DR. ANIL KUMAR

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PERSONAL DETAILS

Father's name	:	Sh. Sukhvir Singh
Date of Birth	:	15- 05 -1975
Marital Status	:	Married
Language Known	:	Hindi, English
Nationality	:	Indian
Permanent Address	:	193/6 Panchsheel Colony, Garh Road, Meerut – 250002, Uttar Pradesh, India.

EDUCATION

► 2000-2006: Doctor of Philosophy, Department of Mathematics, Indian Institute of Technology, Bombay, India.

Dissertation: *Optimal Control Problems Involving Parabolic Differential and Parabolic Integro-Differential Equations*.

Thesis Supervisors: Prof. Amiya K. Pani and Prof. Mohan C. Joshi, Department of Mathematics, IIT Bombay.

► 1999-2000: Master of Philosophy (Mathematics), Indian Institute of Technology (Formerly known as University of Roorkee), Roorkee, India.

Project: A short project on *Factorization of Analytic Functions* in the first semester and a project on *Root Locus Techniques for Control Systems* during the second semester of the program.

Cumulative Performance Index: 7.73.

► 1996-1998: Master of Science (Mathematics), Ch. Charan Singh University, Meerut, Uttar Pradesh, India.

Percentage of marks: 66.12.

- ▶ 1994-1996: Bachelor of Science (Mathematics, Physics, Chemistry), Ch. Charan Singh University, Meerut, Uttar Pradesh, India.

  Percentage of marks: 73.93.

RESEARCH INTERESTS

- ▶ Optimal Control Theory.

- ▶ Ordinary and Partial Differential Equations.

- ▶ Finite Element Method/Virtual Element Method.

COMPUTER SKILLS

- ▶ Extensive programming experience in mathematical packages MATLAB and Mathematica.

- ▶ Conversant in Linux/Unix, Windows operating systems.

- ▶ Conversant in Microsoft Office and LaTeX word processors.

AWARDS AND SCHOLARSHIPS

- ▶ Secured all India 34th rank in Graduate Aptitude Test in Engineering (GATE-2000), conducted by the Ministry of Human Resource and Development, Govt. of India.

- ▶ Awarded the Junior Research Fellowship by GATE in 2000 and the Senior Research Fellowship from 2002 to 2005.

MEMBERSHIPS

- ▶ Life member of Ramanujan Mathematical Society (RMS).

- ▶ Life Member of the Indian Society of Industrial and Applied Mathematics (ISIAM).

- ▶ Life Member of the Indian Association for Computer Science and Discrete Mathematics.

- ▶ Member of American Mathematical Society.

- ▶ Member of Society for Industrial and Applied Mathematics (SIAM).

SPONSORED PROJECTS

Co-PI :   *Some Studies on Neighborhood Magic Graphs* (Reference No. SR/S4/MS: 734/11).
Amount: Rs. 12.69 lakhs.   Duration: July 1, 2013, to July 30, 2016.
Funding Agency: Department of Science and Technology, Govt. of India.
PI: Prof. Tarkeshwar Singh, Department of Mathematics, BITS Pilani K.K. Birla Goa Campus, Goa.

PI :   *A Theoretical and Numerical Study of the Control Problems Involving Differential Equations with memory terms* (Reference No.: MTR/2018/000499).
Amount: Rs. 6.60 lakhs   Duration: March 12, 2019 to March 12, 2022.
Funding Agency: DST-SERB under MATRICS-2018.

PI :   *Numerical Approximation of Optimal Control Problems Using Virtual Element Method* (Reference No.: CRG/2019/003863).
Amount: Rs. 19.07 lakhs.   Duration: 2020 to 2023.
Funding Agency: DST-SERB under Core Research Grant.
Co-PI: Prof. Sarvesh Kumar, Department of Mathematics, IIST Trivandrum.

Ph.D. GUIDANCE

▶ Mr. Santosh K. Bhal, "*Orthogonal Spline Collocation Methods for the Differential Equations with Interfaces,*" awarded in May 2020 (as a Co-supervisor).

▶ Mr. Jai Tushar, "*Numerical Approximation of Optimal Control Problems Using Virtual Element Method,*" awarded in December 2022.

▶ Mr. Sujit Kumar Pradhan, "*Application of optimal control theory in software reliability growth modelling*", (ongoing).

▶ Ms. Geet Verma, under the project "*Optimal Control Problems Using Virtual Element Method*" (Project JRF, ongoing).

PUBLICATIONS

1. Joshi, M. C., & **Kumar, A.** (2005). Approximation of exact controllability problem involving parabolic differential equations. *IMA Journal of Mathematical Control and Information*, 22(3), 350-363.
(DOI: https://doi.org/10.1093/imamci/dni032)

2. **Kumar, A.**, Joshi, M. C., & Pani, A. K. (2007). On approximation theorems for controllability of non-linear parabolic problems. *IMA Journal of Mathematical Control and Information*, 24(1), 115-136.
(DOI: https://doi.org/10.1093/imamci/dnl012)

3. Sonawane, R. B., **Kumar, A.**, & Nimse, S. B. (2013). Numerical optimal control for bilinear hyperbolic pdes. *In 2013 Nirma University International Conference on Engineering (NUiCONE)*, IEEE. 1-5.
DOI: 10.1109/NUiCONE.2013.6780203.

4. Baths, V., Singh, T., & **Kumar, A.** (2014). Disruption of cell wall fatty acid biosynthesis in Mycobacterium Tuberculosis using the concept of minimum robust domination energy of graph. *Annual Research & Review in Biology*, 4(12), 2037-2044.
DOI: https://doi.org/10.9734/ARRB/2014/8960.

5. Sonawane, R. B., **Kumar, A.**, & Nimse, S. B. (2014). Optimal control for a vibrating string with variable axial load and damping gain. *IFAC Proceedings Volumes*, 47(1), 75-81. (3rd International Conference on Advances in Control and Optimization of Dynamical Systems (ACDOS-2014), March 13-15, 2014, IIT Kanpur, Kanpur, India, International Federation of Automatic Control (IFAC), Elsevier. DOI: https://doi.org/10.3182/20140313-3-IN-3024.00087)

6. Sonawane, R. B., **Kumar, A.**, & Nimse, S. B. (2014). Exact controllability of wave equation with multiplicative controls. *Applied Mathematics E-Notes*, 14, 45-52.
   DOI: https://www.emis.de/journals/AMEN/2014/131217(final).pdf

7. **Kumar, A.**, Pani, A. K., & Joshi, M. C. (2016). Approximate controllability of a class of partial integro-differential equations of parabolic type. *arXiv preprint* arXiv:1606.03673.
   DOI: https://arxiv.org/pdf/1606.03673.pdf

8. Sonawane, R. B., & **Kumar, A.** (2017). Optimal control of the velocity term in a Kirchhoff plate equation with multiplicative control. *Proceedings of International Conference on Computational Modelling and Simulation (ICCMS)*, 248-251, ISBN: 978-955-703011-1.

9. Kumar, P., & **Kumar, A.** (2017). Annuli containing all the zeros of a polynomial. *Alabama Journal of Mathematics*, 41, 1-6.
   DOI: http://www.ajmonline.org/wp-content/uploads/2018/12/final_AJM_PKAK_2017.pdf

10. Lamichhane, B. P., **Kumar, A.**, & Kalyanaraman, B. (2017). A mixed finite element method for elliptic optimal control problems using a three-field formulation. *ANZIAM Journal*, 59, C97-C111.
    DOI: https://doi.org/10.21914/anziamj.v59i0.12643

11. Sonawane, R., & **Kumar, A.** (2018). Controllability of a space-time fractional order parabolic equation. hal-01948683. (https://hal.archives-ouvertes.fr/hal-01948683)

12. Kumar, B. S., Danumjaya, P., & **Kumar, A.** (2019). A fourth-order orthogonal spline collocation method to fourth-order boundary value problems. *International Journal for Computational Methods in Engineering Science and Mechanics*, 20(5), 460-470.
    (DOI: https://doi.org/10.1080/15502287.2019.1600070)

13. Dhayal, R., Malik, M., Abbas, S., **Kumar, A.**, & Sakthivel, R. (2021). Approximation theorems for controllability problem governed by fractional differential equation. *Evolution Equations & Control Theory*, 10(2), 411.
    (DOI: https://www.aimsciences.org/article/doi/10.3934/eect.2020073)

14. Pradhan, S. K., **Kumar, A.**, & Kumar, V. (2021). An optimal resource allocation model considering two-phase software reliability growth model with testing effort and imperfect debugging. *Reliability: Theory & Applications*, (SI 2 (64)), 241-255.
    (DOI: 10.24412/1932-2321-2021-264-241-255)

15. Tushar, J., **Kumar, A.**, & Kumar, S. (2022). Approximations of quasi-linear elliptic optimal control problems on polygonal meshes under variational and virtual discretizations. *International Journal*

of Applied and Computational Mathematics, 8(1), 1-35.
(DOI: https://doi.org/10.1007/s40819-021-01215-y)

16. Tushar, J., **Kumar, A.**, & Kumar, S. (2022). Variational and virtual discretizations of optimal control problems governed by diffusion problems. *Applied Mathematics & Optimization*, 85(2), 1-36.
(DOI: https://doi.org/10.1007/s00245-022-09872-1)

17. Tushar, J., **Kumar, A.**, & Kumar, S. (2022). Virtual element methods for general linear elliptic interface problems on polygonal meshes with small edges. *Computers and Mathematics with Applications*, 122, 61-75.
(DOI: https://doi.org/10.1016/j.camwa.2022.07.016)

18. **Kumar, A.**, Pani, A. K., & Joshi, M. C. (2022). Approximate Controllability of linear parabolic equation with memory. *Computers and Mathematics with Applications*, 128, 320-330.
(DOI: https://doi.org/10.1016/j.camwa.2022.11.003)

19. **Kumar, A.**, Latpate, S. G., & Sonawane, R. B. (2022). Controllability of a space-time fractional order parabolic equation. *Discussiones Mathematicae: Differential Inclusions, Control and Optimization*, 42 (2), 131-142.
(DOI: https://doi.org/10.7151/dmdico.1234)

20. Pradhan, S. K., **Kumar, A.**, & Kumar, V. (2023). An effort allocation model for a three-stage software reliability growth model. *Predictive Analytics in System Reliability*, 263-282. Cham: Springer International Publishing.
(DOI: https://doi.org/10.1007/978-3-031-05347-4_17)

21. Tushar, J., **Kumar, A.**, & Kumar, S. (2023). Virtual element methods for optimal control problems governed by elliptic interface problems, FIAM 2021, Springer Proceedings in Mathematics & Statistics, vol 410, 521-533, Springer, Singapore.
DOI: https://doi.org/10.1007/978-981-19-7272-0_36

22. Tushar, J., **Kumar, A.**, & Kumar, S. (2023) Mixed Virtual Element Methods for optimal control of Darcy flow. *Computers and Mathematics with Applications*, 140, 134-153.
DOI: https://doi.org/10.1016/j.camwa.2023.04.022

23. Pradhan, S. K., **Kumar, A.**, & Kumar, V. (2023). An optimal software enhancement and customer growth model: a control-theoretic approach. *International J. of Quality & Reliability Management.*
DOI: https://doi.org/10.1108/IJQRM-08-2022-0240

24. Pradhan, S., **Kumar, A.**, & Kumar, V. (2023). A new software reliability growth model with testing coverage and uncertainty of operating environments, in Proceedings of the *1st International Online Conference on Mathematics and Applications*, 1–15 May 2023, MDPI: Basel, Switzerland.
doi:10.3390/IOCMA2023-14436

25. Danumjaya, P., **Kumar, A.**, & Pani, A. K. (2023). Asymptotic behaviour of the semidiscrete FE approximations to weakly damped wave equations with minimal smoothness on initial data. arXiv preprint arXiv:2302.12476. arXiv: https://doi.org/10.48550/arXiv.2302.12476. Communicated.

26. Tushar, J., Sau, R. C. & **Kumar, A.** (20**) Virtual element method for control constrained Dirichlet boundary control problem governed by the diffusion problem. Communicated.

27. Pradhan, S. K., **Kumar, A.** & Kumar, V. (20**) A new SRGM with an inflection S-shaped fault detection rate subject to the uncertainty of the operating environment. Communicated.

28. Pradhan, S. K., **Kumar, A.** & Kumar, V. (20**) A study of fault detection and correction process in software reliability analysis. Communicated.

LECTURES/SEMINARS

▶ Presented a paper in the *International Conference and Instructional Workshop on Industrial Mathematics* held at the Indian Institute of Technology Bombay, India, from December 2 to December 9, 2002. The paper's title was *Exact Controllability of the Linear Parabolic Differential Equations*.

▶ Delivered a talk in the *International Conference on Partial Differential Equations, Optimal Design and Numerics* held at The Benasque International Center for Science, Benasque, Huesca, Spain, from August 28 to September 9, 2005. The talk title was *On Approximation Theorems for Controllability of Nonlinear Parabolic Problems*.

▶ Presented a paper in the *International Conference on Topics in Functional and Numerical Analysis* held at the Indian Institute of Technology Bombay, India, from December 7 to December 9, 2005. The paper's title was *Optimal Control Problems Governed by Parabolic Integro-Differential Equations*.

▶ Delivered lectures on *MATLAB and MATHEMATICA Software* in the *Summer School on Mathematics Education through Instructional Workshop* held at the Department of mathematics, DSB Campus, Kumaun University, Nanital, India, from June 7 to June 16, 2006.

▶ Delivered lectures on *MATLAB Software* in the *Second Summer School on Mathematics Education through Instructional Workshop for undergraduate and postgraduate students* held at G. B. Pant College of Engineering, Pauri, Uttarakhand, India, from June 4 to June 16, 2007.

▶ Delivered lectures on *Numerical Computation by Using MATLAB* in the *National Workshop on Soft Computing (NWSC-08)* held at Gandhigram Rural University, Tamil Nadu, India, from January 21 to January 27, 2008.

▶ Delivered guest lecture on *MATLAB with Programming* in PSNA College of Engineering and Technology, Dindigul, Tamil Nadu, India, on January 24, 2008.

▶ Delivered lectures on *Numerical Analysis with MATLAB* in the *Third Summer School on Mathematics Education through Instructional Workshop for undergraduate and postgraduate students* held at Birla Institute of Applied Sciences, Bhimtal, Uttarakhand, India, from June 16 to June 28, 2008.

▶ Delivered lectures on *Mathematica and its application* in the *National Workshop on Mathematical Softwares and Applications* held at Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, India, from March 23 to March 27, 2010.

▶ Delivered lectures on *Linear Programming and its Application with MATLAB* in the *National Workshop on Optimization-Theory and Practice* held at SSJ Campus Almora of Kumaun University, Uttarakhand, India, from November 15 to November 19, 2010.

▶ Delivered lectures on *Numerical Computation by Using MATLAB* in the workshop on *Scientific Computing: Theory and Practices* held at Faculty of Engineering and Technology, Gurukula Kangri Vishwavidyalaya Haridwar, Uttarakhand, India, from October 8 to October 13, 2012.

▶ Delivered lectures on *Computation of Steering Controls in MATLAB* in the workshop on *Mathematical Theory of Control and Numerics* held at the Department of Mathematics, Indian Institute of Space Science and Technology, Thiruvananthapuram, Kerala, India, from November 21 to November 30, 2012.

▶ Presented a paper at the *National Conference on Recent Trends in Operations Research* held at Amity School of Engineering & Technology, New Delhi, India, from April 11 to April 12, 2013. The paper's title was *Numerical Approximation of Boundary Optimal Control Problems*.

▶ Delivered lectures on *Mathematica* in the *Introductory Workshop on Mathematica* held at the Department of Mathematics, BITS Pilani K.K. Birla Goa Campus, Goa, India, from July 24 to July 25, 2013.

▶ Presented a paper in the *4th Nirma University International Conference on Engineering (NuiCONE 2013)* from November 28 to November 30, 2013. The paper's title was *Numerical Optimal Control for Bilinear Hyperbolic PDEs*.

▶ Delivered lectures on different computational methods in the advanced level workshop on *Computational Methods for Control Problems* held at the Department of Mathematics, IIST Trivandrum, and Mar Ivanios College, Trivandrum, from March 16 to March 21, 2015.

▶ Delivered lecture series on *Numerical Methods for Solving Integral Equations* in the advanced level Workshop on *Integral Equations—Solvability Analysis and Application* held at the Department of Mathematics, Jaypee University of Information Technology, Waknaghat, Solan, Himachal Pradesh, from October 19 to October 25, 2015.

▶ Delivered lecture series on *Mathematics using MATLAB* under the training program *Making Mathematics Easy for students* organized by the Department of Applied Science, National Institute of Technical Teachers Training and Research (NITTTR), (Under Ministry of Human Resource Development, Govt. of India), Ext. Centre Goa, from October 26 to October 30, 2015.

▶ Delivered an invited talk at the International Conference on *Current Trend in PDEs: Theory and Computations* held at the Department of Mathematics, South Asian University, New Delhi, India, from December 28 to December 30, 2015. The talk title was *Approximation of the Optimal Control Problem Governed by Parabolic Integro–Differential Equations*. I also chaired one paper presentation session.

▶ Presented a paper in the International Conference on *Computational Modeling & Simulation (ICCMS-2017)* held at the University of Colombo, Sri Lanka, from May 17 to May 19, 2017. The paper's title was *Optimal control of the velocity term in a Kirchhoff plate equation with multiplicative control*.

▶ Delivered an invited talk at the International Conference on *Advances in Computational Mathematics* held at the University of Dhaka, Bangladesh, from May 27 to May 28, 2017. The talk title was *Approximate Controllability of a Class of Parabolic Differential Equations with Memory Term*.

▶ Delivered an invited talk at the International Conference on *Recent Advances in PDEs: Theory, Computations and Applications* held at Department of Mathematics, IIT Bombay, India, from June 8 to June 10, 2017. The title of the talk was *Optimal control of the velocity term in plate equation with multiplicative control*. I also chaired one paper presentation session.

▶ Delivered an invited talk at the International Conference on *Nonlinear Differential Equations-Theory, Modelling and Computations* held at SRM University, Kattankulathur, Chennai, from December 8 to December 9, 2017. The title of the talk was *A Computational Study of Orthogonal Spline Collocation Methods for fourth-order Boundary Value Problems*. Also co-chaired one of the paper presentation sessions.

▶ Delivered a talk on *Controllability of a Class of Parabolic Differential Equations with Memory Term* in the International & 14th Biennial Conference of *Indian Society of Industrial and Applied Mathematics (ISIAM)* at Guru Nanak Dev University, Amritsar, from February 2 to February 4, 2018.

▶ Delivered an invited talk at the National Conference on *Advances in Differential Equations -2018* held at the Department of Mathematics, Vivekanand College, Kolhapur, Maharashtra, India, on September 29, 2018. The title of the talk was *Optimal Control Problem: A Use of Pontryagin Minimum Principle*. Also chaired one of the paper presentation sessions.

▶ Delivered lectures and held tutorial sessions on *Ordinary Differential Equations* in the *Winter School on Differential Equations* held at the Department of Mathematics, Savitribai Phule Pune University, Pune, Maharashtra, India, from December 3 to December 14, 2018.

▶ Delivered an invited talk at the 4th International Conference on *Recent Developments in Theory, Computation & Application of Differential Equations* held at the Department of Mathematics, South Asian University, New Delhi, India, from January 21 to January 23, 2019. The title of the talk was *A mixed finite element method for elliptic optimal control problems using a three-field formulation*.

▶ Delivered an invited talk at the International Conference on *Differential Equations and Control Problems: Theory, Modelling and Computation (ICDECP19)* held at the School of Basic Sciences, Indian Institute of Technology, Mandi, Himachal Pradesh, India, from June 17 to June 19, 2019. The title of the talk was *A Fourth-Order Orthogonal Spline Collocation Method to Fourth Order Boundary Value Problems*. Also chaired one of the paper presentation sessions.

▶ Delivered a talk at the 9th International Congress on *Industrial and Applied Mathematics (ICIAM-2019)* held at Campus de Blasco Ibáñez of the Universitat de València, València, Spain, from July 15 to July 19, 2019. The title of the talk was *A Mixed Finite Element Method for Elliptic Optimal Control Problems Based on Biorthogonal Systems*. Also chaired one of the paper presentation sessions.

▶ Delivered a scientific cum popular talk on an online platform through Google meet at the Center for Data Science, Siksha 'O' Anusandhan, Deemed to be University, Bhubaneswar, on February 19, 2022. The title of the talk was *Optimal Control Problem: A Use of Pontryagin Minimum Principle*.

▶ Delivered an invited talk at the International Conference on *Computational Partial Differential Equations and Applications, (ICCPDEA-2022)* held at BML Munjal University, Gurgaon, India, from September 6 to September 8, 2022. The title of the talk was *Virtual Element Methods for Optimal Control Problems Involving Elliptic Partial Differential Equations*. Also chaired one of the sessions.

▶ Delivered a symposium talk at the 37th *Annual Conference of Ramanujan Mathematical Society* held at the Department of Mathematics, Sri Sivasubramaniya Nadar College of Engineering, Chennai, India, from December 06 to December 08, 2022. The title of the talk was *Virtual Element Methods for Optimal Control Problems Governed by Diffusion Problems*. Also chaired one of the sessions.

▶ Delivered an invited talk at the International Workshop on Computational Mathematics (IWCM-2023) held at the Department of Mathematics, Tribhuvan University, Kirtipur, Kathmandu, Nepal, from March 11 to March 13, 2023. The title of the talk was *From Calculus of Variations to Optimal Control*.

WORKSHOPS/CONFERENCES PARTICIPATED

▶ International Conference on *Current Trends in Differential Equations and Dynamical Systems* held at Indian Institute of Technology Kanpur, India, from December 15 to December 17, 2001.

▶ Conference on *Recent Advances in Nonlinear Science 2002* held at the Indian Institute of Science, Bangalore, India, from July 31 to August 2, 2002.

▶ Workshop on Joint Meeting on *Applied Mathematics-II, French Indian Cyber-Workshop* held at the Indian Institute of Science, Bangalore, India, from February 3 to February 6, 2003.

▶ Workshop on *Indo-UK Study Group Meeting on Industrial Problems* held at the Indian Institute of Technology, Bombay, from December 6 to December 10, 2004.

▶ International Conference on *Recent Trends in Nonlinear Analysis and its Applications* held at the Indian Institute of Technology Bombay, India, from December 11 to December 13, 2004.

▶ Workshop on *Instructional School on Computational Partial Differential Equations* held at the Indian Institute of Technology, Bombay, from June 5 to June 24, 2005.

▶ Summer school and workshop on *Partial Differential Equations, Optimal Design, and Numerics* held at The Benasque International Center for Science, Benasque, Huesca, Spain, from August 28 to September 9, 2005.

▶ Indo-German Workshop on *Automatic Differentiation, Optimal Control, and Adaptivity with Applications* at Indian Institute of Technology, Bombay, from November 11 to November 17, 2006.

▶ Workshop on *Recent Trends in Partial Differential Equations and Applications* held at the Department of Mathematics & Statistics, University of Hyderabad, Hyderabad, from March 18 to March 19, 2012.

► Introductory Workshop on *Scilab* held at the Department of Mathematics, BITS Pilani K.K. Birla Goa Campus, Goa, from July 9 to July 10, 2012.

► Conference on *Computational PDEs, Finite Element Meet 2014*, held at TIFR Bangalore from December 18 to December 20, 2014.

► Indo-European Study Group Meeting on *Industrial Problems (IESGMIP-2015)* held at M. S. University of Baroda, Vadodara, Gujarat, from January 5 to January 9, 2015. I worked on *Optimal Placement of Cooling Fans in Power Transformer Radiators* during the meeting.

► Workshop on *Advanced Programming Techniques in MATLAB* held at BITS Pilani K.K. Birla Goa Campus, Goa on July 24, 2015.

► 8th International Congress on *Industrial Congress and Applied Mathematics (ICIAM-2015)* was held at China National Convention Centre in Beijing, China, from August 10 to August 14, 2015.

► A discussion meeting on *Teaching Differential Equations in India* was held at the Indian Academy of Sciences, Bangalore, from February 26 to February 28, 2018.

► Workshop on *Adaptive Finite Element Methods* (an online event) from July 2 to July 7, 2021, organized by the Indian Institute of Technology, Bombay, and Scheme for Promotion of Academic and Research Collaboration (SPARC).

WORKSHOP/CONFERENCE ORGANIZED

► One of the organizers of the *3rd Group Monitoring Workshop cum 6th meeting of the re-constituted expert panel on Fast Track Proposals for Young Scientists in Physical and Mathematical Sciences* held at BITS Pilani K.K. Birla Goa campus, Goa, during January 11-12, 2007.

► Co-Convener of the International Workshop on *Advances in Computational Partial Differential Equations* held at BITS Pilani K.K. Birla Goa campus, Goa, from February 7 to March 5, 2011.

► Co-Convener of *Advanced School on Graph Algorithms* jointly organized by the Department of Mathematics and Department of Computer Science and Information Systems, BITS Pilani K.K. Birla Goa campus, Goa, from July 23 to July 27, 2012.

► Co-Organizer of the research promotion workshop on *Introduction to Graph and Geometric Algorithms* jointly organized by the Department of Mathematics, BITS Pilani K.K. Birla Goa Campus, Goa and School of Technology and Computer Science, Mumbai, held at BITS Pilani K.K. Birla Goa campus, Goa, during January 17-19, 2013.

► Co-Convener of an advanced workshop on *Mathematical Foundation of Advanced Finite Element Methods* Jointly organized by NMI Bangalore and NPDE-TCA, IIT Bombay, held at BITS Pilani K.K. Birla Goa campus, Goa, from December 26, 2013, to January 3, 2014.

► The organizer of the *Advanced Level Training Program on Differential Equations* jointly organized by the National Programme on Differential Equations: Theory, Computation, and Applications (NPDE-TCA), IIT Bombay, held at BITS Pilani K.K. Birla Goa campus, Goa, from May 25 to June 14, 2015.

▶ One of the organizers of *Indo-German Pre-Conference School on Algorithms and Combinatorics* and the 3rd International Conference on *Algorithms and Discrete Applied Mathematics (CALDAM-2017)* held at the Department of Mathematics, BITS Pilani K.K. Birla Goa Campus, Goa, from February 13 to February 18, 2017.

▶ One of the organizers of the International Conference on *Discrete Mathematics and its Applications to Network Science (ICDMANS-2018)* held at the Department of Mathematics, BITS Pilani K.K. Birla Goa Campus, Goa, from July 7 to July 10, 2018. I also acted as the Treasurer of the conference.

▶ Organized a workshop on *Analysis, Differential Equations and Computation* at the Department of Mathematics in BITS Pilani K.K. Birla Goa Campus, Goa, from November 12 to November 13, 2022.

▶ Co-organizer of 9th *International Conference on Mathematics and Computing (ICMC-2023)* held at the Department of Mathematics, BITS Pilani K.K. Birla Goa Campus, Goa, from January 06 to January 08, 2023.

WORK EXPERIENCE

▶ Worked as a Teaching Assistant for B. Tech. at the Indian Institute of Technology Bombay from 2000 to 2004 for Basic Calculus, Advanced Calculus, Linear Algebra, Computational Methods in Linear Algebra, Ordinary Differential Equations, and System of Differential Equations.

▶ Visited Department of Mathematics, Indian Institute of Sciences, Bangalore under IISc-TIFR Short Term Visitors Program from June 01, 2003, to June 18, 2003, and worked with Prof. A. K. Nandkumaran on *Optimal control problems involving partial differential equations*.

▶ Worked as a Research Associate in the project WebOPT (Asia IT & C contract ASI/B7-301/97/0126-73). It was a joint project with Brunel University (U.K.). This project aimed to develop an optimization environment and offer it as an Application Service provider (ASP) solution.

▶ Visited Department of Mathematics, Indian Institute of Science, Bangalore under Indo-French Centre for Applied Mathematics (IFCAM) Visitors Program during the period from May 24, 2014, to June 24, 2014, and worked with Prof. A. K. Nandkumaran and worked on *Optimal control of the velocity term in a Kirchhoff plate equation with multiplicative control*.

▶ Visited School of Mathematical and Physical Sciences, University of Newcastle, University Drive, Callaghan NSW 2308 Australia, from May 21 to July 22, 2016, under the University Immersion program. I worked with Dr. Bishnu Prasad Lamichhane on the numerical computation of optimal control problems involving partial differential equations.

▶ Worked as a Lecturer in the Department of Mathematics, BITS Pilani K.K. Birla Goa Campus, Goa, India, from July 2006 to December 2006.

▶ Worked as a Assistant Professor in the Department of Mathematics, BITS Pilani K.K. Birla Goa Campus, Goa, India, from December 2006 to May 2021.

▶ Working as an Associate Professor in the Department of Mathematics, BITS Pilani K.K. Birla Goa Campus, Goa, India from June 2021 to till date.

    ▷ Courses Taught/Handled in BITS-Pilani Goa Campus:

    Numerical Analysis, Mathematics-I (Calculus), Mathematics-II (Linear Algebra and Complex Analysis), Mathematics-III (Ordinary Differential Equation and Partial Differential Equations), Optimization, Functional Analysis, Ordinary Differential Equations (advance level), Numerical Solutions of Ordinary Differential Equations, Nonlinear Optimization, and Partial Differential Equations (advance level).

ADMINISTRATIVE EXPERIENCE

▶ Worked as a coordinator of internet and intranet website management for the BITS Pilani K.K. Birla Goa campus.

▶ Worked as a Warden of a hostel in BITS Pilani K.K. Birla Goa campus from January-2009 to December-2013.

▶ Worked as a Convener of the Department Research Committee (DRC) till November 27, 2017.

▶ Worked as a Member of the Institute Disciplinary Committee from July 19, 2018 to July 18, 2019.

▶ Worked as a Member of the Department Research Committee (DRC) from November 2017 to December 2019.

▶ Member of Department Steering Committee.

▶ Member of Department Event Management Committee.

▶ Member of Placement Faculty Advisory Council (PFAC).

▶ Member of Cross Campus Departmental Committee for Academics.

▶ Member of Standing Committee for Student's Discipline from October 5, 2020 to October 4, 2021.

BRIEF IDEA OF MY RESEARCH

As part of my research work, I am working on the optimal control problems for linear and nonlinear partial differential equations and their applications, emphasizing theory and computation. The concept of controllability denotes the ability to move a system around in its entire configuration space using only specific admissible manipulations. The time-optimal control problem under consideration consists of finding control in an admissible set that minimizes the particular cost functional. These problems arise naturally in various areas of science and technology, such as controlling the heat in the electrically heated oven and reheating furnaces, controlling the crystal growth/dissolution in the chemical process, controlling the crystal growth/dissolution in the chemical process, control of the concentration of an activator in biochemistry, and optimal portfolio selection process in the financial market. The theory of optimal control is one of the

significant application areas in mathematics today. From its early origin to meet the demands of the automatic control system design in engineering, it has grown steadily in scope and has spread to many unrelated distinct areas such as economics and bio-sciences. In my Ph.D. thesis, we focus our attention on the optimal control problems associated with the controllability of parabolic differential equations and parabolic integro-differential equations using semi-group theory. We also perform numerical experiments on the penalized optimal control problems for different target states or final states for various control problems. Presently, I am working in the following areas:

► Theoretical and numerical study of the Control problems involving differential equations with a memory term.

► Numerical approximation of optimal control problems involves partial differential equations by the virtual element method (VEM), a recently developed technique.

► Application of optimal control theory in software reliability growth modelling.

REFERENCES

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DECLARATION

I hereby declare that all the statements above are correct and complete to the best of my knowledge.

Place: BITS Pilani K.K. Birla Goa Campus. (Anil Kumar)
Date: May 9, 2023.