broad areas of Applied Mathematics, Differential Equations, Numerical Analysis and Scientific Computing.

A country like India, which aspires to be a world leader in science and technology, has relatively a few researchers working in the above mentioned areas; though things have improved since the last five years. These researchers are sparsely located in a small number of institutions, each one having an inadequate number of scientists. Recognizing the importance and the need for training manpower, the Department of Science and Technology (DST) has identified `*Numerical Schemes and Qualitative Properties of Differential Equations*' as one of the thrust areas of Mathematics.

An extension of this NPDE-TCA for the next five years will help in achieving the objectives of training students in the area of DE explicitly and as a service to the nation in terms of providing man power for the various the various academic institutes across the country.

We present the summary of the various activities of NPDE-TCA since the last five years and their major outcomes. More details of this have been given in the attached Progress report.

One of the major highlights of NPDE-TCA has been the training programmes; the details of which are given below.

Activity-1: Training Programmes (a, b and c)

The main goal of the following three week programmes were to create a work force at the national level in broad areas of *Applied Mathematics,* in particular, in Differential Equations, Scientific Computing and Modelling. The training programmes helped the students to acquire the skills needed for quality research work. Moreover, these programmes trained manpower for industry and R&D organizations.

Activity 1(a) : UG level training programme

The broad theme of this activity was ***"Catch them young"*** and goals of this activity were to

- To train undergraduate (B.Sc. and B.Tech.) students in the areas of differential equations, modelling and scientific computing.
- To expose the participants to scientific computing lab sessions with hands on computing.
- To provide a flavour of applied mathematics by exposing them to the links between basic mathematical tools and applications.

The following ***broad topics*** were covered:

Linear Algebra, Analysis, Mathematical Modeling, Ordinary Differential Equations (ODE), Numerical analysis, Scientific Computation of Differential Equations.

*A total number of **271 students** were trained in this programme over the last five years.*

Activity 1(b) : PG level training programme

The broader theme for this programme was to ***prepare students for higher studies and/or industrial jobs*** goals of this programme were

- To motivate young students to pursue a career in the proposed areas by providing platform to link to DEs and modellings to other areas of mathematics.
- To train final year B.Sc, B.Tech. and first year M.Sc. students in DEs, Scientific Computing and Modelling.
- To create man power to support scientific organisations and industry in particular.
- To expose the participants in Scientific Lab sessions with hands on computing.

The ***broad topics*** which were covered in this programme are:

Modelling, Dynamical Systems, PDE, Computations, Measures Theory, Analysis, Computational PDE with hands on computations.

*A total number of **283 students** were trained in this programme over the last five years.*

Activity 1(c) : Advanced level training programme

The broader theme for this programme was to Pre Ph.D training and Prepare for Industrial jobs goals of this programme were

- To prepare a common background for first and second year Ph.D. students in Applied Mathematics.
- To expose young researchers to frontier areas of applied Mathematics.
- To create a pool of trained manpower to support advancement of science and technology.
- To promote fruitful interaction between academia and industry.
- To expose to scientific computing lab sessions with hands on computing.

Topics covered:

Dynamical Systems, PDE, Measure Theory, Analysis, Theory of distributions, Finite element Methods, Sobolev Spaces, Computational PDE with hands on computations.

*A total number of **280 students** were trained in this programme over the last five years.*

One of the common features of these training programmes were scientific computing labs as well as problem solving sessions. *These three training programmes were organised annually in universities and institutes spread over the country during the last five years.*

Major Outcomes

The programme has been successfully running since the last five years and the **major outcomes** of this component can be summarized as follows:

- One of the intangible benefits of the programme is the mathematical maturity which the participants gain as a result of attending the lectures by resource persons who are experts in the area. We believe that this has tremendous help in their overall understanding and outlook of the current trends in DEs and Numerical Analysis.
- Students in rural areas are also chosen for this programme and this has helped in giving them exposure to DE and has possibly help them choose an academic career path.

- A large number of girl students have been trained in all our programmes. In our country, the number of women who have exposure to higher education is quite less and NPDE programmes do support the idea of giving ample opportunities given to women.

- An informal forum on Differential Equations: Theory, Computations and Applications has been helping the local groups to organise two CIMPA Schools in India in the area of DE and Numerical Analysus, already one international conference and other programmes. One more CIMPA school is planned in 2017. Google groups have been set up so that the participants can actually interact with the experts even after the programme.

- Through the training programmes, several lecture notes are put in the web site and a couple of those notes may be put in book form.

Please see the Attached Progress Report Pages ….....for elaborate details on this activity.

As a part of extension, we propose to continue the Activity on Training Programmes (a), (b) and (c) in exactly the same format for the next five years. The outreach in this model has been quite successful and well appreciated and a large number of students seem to have benefitted from this activity.

The budget for this activity in the extension is presented in Pages.....

Activity II: Research Activity

The second kind of activities involved *Advanced one week long workshops, Modelling week and Study group meetings on industrial problems, Visitor's Programme and Summer internship Programme.* All these activities were also found extremely useful and beneficial to the applied mathematics community and possibly some industries.

Goals:

The second set of activities were primarily intented to

- initiate new collaboration in the emerging areas of PDEs : Theory, Computations and Applications,
- organize lecture series, advanced seminar talks and mini workshops,
- train manpower by involving students and young researchers in some concrete research activity,
- enrich the ongoing research activities in the proposed areas in different institutes and universities of our country,
- promote active interaction with national and international experts,
- expose young researchers to the latest developments in proposed areas,
- provide a platform for interaction between academia and industry,
- develop a network of national and international researchers in the stated areas.

Now we detail the major activities under this heading.

Activity 2(a): Advanced One Week Workshops

These one week workshops have been conducted in different institutes in different parts of the country. A total of 29 one week workshops have been carried out till now with around 1052 participants in total.

The broad objectives of these workshops are:

- To expose the young researchers to the state of the art in the proposed areas.
- To provide a platform for interaction between academia and industry personnel.

These short workshops have been quite intense in terms of content and have helped the participants to learn lots of current ideas and concepts in their respective areas of research.

Activity 2(b): Modeling Week and Study Group Meeting on Industrial Problems

A total of four one week workshops were conducted. There were a total of 222 participants in these workshops.

In order to expose young researchers to raw and open ended problems from industry, it was planned to have at least one Study Group Meeting on Industrial Problems every year. This was on the lines of study group meetings organized by OCIAM or OCCAM, Oxford University. Such meetings not only provide many interesting problems and give a first hand experience for the participants on problems from industry, but additionally the interaction with the participating industries brings new opportunities in terms of jobs and association in terms of long term projects.

Activity 2(c): Visitors Programme

A total of 35 visitors were entertained under this programme in the last five years.

- A good number of international visitors visited various universities and institutes to initiate new interaction and strenghten the ongoing research collaborations.
- As an outcome, 19 research publications in top ranking journals were published.
- A good number of CIMPA schools on Numerical Analysis is conducted regularly in India now (2013, 2015 and in 2017). The NPDE workshops provide a way to train the participants for the CIMPA programme where many international resource persons visit and lecture on the state-of-the-art topics.

There are about 43 journal publications out of which 29 are in the last four years.

Most of these publications are in the top ranking journals like: SIAM J. Numer. Anal. IMA J. Numer. Anal., Math.comp., J. Sci. Comp., SIAM J. Sci. Comp., M2$AN, J. Comp. Phy., etc. Some of the publications are the outcome of collaborations with visitors in the Visitor Programme.

Activity 2(d) : Summer Internship Programme

Started with a motto: ***Learn mathematics while working on a real life problem***; the programme is becoming more popular year after year. Around 200-300 apply for this every year.
The total man power trained through this programme till now is 121.

Achievement of Goals in Activity II.

- Overall impact in the country in terms of education on DE in the right perspective rather than rote learning mainly facilitated by the lectures of experts in the area.
- The infectious enthusiasm for research of very active visitors who are experts in subject areas are translating to young researchers and faculty members in the country.
- The programmes at different levels have helped students, researchers and young faculty members in realising their potential and working towards attaining positive goals.
- The visit of eminent Professors as a part of this programme has benefitted many faculty members who are working in Applied Mathematics. The constant interaction has not only resulted in many joint publications with reputed faculty from abroad but also has been playing a role in mentoring research scholars.
- The programmes has helped formation of different groups such as : Control and Optimal control, Evolution Equations: Theory and Computation, Finite Element Analysis, Multiscale Problems, Biomathematics, Industrial Maths.
- Through Modelling and Study Group Meetings with industry every year, for the last 4 years, participants have started getting a feel for industrial problems and in a similar manner, industries have started looking forward for greater interaction. \pause
- A part from Ph.D theses under the supervision of PI & Co- PI's, more Ph.D theses were written (each in IITK, Panjab University, Ravenshaw University, South Asian University) in the areas different from areas of expertise of the PI's is a positive outcome of the National Programme.

In the extension we plan to continue with all the four programmes in the Acitvity II.

D. List of Some Participating Institutions/Universities:

TIFR Bangalore, IMSc Chennai, IMA Bhubaneswar, IISc Bangalore, IIT Bombay, IIT Roorkee, IIT Delhi, IIT Guwahati, IIT Kanpur, BITS Goa, IIST Trivandrum, IIT Madras, JNTU Hyderabad, Utkal University, University of Delhi, NIT Warangal, University of Baroda.

APPLICATION FORM FOR EXTENSION IN DST FORMAT

DEPARTMENT OF SCIENCE & TECHNOLOGY
(MATHEMATICAL SCIENCES OFFICE)

APPLICATION FORM
FOR SEEKING GRANT FOR TRAINING AND OTHER RELATED ACITVITIES IN MATHEMATICAL SCIENCES

(Please read the instructions carefully before filling up the form. Incomplete applications will not be entertained. Ten copies of the application, complete in all respects, shall be submitted at least six months in advance)

(For Office use in DST)

FILE NO. …….. DATE OF RECEIPT …….

A. INFORMATION RELATED TO THE SUBJECT OF ACTIVITY

A.1. Subject & title of the proposed activity:

A.1.1 Broad subject : *Differential Equations, Modelling & Scientific Computing*

A.1.2&3 Topics & Titles

ACTIVITY 1: TRAINING PROGRAMMES

Training Programme (a)

Title 1.1: UG Level *Training Programme*

Topic 1.1: Linear Algebra, Analysis, Mathematical Modeling, Ordinary Differential Equations (ODE), First order Partial Differential Equations (PDE) Scientific Computation of Differential Equations.

Training Programme (b)

Title 1.2: PG Level *Training Programme*

Topic 1.2: Multi-variable Calculus and Analysis (topics relevant to PDEs); Advanced Ordinary Differential Equations (ODE); Partial Differential Equations (PDEs) (Classical treatment); Modelling; Numerical Linear Algebra, Finite Difference & Finite Volume Methods with hands on Computing

Training Programme (c)

Title 1.3 : *Advanced Level Training Programme*

Topic 1.3: Theory of Distributions, Sobolev spaces, Weak solutions of elliptic problems (regularity, eigenvalue problems), Finite element or /and spectral methods. Control Theory.

ACTIVITY 2: RESEARCH ACTIVITY

Topics

(a) One-Week Programmes on Advanced Topics*:* .
(b) Modeling Week and Study Group Meeting on Industrial Problems
(c) Visitors Programme (both short-term and long-term)
(d) Summer Internship Programme

A.2. Brief description of the following items in respect of the activity highlighting its importance in national context (attach separate sheets wherever necessary) :

A.2.1 Objectives:

Activity 1: Training Programme (a)

- To train undergraduate (B.Sc. and B.Tech.) students in the areas of differential equations, modelling and scientific computing.
- To expose the participants to scientific computing lab sessions with hands on computing.
- To provide a flavour of applied mathematics by exposing them to the links between basic mathematical tools and applications.

Broader Theme: *Catch them young*

Activity 1: Training Programme (b)

- To motivate young students to pursue a career in the proposed areas by providing platform to link to DEs and modellings to other areas of mathematics.
- To train final year B.Sc, B.Tech. And first year M.Sc. students in DEs, Scientific Computing and Modelling.
- To create man power to support scientific organisations and industry in particular.
- To expose the participants in Scientific Lab sessions with hands on computing.

Activity 1: Training Programme (c)

- To prepare a common background for first and second year Ph.D. students in Applied Mathematics.
- To expose young researchers to frontier areas of applied Mathematics.
- To create a pool of trained manpower to support advancement of science and technology.
- To promote fruitful interaction between academia and industry.

- To provide a platform to explore through individual or group project.
- To expose to scientific computing lab sessions with hands on computing.

Activity 2: Research Activity

The broad objectives of Activity 2 are to:

- initiate new collaboration in the emerging areas of PDEs : Theory, Computations and Applications,
- organize lecture series, advanced seminar talks and mini workshops,
- train manpower by involving students and young researchers in some concrete research activity,
- enrich the ongoing research activities in the proposed areas in different institutes and universities of our country,
- promote active interaction with national and international experts,
- expose young researchers to the latest developments in proposed areas,
- provide a platform for interaction between academia and industry,
- develop a network of national and international researchers in the stated areas.

A.2.2 Review of the state-of-art of the topic

The study of Differential Equations (DEs) is a fundamental subject area of Mathematics which links important strands of Pure to Applied and Computational Mathematics. As has been emphasized by V.I. Arnold " *Differential Equations are the foundation of the natural scientific, mathematical view of the world"*. In fact, DEs are omni-present in almost all applications of Mathematics where they provide a natural Mathematical description of phenomena in the physical, natural, biological and social sciences.

Differential Equations and their solutions exhibit rich and complex structures. Unfortunately, closed and analytical expressions for their solutions can be found in very special cases, and these are mostly of limited theoretical and practical interest. Thus, it is natural to seek techniques for the approximation of solutions. The advent of digital computers has stimulated the incarnation of Computational Mathematics, much of which is concerned with the construction and the mathematical analysis of numerical algorithms for the approximate solutions of differential equations. As a result, there is an increase use of Mathematics in Industry and Research & Development (R&D) Organizations. While new generation of problems coming from the industry and R&D Organizations have thrown up interesting and challenging problems in Applied Mathematics, the theory as well as computational aspects of Differential Equations have become essential tool for providing innovative solutions and smart strategies.

A country such as India, which aspires to be a world leader in science and technology, has only a few researchers in Differential Equations and Numerical Analysis. Further, these researchers are sparsely located in a small number of institutions-each one having an inadequate number of scientists. Recognizing the importance and the need for training manpower, the Department of Science and Technology (DST) has identified `*Numerical*

Schemes and Qualitative Properties of Differential Equations' as one of the thrust areas of Mathematics.

A.2.3 Genesis of the proposed activities (that is where from the idea of holding the activities emerged)

Although from time to time efforts were made by faculty in TIFR Bangalore; IISc Bangalore; IITs and few other institutions/universities to formulate a national programme in this thrust area, it was in November 2005 at IIT Kanpur that a major deliberation on this was held and a rough plan was proposed. As a follow up, we had organized a brain storming session on October 18th and 19th, 2006 at IIT Bombay under Research Initiatives in Computational PDEs to chalk out a road map for the next five years. The deliberations have culminated into this envisaged vision document.

A.2.4 Expected consequential benefits of the proposed activities

- Participants with well-grounded knowledge in basic mathematics with hands on computing that is essential to study DEs and Applications.
- Motivated young students with a strong desire to work in Applied Mathematics, in particular in the areas of Differential Equations, Modelling and Scientific Computing.
- Manpower generation to support the ongoing demand in Scientific organisations, industries and institutes of national importance
- Motivated students to pursue quality research in DEs.

A.2.5 Work plan:

Activity 1:

Training Programme (a)

To conduct an instructional school of four weeks duration for the students of B. Sc. (second and third year), B. Tech/B.E. (second year onwards). Experienced teachers from various universities and research institutions of our country will be invited to teach in the school. The number of participants will be 40 and they will be selected based on recommendations and their academic records.

Training Programme (b)

To conduct a four week-long instructional school for the students who have completed ***Training Programme (a)*** and/or B.Sc., M.Sc., (first year), B.Tech/B.E. (third year onwards), Young teachers. Experienced teachers from various universities and research institutions of our country will be invited to teach in the school. The number of participants will be 40 and they will be selected based on recommendations and their academic records.

Training Programme (c)

To conduct a four week-long instructional school for the students who have completed ***Training Programme (b)*** and/or M.Sc., B.Tech/B.E., Ph.D. (first and second year), Faculty from educational institutions, scientists from R & D organizations and from industry can also participate in this programme. Experts in the area of differential equations, from various universities and research institutions of our country will be invited to teach in the school. The number of participants will be 40 and they will be selected based on recommendations and their academic records.

Activity 2:

The research group which organises the advanced level programme in a given year will be invited to organise a year long thematic programmes based on their local expertise. In addition to quality research output, through such programmes, it is expected to generate quality manpower in priority areas.

Topic (a) One-Week Programmes on Advanced Topics:

We will organize three to four programmes each of one week duration which are spread over the entire year. These programmes may be symposia, conferences or Group meetings on some advanced, but they will always be centred around focussed topics for the participants of the Advanced Level Program and for researchers in Applied Mathematics, in particular, in differential equations, modelling and scientific computing. In particular, it is intended to expose the young researchers to the state of the art in the proposed areas. This program will also provide a platform for interaction between academia and industry personnel.

Topic (b) Modeling Week and Study Group Meeting on Industrial Problems:

In order to expose young researchers to raw and open ended problems from industry, it is planned to have at least one Study Group Meeting on Industrial Problems every year. It may be on line of the study group meetings organised by Oxford Centre for Industrial and Applied Mathematics (OCIAM), Oxford. Industrial Mathematics Group (IMG) in the department of mathematics at IIT Bombay; in collaboration with OCIAM, Oxford and the University of Baroda has a track record of organising four to five such meetings in India **(see Appendix)**. Such meetings not only provide many interesting research problems and give a first-hand experience for the student participants on problems from industry, but , additionally, the interaction with participating industries in our country brings new opportunities in terms of jobs and associations in terms of long-term projects. In order to make it more effective for the student participants, it is proposed to have one Modeling Week just before each Study Group Meeting.

Topic (c) Visitors Programme (short-term and long-term) :

Depending on the thrust areas of the year-long programme, some experts from India and abroad will be invited to join or organize year-long activities. Moreover, a few short-term visitors from

India will also be invited to participate in the year long activities. The major objectives of the visitors programme are as follows:

- Participation by eminent visitors is likely to encourage and enhance the research output of the organizing group.
- The invited short-term visitors mainly from India will be able to confront some front line areas of research.
- There will be a greater possibility for further research collaborations.

Since there is not enough expertise available in the proposed areas in India, it is important to have both short-term and long-term visitors from abroad also. In a given year, it is proposed to have five to six visitors from abroad and 10 to 16 visitors from India.

Topic (fd) Summer Internship Programme:

Based on a theme entitled ``*Learning Mathematics while working on a project''*,a few bright participants from both Basic and Advanced Level Programmes will be selected to do their summer internship with eminent researchers in our country or with industry for a period of two to three months.

In a given year, 15 to 20 internships may be offered.

A list of groups that agreed to undertake these activities (from (a) to (f)) are :

TIFR Bangalore, IMS Chennai, IMA Bhubaneswar, IISc Bangalore, IIT Bombay, IIT Roorkee, IIT Delhi, IIT Guwahati, IIT Kanpur, BITS Goa, IIST Trivandrum, IIT Madras, JNTU Hyderabad, Utkal University, University of Delhi, NIT Warangal, University of Baroda.

A.3. Topics (alongwith the detailed course content)

Activity 1: UG Training Programme (a)

1. Linear Algebra (essential for understanding ODEs, numerics)
2. Analysis (mostly topics having relevance in understanding ODEs)
3. Modeling (specially related to biological, mechanical,interest rate, and environmental requiring mainly ODE modelling)
4. Ordinary Differential Equations
5. Elementary first order Partial Differential Equations
6. Scientific Computation of Differential Equations
7. Exposing to public domain software packages in the associated lab sessions.

Activity 1: PG Training Programme (b)

1. Multi-variable Calculus (relevant to PDEs)
2. Analysis (relevant to understand ODEs and PDEs)
3. Advanced Ordinary Differential Equations : Dynamical Systems, Geometric Theory
4. Partial Differential Equations (PDEs) (Classical treatment)
5. Numerical Linear Algebra : Direct and Iterative methods, Conjugate Gradient methods, least square methods, linear optimization tools etc.
6. Finite Difference & Finite Volume Methods
7. Mathematical Modeling (mostly in fluid flow, heat transfer, air and water pollution, biological models, materials etc. requiring PDEs)
8. Problem Solving Sessions and Scientific Computing Lab sessions.

Activity 1: Advanced Level Training Programme (c)

1.Theory of Distributions : Distributional Derivatives, Fourier transforms and tempered distributions, Fundamental Solutions
2. Sobolev spaces : Basic properties, density theorems, Dual spaces, trace theorems, embedding theorems (without proof)
3. Weak solutions of elliptic problems (regularity, eigenvalue problems)
4. Weak solutions of parabolic and wave equations : existence, uniqueness and properties
5. Finite element methods
6. Optimal Control Theory (theme)
7. Problem solving sessions and Lab Sessions

The first four topics will be mostly covered from S. Kesavan's book on Topics in Functional Analysis.

A.4. Is this activity organized annually? If yes, please give a brief statement on the follow-up of the recommendations of the activity held in the past 3 years.

Activity 1: Training Programme (a,b and c)
No, not yet. But however, it is now planned to organize the training programmes every year starting from 2010 for the next five years in different institutes.

B. INFORMATION RELATED TO THE MANAGEMENT/EXECUTION

B.1. Name & Address (along with telephone, FAX, e-mail/Mobile) of the Coordinator:

Professor Amiya K. Pani
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B. 2. Name & Address (along with telephone, FAX, e-mail/Mobile) of the Co-Coordinators

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B. 3. Name & Address of the Institution/Department/Division where training is proposed to be conducted:

Nodal Organisation

Department of Mathematics
Indian Institute of Technology Bombay
Powai, Mumbai – 400076.

The venues for all the three training programmes for the next five years will be decided in due course of time.

B 4. Status of Organizing Institute :

University/ Govt. College/ Govt. Organization/ College run by Registered Society/ Registered Society/Professional Body/ Private Industry/ Others.

Institute of National Importance

B 5. Duration of the activity along with the dates:

Training Programmes will have a duration of three to four weeks during summers and the IGIAM activities will be spread over throughout the year.

B 6. List of resource persons

Activity 1

1. Adimurthi, TIFR Bangalore (adi@math.tifrbng.res.in)
2. Raju K. George, IIST, Trivandrum
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Activity 2:

1. *S. Baskar (IITB)*
2. *Francois Coulvart (Universite Pierre Marie Curie, France)*
3. *Phoolan Prasad (IISc, Bangalore)*
4. *Mira Mitra (IITB)*
5. *Rathish Kumar (IITK)*
6. *J.C. Mandal (IITB)*
7. *A.K. Pani (IITB)*
8. *Neela Nataraj (IITB)*
9. *Shalini Baskar (IITB)*
10. *V.S. Borkar (TIFR Mumbai)*
11. *M.K. Ghosh (IISc)*
12. *K. Suresh Kumar (IITB)*
13. *K.S. Mallikarjuna Rao (IITB)*
14. *A.J. Shaiju (IITM)*
15. *S. Sivaji Ganesh (IITB)*
16. *Thirupathi Gudi (Lousiana State University)*
17. *Olivier Pironneau (University of Paris VI)*
18. *Bobby Philip (Oak Ridge National Lab)*
19. *Andreas Griewank (Humboldt University)*
20. *Nupur Gupta (IITB)*
21. *Anil Kumar Pundir (BITS, Goa)*
22. *M. Vanninathan (TIFR, Bangalore)*
23. *R. Alexandre (Naval Institute, France)*
24. *E. Bonnetier (UJF, Grenoble, France)*
25. *G. Panasenko (UJM, France)*
26. *Sarvesh Kumar (BITS, Goa)*
27. *Madhu Venjamur (IITB)*
28. *John R. Whiteman (Brunel Univ, UK)*
29. *Rajen K. Sinha (IIT G)*
30. *Deepjyoti Goswami (IITB)*

31. ***Kshitij Kulshreshtha (Humboldt Univ, Germany)***
32. ***P. Dhanumjaya(BITS, Goa)***
33. ***Arindama Singh (IITM)***
34. ***Carsten Carstensen (Humbodt Univ, Germany)***
35. ***Sangita Yadav (IITB)***
36. ***Sajid Memon (IITB)***

B. 7. Geographical Coverage (strike-out those not applicable): National /International/ Regional

National (India)

B. 8. Details of participants :

(Local participants shall not be more than 30% of the total participants in case of training programmes and also at least 70% shall be below the age of 35 years). (List of participants shall be finalized in consultation with DST)

For Activity 1

B.8.1 No. of foreign Young Scientists : 0
B.8.2 No. of foreigh Scientists : 02* (for ***Activity 1, Training Programme (c))***
B.8.3 No. of Indian Young Scientists : 40
B.8.4 No. of Indian Scientists : 15
B.8.5 No. of Indian Participants : 55
(for whom TA/DA being offered)

* Since there are not enough experts available in our country, it may be important to have a couple of experts from abroad for ***Activity 1, Training Programme (c).*** Their presence may also boost the research activity in the group that organises this programme.

B. 9. In case of International Facutly/Participants, kindly give following additional particulars in respect of the following as per enclosed guidelines :

B. 9.1 Resources for International Travel and local hospitality:
B. 9. 2 Status of clearance from

1. Administrative ministry of the organizing institution: Not applicable
2. Ministry of External Affairs : Not Applicable
3. Ministry of Home Affairs: Not Applicable

C. FINANCIAL DETAILS

C. 1. Broad details of estimated expenditure :

FOR 1 YEAR

*1. Yearly Budget on Secretarial help, Contingency, travel, equipments**

Account Head (secretarial help, contingency, travel , equipments)	**Amount (in Rupees)**
1. **Secretary** @15,000/per month x 12*	**1,80,000/-**
2. Contingency (stationary, miscellaneous (tea, coffee etc))	**2,00,000/-**
3. Travel money for organisational purpose	**3,50,000/-**
4. Equipments (minimum 10 computers (one for secretary, one each for each PDF) each @50,000 x 10 and one server @ 100,000 + two printers @ 25,000)	**6,50,000/-**
5. Overhead @ 20% of 13,80,000/-	**2,76,000/-**
TOTAL	**16,56,000/-**

*Justification for this budget:

For such activities, at least one full time secretarial help is quite essential. A small amount of travel money will be needed for organisational purpose as there is a need to coordinate organizational activities in different institutes.

Since we expect to have one secretary, three post-doc fellows and six research fellows, it is essential that we should have at least 10 good machines (each worth 50,000/-) and one high end server (worth Rs. 1,00,000/-) and two printers (each worth 25,000/-).

Regarding travel: It is expected to have co-ordination committee meetings as well as advisory committee meetings. Also, we need to provide travel grant for post-docs and research fellows to participate in scientific meetings.

2. Yearly Budget - Activity 1: Training Programme (a)

Account Head	**Amount (in Rupees)**
TA for Young Scientists (Indian) : @ 1000/- per participant x 40	40,000
TA for Senior Scientists (Indian) : @ 10,000 per person x 10	1,00,000
Pre-Conference Printing	
Stationery	30,000
Secretarial assistance	30,000
Publication of proceedings	0
Local hospitality (including both lodging and boarding) : @300/ per participants per day x 30days=9,000 x 40;	0 3,60,000
@1000/- per day x 30 days = 30,000 x 3 (on an average)	90,000
Honorarium : @500/- per lecture per day @3000/- x 24= 72,000/-	72,000
Rental for venue, if any	
Folders	20,000
	40,000
k. @20% of total 7,82,000/- towards Institute Overhead	1,56,400
TOTAL	**9,38, 400**

3. Yearly Budget: Activity 1 : Training Programme (b)

Account Head	**Amount (in Rupees)**
a. TA for Young Scientists (Indian) : @ 1000/- per participant x 40	40,000
b. TA for Senior Scientists (Indian) : @ 10,000 per person x 10	1,00,000
c. Pre-Conference Printing	
d. Stationery	30,000
e. Secretarial assistance	30,000
f. Publication of proceedings	0
g. Local hospitality (including both lodging and boarding) : @300/ per participants per day x 30days=9,000 x 40;	0 3,60,000
@1000/- per day x 30 days = 30,000 x 3 (on an average)	90,000
h. Honorarium : @500/- per lecture per day @3000/- x 24= 72,000/-	72,000
i. Rental for venue, if any	20,000
j. Folders	40,000
k. @20% of total 7,82,000/- towards Institute Overhead	1,56,400
TOTAL	**9,38, 400**

4. Yearly Budget : Activity 1 : Training Programme (c)

Account Head	**Amount (in Rupees)**
1.TA for Young Scientists (Indian) : @ 2000/- per participant x 40	80,000
2.TA for Senior Scientists (Indian) : @ 10,000 per person x 15	1,50,000
3.Two Foreign Senior Scientists	2,00,000
4. Pre-Conference Printing	43,300
5. Stationery	50,000
6. Secretarial assistance	0
7. Publication of proceedings	0
8. Local hospitality (including both lodging and boarding) : @300/ per participants per day x 30days=9,000 x 40;	3,60,000
@1000/- per day x 30 days = 30,000 x 5 (on an average)	1,50,000
9. Honorarium : @500/- per lecture per day @3000/- x 24= 72,000/-	72,000
10. Rental for venue, if any	20,000
11. Folders	50,000
12. **@20% of total 11,75,300/- towards Institute Overhead**	2,35,060
TOTAL	**14,10, 360 (~ 14,10,400)**

5. Yearly Budget: Activity 2 (b) One Week Long Programme on Focussed Topics:

Details of participants :

No. of Indian Young Scientists : 20
No. of Indian Scientists : 6
No. of Indian Participants : 26

Broad details of estimated expenditure per program :

	Account Head	**Amount (in Rupees)**
k.	1. TA for Young Scientists (Indian) : @ 2000/- per	
l.	participant x 20	40,000
m.		
n.	2. TA for Senior Scientists (Indian) : @ 10,000	60,000
o.	per person x 6	
p.		
q.	3. Pre-Conference Printing	5,000
r.		
s.	4. Stationery	5,000
t.		
u.	5. Secretarial assistance	0
v.		
w.	6. Publication of proceedings	0
x.		
y.	7. Local hospitality (including both lodging and	
z.	boarding) : @300/ per participant per day x 7	42,000
aa.	days=2100 x 20 ;	
bb.		
cc.	@1000/- per day x 7 days =	42,000
dd.	7,000 x 6 (on an average)	
ee.		
ff.	8. Honorarium : @500/- per lecture	
	per day @3000/- x 7= 21,000/-	21,000
		10,000
gg.	9. Rental for venue, if any	5,000
hh.	10. Folders	
ii.	11. Misc. **@20% of total 2,30,000/- towards**	46,000
jj.	**Institute Overhead**	
	TOTAL	**2,76,000/-**

Budget for 4 programmes in one year = 2,76,000 X 4 = 11,04,000/-

6. Yearly Budget: Activity 2 (c) Modelling Week & Study Group Meetings.

Budget for Indian participants as in *Activity 2(b)* :

Rs. 2,76,000/- (per programme) x 2 = Rs. 5,52,000/- (per year)

7. Yearly Budget: Activity 2 (d) Visitors Programme (short term and long term).

(Long term visitors one to three months)

Foreign visitors.

No. of visitors	: 4 to 6
Air Fare	: Rs. 4,00,000 (on an average)
Hospitality and honorarium	
@ Rs. 50,000 per month × 4 × 2	: Rs. 4,00,000 (on an average)

Indian Visitors:

No. of visitors	: 16
Air Fare	: Rs. 1,60,000
Hospitality	
@ Rs. 50,000 per month× 8	: Rs. 4,00,000/-
TOTAL	**: Rs. 13,60,000/- (per year)**

8. Yearly Budget: Activity 2 (e) Post-doctoral and Research fellowships

Post-doc Fellows: @Rs. 30,000/- per month x 12 x 3 = Rs. 10,80,000
Research Fellow: @Rs.20,000/- per month x 12 x 6 = Rs. 14,40,000

Total : Rs. 25,20,000

9. Yearly Budget: Activity 2 (f) Summer Internship Programme

15 to 20 internships to be offered per year.

20 summer internships:

Travel		: Rs.40,000
Internship	@Rs. 5000/-per month x 2 x20	: Rs.2,00,000
Total		**Rs. 2,40,000/- (per year)**

BUDGET SUMMARY

Yearly Budget on Activity-1

Account Head	**Amount (in Rupees)**
Activity-1 Training Programme-(a) Training Programme-(b) SERC Advanced School (Training Programme (c))	 9,38,400/- 9,38,400/- 14,10,400/-
TOTAL	**32, 87, 200/-***

*** over head charges @ rate of 20% has been included in budget of training programmes (a)-(c).**

Yearly Budget on Activity-2

Account Head	**Amount (in Rupees)**
Activity-2 (i) @2,76,000/- per workshop x 4 = (ii) Modelling Week & Study Group (iii) Visitors : 6 from abroad +16 from India (iv) Postdoc : @30,000/-per month x12x3 Research Fellow: @20,000/- per month x12x6 (v) Summer internships (vi) Overhead @ 20% of item (iii)-(v) that is 20% of **Rs.41,20,000/- as for item (i)-(ii) the overhead is included with the budget.**	 **11,04,000/-** **5,52,000/-** **13,60,000/-** 10,80,000/- 14,40,000/- 2,40,000/- 8,24,000/-
TOTAL	**66,00,000/-**

Consolidated Budget for One year

Head	Amount (in Rupees)
• Secretarial help, travel,contigency and equipments	**16,56,000**
• Activity-1 Training Programme (a) Training Programme-(b) SERC Advanced School total for Activity-1 (Training Programme (c))	**32,87,000***
• Activity-2 (i)@2,76,000/- per workshop x 4 = (ii) Study Group (iii) Visitors : 6 from abroad +16 from India (iv) Postdoc : @30,000/-per month x12x3 RF : @20,000/-per month x12x6 (v) Summer internships Total for Activity-II	**66,00,000**
TOTAL	**1,15,43,000**

*** approximated to the nearest thousand**

FOR 5 YEARS

Broad details of estimated expenditure for five years :

Account Head	Amount (in Rupees)
@ 1,15,43,000/- per year x 5 years	**5,77,15,000/-**
On an average add 10% to compensate inflation	**57,71,500/-**
TOTAL	**6,34,86,500 /-**

C. 2. Details of income from other sources: **-NA-**

Source	**Amount committed/received, if any**	**Account head (as per item No. 11) for which grant requested/ committed**
a.		
b.		
c.		
d.		

C. 3. Financial Assistance required from DST for this Activity:

Account Head	**Amount (in Rupees)**
	Rs. 6,34,86,500

C. 4. Details of previous grant received from DST in past :

C.4.1 DST reference No. DST/GIA/3391/2008-2009/Cash, dated 14th Nov.' 08.
C.4.2 Type of activity : International Workshop and International Conference
C.4.3 Accounts reconciled : YES
C.4.4 Date of furnishing Utilization Certificate(4) :06-04-09

C. 5. Estimates of cost of proceedings, if planned to be brought out : -NA-

C. 5.1 No. of pages :
C. 5.2 No. of copies :
C. 5.3 Will the contents of the proceedings be referred and edited ?
C. 5.4 Will the proceedings be priced? If so, then proposed cost of each volume and expected income: Rs.
C. 5.5 Cost of Printing : Rs.
C. 5.6 Copy of acceptance by publishing agency (if any) to be attached.
C. 5.7 Approximate duration (in months) required for publication.

C. 6. Name and designation of the Official empowered to receive the grant:

The Registrar,
Indian Institute of Technology, Bombay.

Signature of the applicant

Signature of Head ,
Department of Mathematics

Signature of Dean,
Research & Development