माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर (म.प्र.), भारत
MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR (M.P.), INDIA
Deemed University
(Declared under Distinct Category by Ministry of Education, Government of India)
NAAC ACCREDITED WITH A++ GRADE

Report on Online Faculty Development Programme

On

Emerging Frontiers in Quantum Technology and Communication

(Application Number: 1749121066)

15th Dec. – 20th Dec. 2025

Organized by:

Department of Electronics Engineering,

Madhav Institute of Technology & Science, Gwalior, Deemed University

Website: https://web.mitsgwalior.in

Sponsored by

AICTE Training and Learning (ATAL) Academy,

All India Council of Technical Education, New Delhi

Introduction

The Department of Electronics Engineering, Madhav Institute of Technology & Science (MITS), Gwalior, Deemed University, successfully organized a six-day AICTE–ATAL Online Faculty Development Programme (FDP) on *"Emerging Frontiers in Quantum Technology and Communication"* from 15th to 20th December 2025. The programme was conducted in online mode through the AICTE ATAL Academy portal. The FDP was designed to strengthen faculty competence, research orientation, and practical understanding in the rapidly evolving domain of quantum technologies, with a special emphasis on quantum communication, quantum computing, sensing and quantum algorithms.

The key objectives of the FDP were:

- To introduce fundamental concepts of quantum mechanics relevant to communication system.
- To explore quantum computing, quantum cryptography, and quantum key distribution (QKD).
- To familiarize participants with the challenges, opportunities, and future scope of quantum technologies in communication systems.
- To provide experience and knowledge on quantum simulators and experimental setups.

About the Institute

Madhav Institute of Technology & Science (MITS), Gwalior, established in 1957 by Sir Jiwaji Rao Scindia, is a premier technical institution in India. Declared a Deemed University in 2024 under Distinct Category by Ministry of Education, Government of India and accredited with an A++ grade by NAAC. MITS offers undergraduate, postgraduate, and doctoral programs in various engineering and technology disciplines, including Electronics, Computer Science, Information Technology Electrical, Civil, Mechanical, Chemical Engineering, Architecture, etc. The institute is committed to providing quality education, fostering research, and offering innovative courses to meet global advancements.

About ATAL

AICTE Training and Learning (ATAL) Programme is an initiative by AICTE which aims at empowering faculty to achieve goals of Higher Education such as access, equity and quality. Proposed programme is designed to fulfill the need to train the young generation in the skill sector and having faculty & technicians to be trained in their respective disciplines. It was felt that training with the latest tools and technologies is vital to keeping an institute competitive and productive. Training is required for increasing the knowledge and skills of students to make them more employable to acquire global competencies. It also transforms them to harmonize with society and most importantly to make them good citizen of the country.

Skill Enhancement & Future Readiness Outcomes

- **Quantum Competence:** Develop a strong foundation in quantum mechanics, qubits, and information theory, enabling analysis and design of next-generation communication systems.
- **Practical & Computational Proficiency:** Gain hands-on experience with quantum simulators, algorithms, and quantum machine learning tools to bridge theory with real-world applications.

- **Secure & Intelligent Communication Expertise:** Build expertise in quantum cryptography, QKD, and post-quantum security for secure 6G networks.
- **Research & Innovation Readiness:** Cultivate future-ready skills and adaptability to lead advancements in quantum research, industry, and emerging communication technologies.

Patrons

Dr. R. K. Pandit, Vice Chancellor, MITS-DU Gwalior.

(Advisory) Committee Members

Dr. Manjaree Pandit, Pro-Vice Chancellor, MITS-DU Gwalior.

Dr. Vimal Bhatia, Professor, EE, IIT Indore.

Dr. Aditya Trivedi, Professor, IT, ABV-IIITM Gwalior.

Dr. G. S. Tomar, Director, Govt. Engg. College, Sonbhadra, UP.

Dr. Y. K. Prajapati, Professor, ECE, MNNIT Allahabad, Prayagraj.

Dr. P. K. Singhal. Professor, Dean, Quality Assurance, MITS-DU Gwalior.

Dr. M. K. Gaur, Professor, Dean Research, MITS-DU Gwalior.

Dr. Laxmi Shrivastava, Professor, HoD, Electronics Engineering, MITS-DU Gwalior.

Coordinator

Dr. Vandana Vikas Thakare

Professor and HoD,

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Co-Coordinator

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Assistant Professor,

Department of Electronics Engineering, MITS-DU Gwalior, India

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Details of Resource Persons

S.No	NAME, Designation, and Contact Details	Brief Bio
1.	**Prof. Arun K. Pati** Director, Centre for Quantum Technology, KIIT Bhubaneswar, former Professor of Harish-Chandra Research Institute, Prayagraj **Email:** akpati@hri.res.in Contact No.8756612314	Prof. Arun K Pati has made many pioneering contributions in the area of Quantum Computation and Quantum Information. He has been working in the area of Quantum Science, Quantum computing and Quantum information over last 35 years. His seminal contributions include the No-Deletion theorem, No-Hiding theorem, No-Masking theorem, Remote State Preparation, and Stronger Uncertainty Relations. His research papers have been featured in Nature, Science, Scientific American and Nature Asia. For his original and creative contributions he has received many awards. This include the Indian Physical Society Award for Young Scientists, Kolkota (1996), Indian Physics Association Award for Young Physicist of the Year, Mumbai (2000), Samanta Chandra Sekhar Award for the year 2009 from the Orissa Science Academy, India and the Distinguished Alumni award from Berhampur University Odisha. He is an elected Fellow of the Indian Academy of Science, Bangalore and also Fellow of the National Academy of Science, Allahabad. He was a J C Bose National Fellow in 2019. He consistently ranks in top 2% Scientists in the world by the Stanford University. He also figures in No 1 position as World's Famous Quantum Information scientists. He is regarded as the Father of Indian Quantum Computing.
2.	**Prof. Tharm Ratnarajah** Fred Harris Endowed Chair Professor, Dept. of Electrical and Computer Engineering, San Diego State University, **USA** **Email:** tratnarajah@sdsu.edu T.Ratnarajah@ieee.org Contact No. 0447904866402	Prof. Tharm Ratnarajah works as a Fred Harris Endowed Chair in Digital Signal Processing at San Diego State University and Director of the Communication Systems and Signal Processing Institute. His research interests include signal processing and information-theoretic aspects of beyond 5G cellular networks, full-duplex radio, mmWave communications, random matrix theory, big data analytics and machine learning for wireless networks, statistical and array signal processing, physical-layer secrecy and interference alignment. He has published over 475 Peer-reviewed papers in these areas and holds four US patents. He was the lead coordinator of the European Union (EU) projects HARP (4.6Me) in the area of highly distributed MIMO and ADEL (3.7Me) in the area of licensed shared access. He was also the coordinator of the European Union Future and Emerging Technologies project CROWN (3.4Me) in the area of cognitive radio networks and HIATUS (3.6Me) in the area of interference alignment. Prof Ratnarajah was an associate editor of IEEE Transactions on Signal Processing, 2015-2017, and Technical co-chair of the 17th IEEE International Workshop on Signal Processing Advances in Wireless Communications, Edinburgh, UK, 3-6, July 2016.

		Prof. Ratnarajah is a Fellow of the Higher Education Academy (FHEA).
3.	**Dr. Satyendra Kumar Mishra,** Associate Professor, Senior Researcher, SRCOM, CTTC, Castedefels Barcelona **Spain** **Email:** satyendramishraiitd@gmail.com, satyenda.mishra@cttc.cat Contact No. +34637286649	Satyendra K. Mishra is a Senior Researcher (Associate Professor) at the Centre Tecnològic de Telecomunicacions de Catalunya (CTTC), working in the Space and Resilient Communications and Systems unit. With an M.Tech. in Nanotechnology and a Ph.D. in Physics from IIT Delhi, he has held research positions across Hong Kong, the USA, Canada, and Denmark. His work focuses on quantum communication, optical and photonic sensing, fiber-optic devices, and advanced nanomaterials for next-generation communication and sensing systems. He has authored more than 140 scientific publications and serves as an editor for several international journals and conferecne, he is the editors of IEEE Sensors Journal, Scientific Reports, and Discover Journals.
4.	**Prof. Aditya Trivedi** Professor (H), Dept. of IT, ABV-IIITM, Gwalior **Email:** atrivedi@iiitm.ac.in Contact No.9425137999	Prof. Aditya Trivedi is a Professor (HAG) in the Department of Information Technology at ABV-IIITM, Gwalior, India. He holds a PhD from IIT Roorkee and an M.Tech from IIT Kanpur, He is a Senior Member of IEEE. Prof. Trivedi has three decades of academic and research experience. He also held an international academic engagement as a Visiting Faculty at the Asian Institute of Technology (AIT), Bangkok, Thailand (Jan–May 2020). Prof. Trivedi's recent research leadership includes serving as Principal Investigator of a Faculty Initiation Grant (FIG) project (₹1.615 Cr, 2025–2027). The project focuses on developing meaning-aware, semantic learning–driven communication frameworks for next-generation networks. His scholarly contributions include several patents, 60 journal publications, 115 conference papers, and 5 book chapters.
5.	**Dr. Bhaskar Kanseri** Associate Professor, Dept. of Physics, IIT Delhi, India. **Email:** bkanseri@physics.iitd.ac.in Contact No.9811026412	Dr. Bhaskar Kanseri is working as IHFC chair professor at Department of Physics and a joint faculty at Optics and Photonics Center (OPC), IIT Delhi. Prior joining IITD, he was postdoctoral fellow at Institut d'Optique, Palaiseau France, and earlier at Max Planck Institute for the Science of Light, Erlangen Germany. He received his PhD from University of Delhi and National Physical Laboratory, New Delhi. His research interests span in optics and photonics, statistical optics, quantum optics, and photonic quantum technologies. He has more than 80 publications in peer-reviewed international journals and about 150 conference presentations and invited lectures in his credit. He has been awarded "Teaching excellence award-2022" and "Veena Arora Early Career Research Award-2022" by IIT Delhi for his teaching and research contributions. In 2023, he has been selected as member of The National Academy of Sciences India (NASI), and Indian National Science Academy (INSA) Associate Fellow. Some of his notable contributions in

		fiber based secure quantum communication are the "first Indian intercity quantum secure communication for 100km" in 2022 and the "trusted node free quantum secure communication for 380km" achieved in 2023. Currently Dr. Kanseri is pioneering entanglement-based quantum network activities at IIT Delhi under National Quantum Mission of India.
6.	**Dr. Vivek Venkataraman** Associate Professor Dept. of Electrical Engineering, IIT Delhi, India **Email:** Vivek.Venkataraman@ee.iitd.ac.in Contact No.9599251770	Dr. Vivek Venkataraman is currently an Associate Professor in the Department of Electrical Engineering at IIT Delhi with a joint appointment in the Department of Physics. He completed his BTech in 2006 from IIT Delhi, followed by MS+PhD from Cornell University in 2012. He was a postdoctoral fellow and research associate at Harvard University until 2017 before joining IIT Delhi. His research interests and expertise lie in the areas of quantum and non-linear optics, light-matter interaction and atomic physics, fiber-optics & integrated photonics, all-optical devices and novel light sources, optical signal processing and communication.
7.	**Dr. Gurmohan Singh** Joint Director, CDAC, Mohali Email:gurmohan@cdac.in, Contact No.9417483045	Dr. Gurmohan Singh is a Joint Director & Scientist-E at the Centre for Development of Advanced Computing (C-DAC) in Mohali, specializing in quantum computing and cybersecurity. With over 19 years of experience in research and development, he has made significant contributions to the fields of quantum algorithms, machine learning, and VLSI design. He holds a Ph.D. from NIT Jalandhar with his thesis focused on Quantum-Automata Based Circuits. Dr. Singh has held various key positions at C-DAC making him a pivotal figure in advancing research and innovation at C-DAC. Dr. Singh's research interests include quantum computing, quantum machine learning models, quantum circuit optimization, and quantum applications & use cases development. He has supervised multiple 01 Ph.D. and 50 Master's theses, published more than 60 research papers in reputed journals and conferences, and played an active role in organizing quantum computing workshops and training programs both nationally and internationally. For his exceptional contributions, he received the prestigious Award in 2020 from C-DAC for implementing a high-value project, and his work continues to influence the future of quantum computing and cybersecurity in India.

8.	**Mr. Arka Mukherjee** Scientist E, CDoT, New Delhi Email: arka@cdot.in, Contact No.8447455338	Arka Mukherjee works as a Scientist 'E' and Team Leader at the Centre for Development of Telematics (C-DOT), India and is responsible for the hardware design aspects of fibre-based quantum key distribution (QKD) systems. He has over 13 years of experience designing embedded hardware for optical access networks and QKD systems. He is a gold medalist in Master of Science (Research) from the Indian Institute of Technology, Delhi. He holds a Bachelor's degree in Electronics and Tele-communication Engineering from Jadavpur University, Kolkata, India. He has authored multiple technical articles in peer-reviewed international journal, technical magazines, and conferences.
9.	**Mr. Lakshya Priyadarshi** VP Quantum Strategy andSolutions, QpiAI, Pvt. Ltd. Bangaluru Email: lakshya.priyadarshi@qpiai.tech Contact No.9980724306	Lakshya Priyadarshi is the Vice President of Quantum Platforms and Solutions at QpiAI India Private Limited. At QpiAI, he leads the Quantum Software Platforms and Solutions vertical, overseeing the development of QpiAI's Quantum Computing as a Service (QCaaS) platform and the complete quantum software toolchain for QpiAI Indus and future systems. He manages a team of over 20 scientists and engineers, delivering quantum solutions for industries including pharmaceuticals, life sciences, automotive, manufacturing, financial services, and energy. He has led the development of QpiAI-Quantum, a comprehensive quantum development platform; QpiAI-Opt, an optimization platform applied in the automotive sector; and QpiAI-Pharma, a drug discovery platform deployed by a leading global pharmaceutical company. Lakshya holds a B.Tech. in Computer Science and Engineering from the Institute of Engineering and Technology (IET), Lucknow. He has published 2 research papers and has filed 7 patents in the field of quantum computing.
10.	**Ms. Janhavi Hatwar** VP Quantum Strategy and Solutions, QpiAI, Pvt. Ltd. Bangaluru Contact No.94030 81610	Janhavi Hatwar is a Quantum Algorithms Researcher at QpiAI, specializing in the development and optimization of advanced quantum computing techniques. She holds an MS in Quantum Computing and a BS in Physics with a minor in Data Science Engineering from IISER Bhopal. During her academic journey, she has worked on cutting-edge projects, including implementing quantum factorization using the Quantum Approximate Optimization Algorithm (QAOA) at IIT Bombay and contributing to experimental data analysis at the University of Alberta. Her research on Variational Quantum Factorization (VQF) using QAOA has been accepted for presentation at COMSNETS 2025. Janhavi has been recognized with prestigious fellowships and scholarships such as the MITACS Globalink Research Internship, the CHANAKYA fellowship, and the INSPIRE Scholarship. With a strong background in physics, data science, and algorithm design, she is passionate about advancing the frontier of quantum computing through innovative algorithmic solutions.

Summarized Schedule of FDP 2025-26 Schedule

Day 1 (15-12-2025)	Day 2 (16-12-2025)	Day 3 (17-12-2025)	Day 4 (18-12-2025)	Day 5 (19-12-2025)	Day 6 (20-12-2025)
4:30 PM – 5:00 PM Inauguration Session	-	-	-	-	**2.00 PM to 3.30 PM** **Session 11 *** **Title:** Quantum Computing, **Expert: Ms. Janhavi Hatwar, Quantum Algorithms Researcher, (QpiAI Pvt Ltd, Bangalore) Years of Exp.: 10+**
5.00 PM to 6.30 PM **Session 1** **Title:** Quantum Information Theory and Computation, **Expert: Prof. Arun K. Pati (Harish-Chandra Research Institute, Prayagraj) Years of Exp.: 35+**	**6.00 PM to 7.30 PM** **Session 3** **Title:** Quantum Simulators, **Expert: Mr. Lakshya Priyadarshi, VP Quantum Strategy and Solutions, (QpiAI Pvt. Ltd., Bangalore) Years of Exp.:11+**	**6.00 PM to 7.30 PM** **Session 5** **Title:** Quantum Secure Communication: Basic Aspects, **Expert: Dr. Bhaskar Kanseri, Associate Professor, IIT Delhi Years of Exp.:15+**	**6.00 PM to 7.30 PM** **Session 7** **Title:** Federated Quantum Learning **Expert: Prof. T. Ratnarajah Electrical & Comp. Engg, San Diego State University, USA Years of Exp.: 27+**	**6.00 PM to 7.30 PM** **Session 9** **Title:** Intro. to Quantum Communication, **Expert: Mr. Arka Mukherjee, Scientist E, CDoT, New Delhi Years of Exp.:13+**	**3.30 PM to 5.00 PM** **Session 12** **Title:** Quantum Communication over Telecom Fiber-optic Networks, **Expert: Dr. Vivek Venkataraman, Associate Professor, (IIT Delhi) Years of Exp.: 12+**
6.30 PM to 7.30 PM **Session 2** **Title:** Quantum Machine Learning, **Expert: Mr. Lakshya Priyadarshi, VP Quantum Strategy and Solutions, (QpiAI Pvt. Ltd., Bangalore) Years of Exp.:11+**	**7.30 PM to 9.00 PM** **Session 4** **Title:** Future Trends in Quantum Communication, **Expert: Prof. Aditya Trivedi, (ABV-IIITM Gwalior) Years of Exp.: 35+**	**7.30 PM to 9.00 PM** **Session 6** **Title:** Quantum Gates to Algorithms, **Expert: Dr. Gurmohan Singh (CDAC, Mohali) Years of Exp.: 13+**	**7.30 PM to 9.00 PM** **Session 8** **Title:** Quantum Secure Communication: Some Realisations **Expert:Dr. Bhaskar Kanseri, Associate Professor, IIT Delhi Years of Exp.:15+**	**7.30 PM to 9.00 PM** **Session 10** **Title:** Quantum Sensing Materials, **Expert: Dr. Satyendra Kumar Mishra, Associate Professor SRCOM, CTTC, Castedefels Barcelona Spain Years of Exp.:12+**	**5.00 PM to 6.30 PM** **Session 13** **Title:** QKD Protocols and QRNG, **Expert: Mr. Arka Mukherjee, Scientis E, CDoT, New Delhi Years of Exp.:13+**
					6:30PM to 7:30 PM Online Test & Feedback
					7.30 PM to 8.00 PM Valedictory Session

***Note:** Session 11 was originally scheduled to be delivered by Dr. Manjunath R. V., VP – Quantum Hardware, QpiAI Pvt. Ltd., Bengaluru**.** However, due to unforeseen circumstances at the last moment, the session was conducted by Ms. Janhavi Hatwar**,** Quantum Algorithm Researcher, QpiAI Pvt. Ltd.

Day-wise Programme Schedule and YouTube Link

Day & Date	Session Title	Resource Person	YouTube Link
Day 1 (15 Dec 2025)	Inauguration Session	—	Inauguration Session and Session1: https://youtu.be/9cAiL4FUIC8
Day 1	Quantum Information Theory and Computation	Prof. Arun K. Pati (HRI Prayagraj)	
Day 1	Quantum Machine Learning	Mr. Lakshya Priyadarshi (QpiAI Pvt. Ltd., Bengaluru)	Session 2: https://youtu.be/SSwD5wOA19A
Day 2 (16 Dec 2025)	Quantum Simulators	Mr. Lakshya Priyadarshi (QpiAI Pvt. Ltd., Bengaluru)	Session 3: https://youtu.be/HvvOzX8ml0o
Day 2	Future Trends in Quantum Communication	Prof. Aditya Trivedi (ABV-IIITM Gwalior)	Session 4: https://youtu.be/JP-iaGxttaM
Day 3 (17 Dec 2025)	Quantum Secure Communication: Basic Aspects	Dr. Bhaskar Kanseri (IIT Delhi)	Session 5: https://youtu.be/w1bbsfSSTAk
Day 3	Quantum Gates to Algorithms	Dr. Gurmohan Singh (CDAC Mohali)	Session 6: https://youtu.be/XKU__0LldPE
Day 4 (18 Dec 2025)	Federated Learning	Prof. T. Ratnarajah (SDSU, USA)	Session 7: https://youtu.be/xMpMwCYP4rE
Day 4	Quantum Secure Communication: Realisations	Dr. Bhaskar Kanseri (IIT Delhi)	Session 8: https://youtu.be/iSevurVSIDk
Day 5 (19 Dec 2025)	Introduction to Quantum Communication	Mr. Arka Mukherjee (C-DOT New Delhi)	Session 9: https://youtu.be/TO510AdzgK8
Day 5	Quantum Sensing Materials	Dr. Satyendra Kumar Mishra (CTTC Barcelona, Spain)	Session10: https://youtu.be/RCNz38OSIMc
Day 6 (20 Dec 2025)	Quantum Computing	Ms. Janhavi Hatwar, (QpiAI Pvt Ltd, Bangalore)	Session 11: https://youtu.be/63varJYup7U
Day 6	Quantum Communication over Telecom Fiber Networks	Dr. Vivek Venkataraman (IIT Delhi)	Session12: https://youtu.be/tWf2yKIB8jw
Day 6	QKD Protocols and QRNG	Mr. Arka Mukherjee (C-DOT New Delhi)	Session13: https://youtu.be/pSCSQABcUFc
Day 6	Online Test, Feedback & Valedictory	—	https://youtu.be/omi4uKJsBuU https://youtube.com/shorts/m0rrd-4vO78

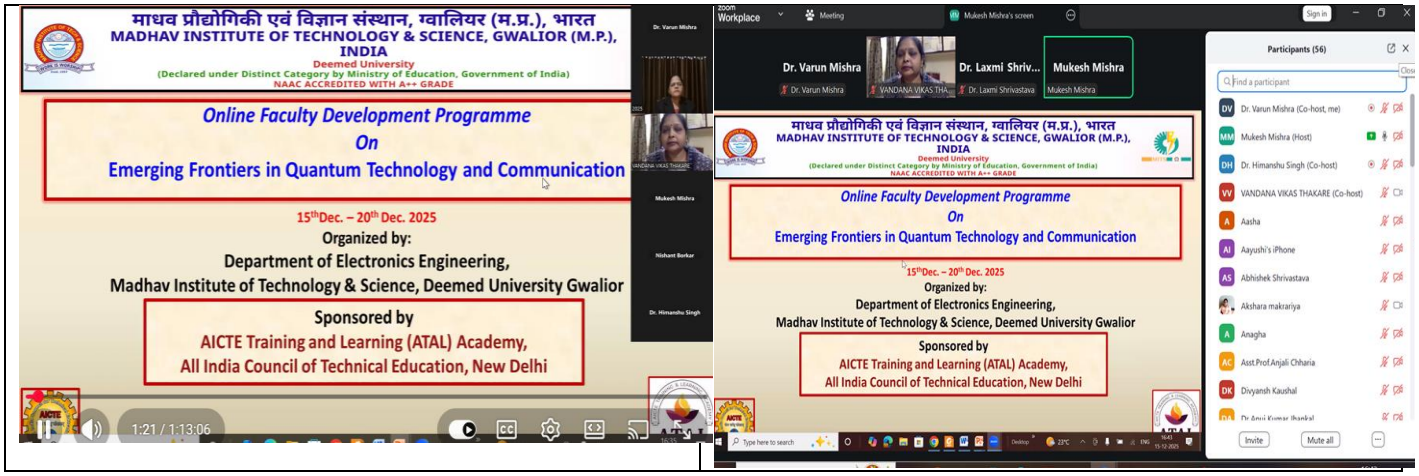
Brief Report on Sessions

1. Report on Inauguration Session

The Inauguration Session of the AICTE-sponsored ATAL Online Faculty Development Programme (FDP) on *"Emerging Frontiers in Quantum Technology and Communication"* was held successfully on 15 December 2025 in online mode. The programme is organized by the Department of Electronics Engineering, Madhav Institute of Technology & Science (MITS), Gwalior, Deemed University**,** and is scheduled from 15th to 20th December 2025.

The session commenced with a warm welcome to all dignitaries, expert speakers, and participants. The organizing team expressed sincere gratitude to the ATAL Academy for sponsoring this prestigious FDP. Participants were briefed about the online conduct of the programme. Dr. Laxmi Shrivastava, Professor and HoD, Electronics Engineering, introduced the institute, department, and relevance of the ATAL FDP. Subsequently, Dr. Vandana Vikas Thakare, Professor and Head, Department of Electronics and Telecommunication Engineering and FDP Coordinator, formally introduced the FDP, outlining its objectives, structure, and the key quantum technology themes to be covered during the six-day programme. The Co-Coordinator, Dr. Mukesh Kumar Mishra, briefed participants on the expected learning outcomes, expert sessions, and ATAL guidelines related to attendance, assessment, and certification. Participants were informed that the FDP comprises 13 expert sessions, delivered by eminent academicians and industry professionals, with a strong emphasis on conceptual clarity, real-world applications, and emerging research directions. Important rules regarding minimum 80% attendance, mandatory MCQ-based assessment, and minimum 70% qualifying marks for certification were clearly communicated, in accordance with ATAL Academy norms.

The Inauguration Session concluded with a vote of thanks to AICTE–ATAL Academy, the leadership of MITS Deemed University, distinguished resource persons, and all participants. The session seamlessly transitioned to the first expert lecture, delivered by Prof. Arun K. Pati, an eminent expert in quantum science, marking an inspiring beginning to the FDP.



दैनिक भास्कर

क्वांटम टेक्नोलॉजी से करियर की उड़ान विषय पर कार्यक्रम शुरू

ग्वालियर| माधव प्रौद्योगिकी एवं विज्ञान संस्थान डीम्ड विवि के इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग द्वारा एआईसीटीई–प्रायोजित अटल ऑनलाइन फैकल्टी डेवलपमेंट प्रोग्राम (एफडीपी) "क्वांटम प्रौद्योगिकी एवं संचार के उभरते आयाम" का शुभारंभ किया गया। कार्यक्रम में कुलपति डॉ. आरके पंडित एवं प्रो. वाइस चांसलर डॉ. मंजरी पंडित मौजूद रहीं।

नव भारत

एमआईटीएस में शुरु हुई राष्ट्रीय एफडीपी

नवभारत न्यूज

ग्वालियर, 16 दिसंबर। प्रौद्योगिकी पर एआईसीटीई अटल एफडीपी का शुभारंभ माधव प्रौद्योगिकी एवं विज्ञान संस्थान, डीम्ड विश्वविद्यालय, ग्वालियर के इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग द्वारा एआईसीटीई–प्रायोजित अटल ऑनलाइन फैकल्टी डेवलपमेंट प्रोग्राम (एफडीपी) 'क्वांटम प्रौद्योगिकी एवं संचार के उभरते आयाम' का विधिवत शुभारंभ किया गया।

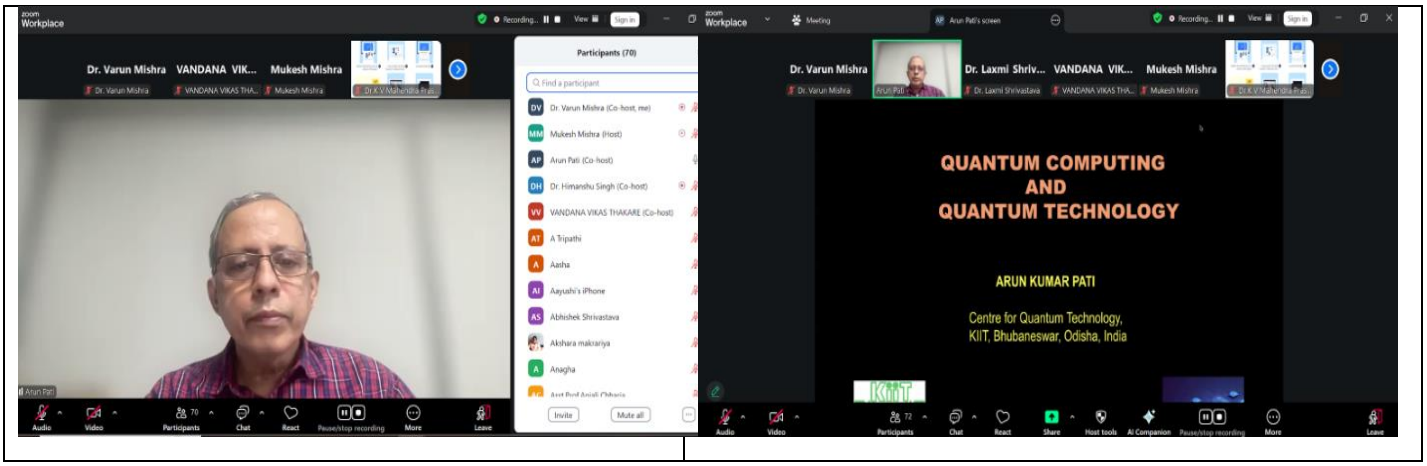
यह कार्यक्रम कुलपति डॉ. आर. के. पंडित एवं प्रो–वाइस चांसलर डॉ. मंजरी पंडित के संरक्षण, मार्गदर्शन एवं दूरदर्शी नेतृत्व में संचालित हो रहा है। उद्घाटन सत्र के दौरान डॉ. लक्ष्मी श्रीवास्तव, विभागाध्यक्ष, इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग ने एमआईटीएस–डीयू की शैक्षणिक एवं अनुसंधान उपलब्धियों को रेखांकित किया। कार्यक्रम की समन्वयक डॉ. वंदना विकास ठाकरे ने सभी अतिथियों एवं प्रतिभागियों का स्वागत करते हुए एफडीपी के उद्देश्यों एवं विषयवस्तु की जानकारी दी। अधिक जानकारी प्रदान करते हुए डॉ. मुकेश कुमार मिश्रा, एफडीपी के सह–समन्वयक ने कहा कि यह कार्यक्रम आईआईटी, अंतरराष्ट्रीय विश्वविद्यालयों, सी–डैक, सी–डॉट तथा अग्रणी उद्योग संगठनों के विशेषज्ञों को एक मंच पर लाता है, और इसमें क्वांटम सिमुलेटर्स, एल्गोरिथ्म तथा भविष्य की क्वांटम–सक्षम संचार प्रणालियों पर विशेष सत्र भी शामिल हैं। तकनीकी सत्र देश एवं विदेश के प्रतिष्ठित विशेषज्ञों द्वारा प्रस्तुत किए जा रहे हैं। उद्घाटन व्याख्यान 'क्वांटम सूचना सिद्धांत एवं संगणना' विषय पर प्रो. अरुण पति द्वारा दिया गया, जिन्हें व्यापक रूप से भारतीय क्वांटम कंप्यूटिंग का जनक माना जाता है। इसके बाद श्री लक्ष्य प्रियदर्शी द्वारा 'क्वांटम मशीन लर्निंग' पर उद्योग–उन्मुख सत्र प्रस्तुत किया गया। अंतरराष्ट्रीय विशेषज्ञ प्रो. टी. रत्नराजह (सैन डिएगो स्टेट यूनिवर्सिटी, अमेरिका) एवं डॉ. सत्येंद्र कुमार मिश्रा (सीटीटीसी, बार्सिलोना, स्पेन) क्रमशः 'फेडरेटेड क्वांटम लर्निंग' एवं 'क्वांटम सेंसिंग' पर व्याख्यान देंगे, जबकि आईआईटी दिल्ली के डॉ. भास्कर कंसेरी 'क्वांटम सुरक्षित संचार' विषय को संबोधित करेंगे। इस कार्यक्रम में देशभर से 175 शिक्षकों, शोधकर्ताओं एवं उद्योग पेशेवरों की उत्साहपूर्ण सहभागिता देखी गई है, जिससे क्वांटम प्रौद्योगिकियों के क्षेत्र में राष्ट्रीय स्तर पर अकादमिक सहयोग, अनुसंधान सहभागिता एवं नवाचार को मजबूती मिली है।

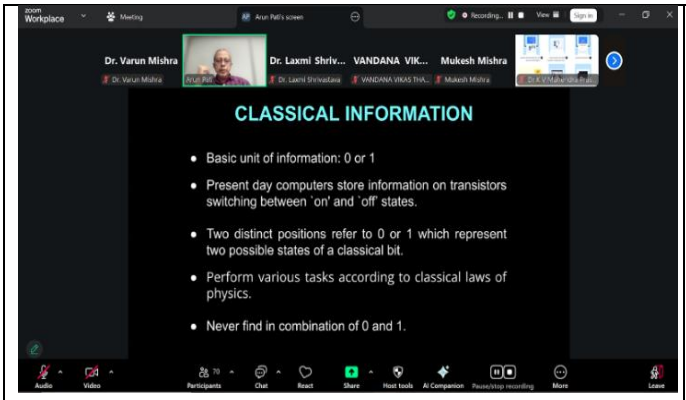
2. Report on Session: 1

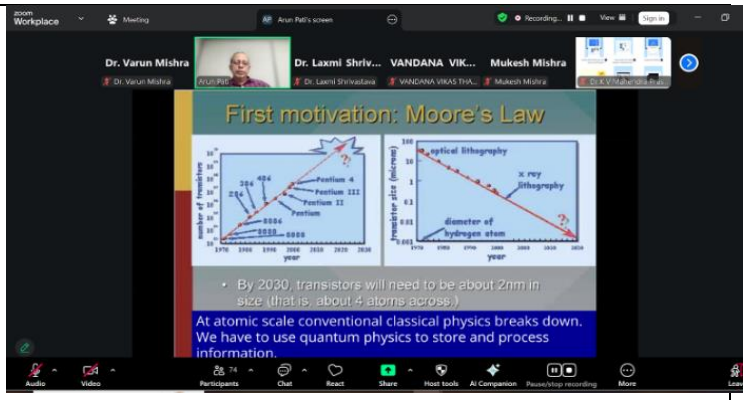
Title: Quantum Information Theory and Computation

Expert: Prof. Arun K. Pati (Director, Centre for Quantum Technology, KIIT Bhubaneswar, former Professor of Harish-Chandra Research Institute, Prayagraj)

The first expert lecture of the AICTE–ATAL FDP was delivered by Prof. Arun K. Pati**,** Director, Centre for Quantum Technology, KIIT Bhubaneswar, former Professor of Harish-Chandra Research Institute, Prayagraj. He highlighted how quantum mechanics enables fundamentally new ways of storing and processing information**,** distinct from classical systems. Prof. Pati explained the computational advantages of quantum computers and emphasized that quantum information offers inherently stronger security. He concluded by noting that quantum computing and quantum communication will drive the next major technological revolution.





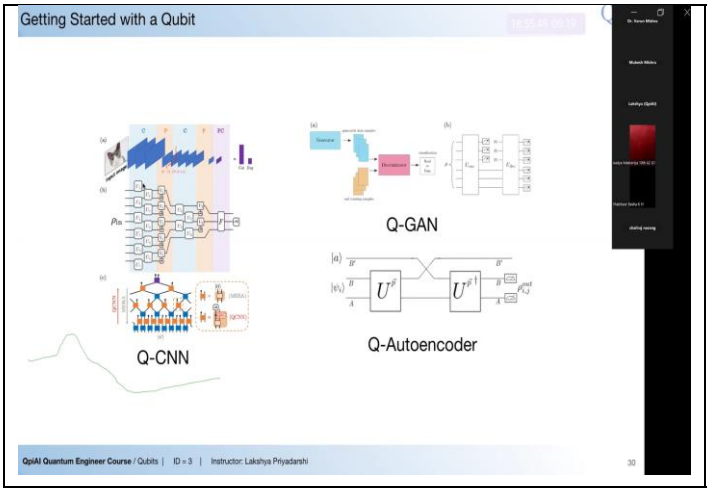


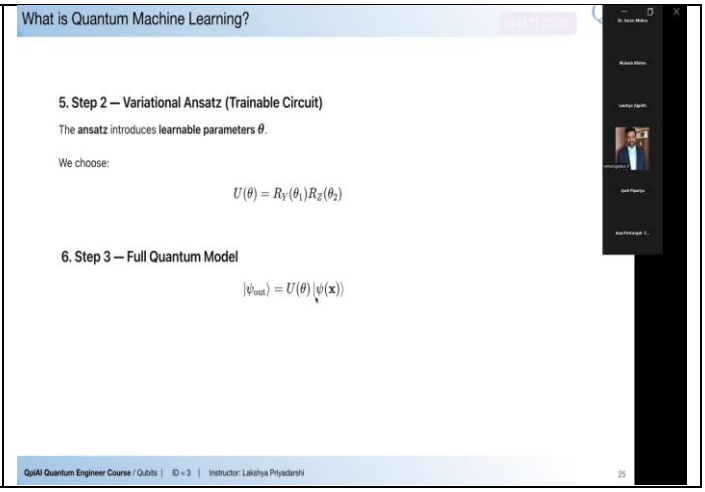
3. Report on Session: 2

Title: Quantum Machine Learning

Expert: Mr. Lakshya Priyadarshi, VP Quantum Strategy and Solutions, (QpiAI Pvt. Ltd., Bangalore).

Session 2 of Day 1 (15 December 2025) of the AICTE–ATAL Online FDP on *Emerging Frontiers in Quantum Technology and Communication* featured an expert talk on "Quantum Machine Learning" delivered by Mr. Lakshya. The session introduced the fundamentals of quantum machine learning, explaining how quantum computing principles can enhance classical machine learning algorithms. Mr. Lakshya discussed key concepts, potential advantages, and emerging applications of quantum machine learning, along with current challenges and future research opportunities. The talk was insightful and well-received, providing participants with a clear understanding of the role of quantum machine learning in next-generation intelligent systems.

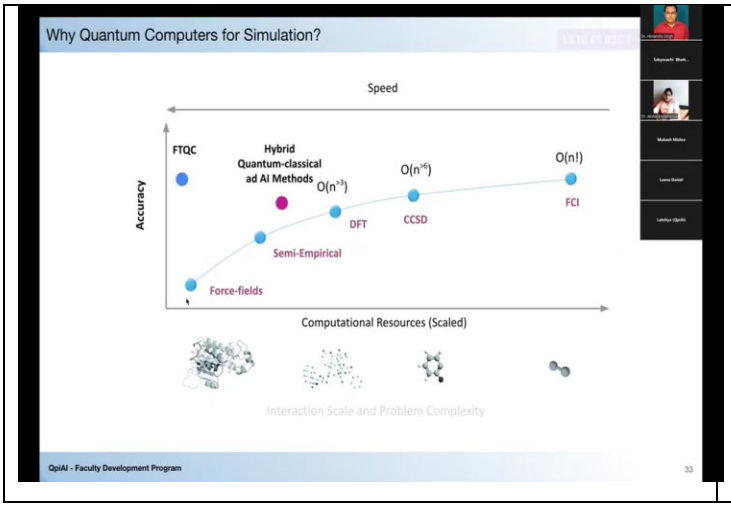


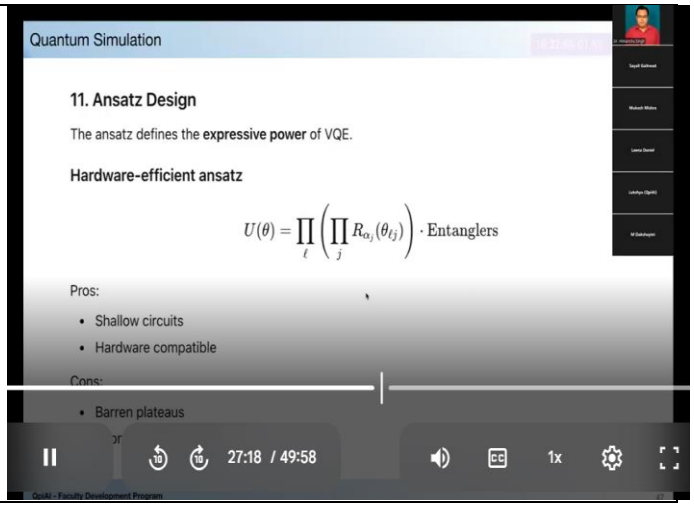


Report on Session: 3

Title: Quantum Simulators,
Expert: Mr. Lakshya Priyadarshi, VP Quantum Strategy and Solutions, **(QpiAI Pvt. Ltd., Bangalore).**

The session 3 provided an overview of quantum simulation techniques and their importance in modeling complex quantum systems that are difficult to study using classical computers. Mr. Priyadarshi discussed key concepts, practical examples, and applications of quantum simulations in areas such as material science, chemistry, and quantum physics, along with current challenges and future research directions. The talk was informative and engaging, enhancing participants' understanding of the role of quantum simulations in advancing quantum technologies.



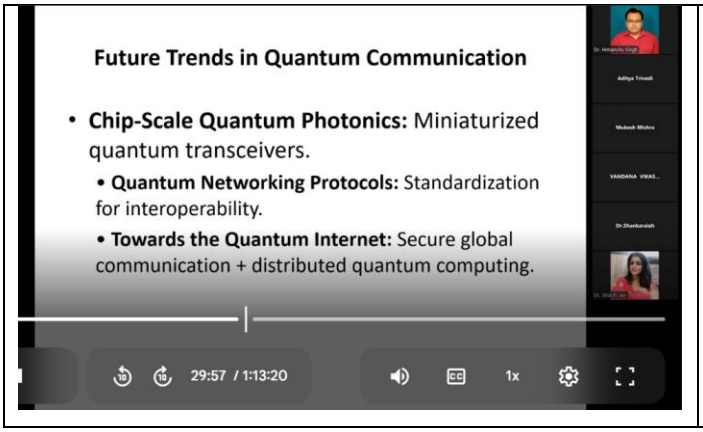


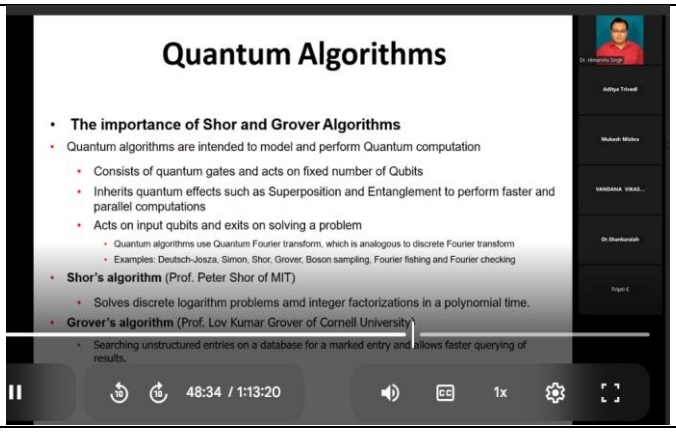
Report on Session: 4

Session 4: Future Trends in Quantum Communication

Expert: Prof. Aditya Trivedi, (ABV-IIITM Gwalior)

Session 4 of the AICTE–ATAL Online Faculty Development Programme on Emerging Frontiers in Quantum Technology and Communication featured an expert talk on "Future Trends in Quantum Communication" delivered by Prof. Aditya Trivedi, ABV-IIITM Gwalior. The session highlighted emerging trends, enabling technologies, and research challenges in quantum communication systems. Prof. Trivedi discussed advancements in quantum key distribution, secure communication frameworks, and the integration of quantum communication with next-generation networks. The talk provided valuable insights into future research directions and practical deployment challenges. The session was insightful and well-received, enriching participants' understanding of secure and next-generation quantum communication technologies.



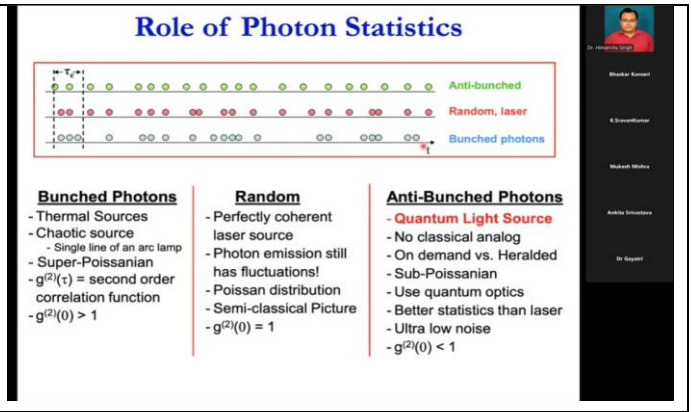


Report on Session: 5

Title: Quantum Secure Communication: Basic Aspects,
Expert: Dr. Bhaskar Kanseri, Associate Professor, IIT Delhi

Session 5 of the AICTE–ATAL Online Faculty Development Programme on *Emerging Frontiers in Quantum Technology and Communication* featured an expert talk on "Quantum Secure Communication: Basic Aspects" delivered by Dr. Bhaskar Kanseri, Associate Professor, IIT Delhi.

The session covered the fundamental principles of quantum secure communication, including the role of quantum mechanics in ensuring information security. Dr. Kanseri discussed basic concepts such as quantum key distribution, security advantages over classical systems, and foundational protocols. The talk provided a strong conceptual base for understanding secure quantum communication systems. The session was informative and highly appreciated, strengthening participants' foundational knowledge in quantum security.

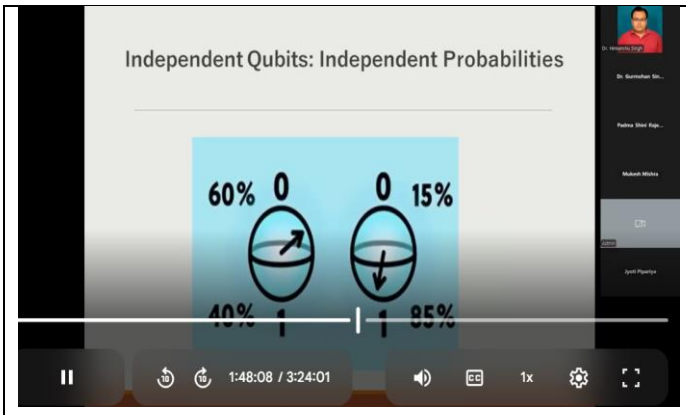


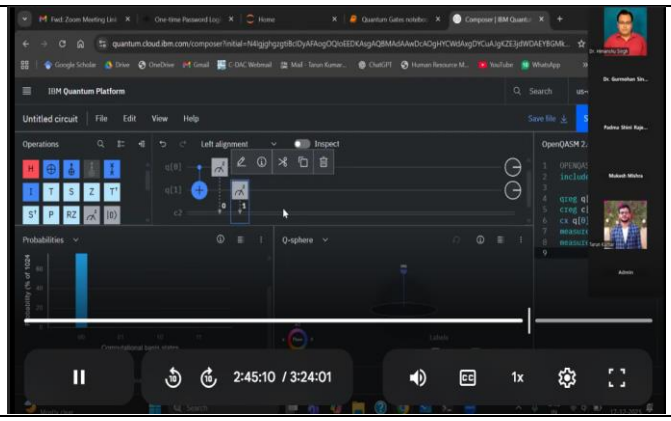
Report on Session: 6

Title: Quantum Gates to Algorithms,
Expert: Dr. Gurmohan Singh (CDAC, Mohali)

The session 6 explained the transition from basic quantum gates to the design of quantum algorithms. Dr. Singh discussed commonly used quantum gates, their role in building quantum circuits, and how these circuits form the basis of quantum algorithms. The session also included a live demonstration on simulating quantum gates using quantum simulators, which helped participants gain practical insights into quantum circuit implementation.

The talk was highly informative and interactive, strengthening participants' conceptual and practical understanding of quantum computing fundamentals.



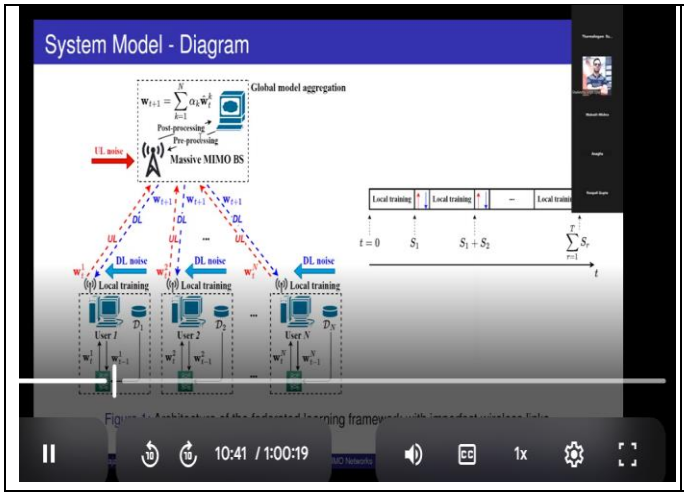


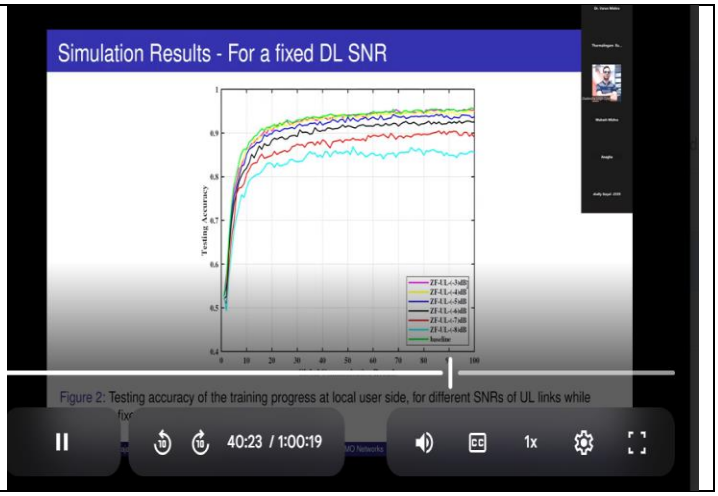
Report on Session: 7

Title: Federated Quantum Learning
Expert: Prof. T. Ratnarajah, Dept of Electrical & Comp. Engg, San Diego State University, USA

Session 7 of the AICTE–ATAL Online Faculty Development Programme on *Emerging Frontiers in Quantum Technology and Communication* featured an expert talk on "Federated Quantum Learning" delivered by Prof. T. Ratnarajah, Department of Electrical & Computer Engineering, San Diego State University, USA.

The session introduced the concept of federated learning in the quantum computing context, highlighting its potential for privacy-preserving and distributed quantum intelligence. Prof. Ratnarajah discussed key frameworks, advantages, and research challenges of federated quantum learning, along with its relevance to next-generation secure and scalable quantum systems. The session was insightful and thought-provoking, offering participants a global perspective on advanced research directions in quantum machine learning and distributed quantum computing.



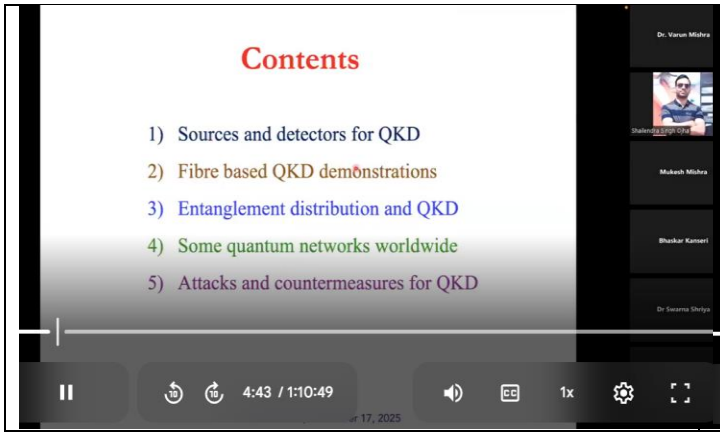


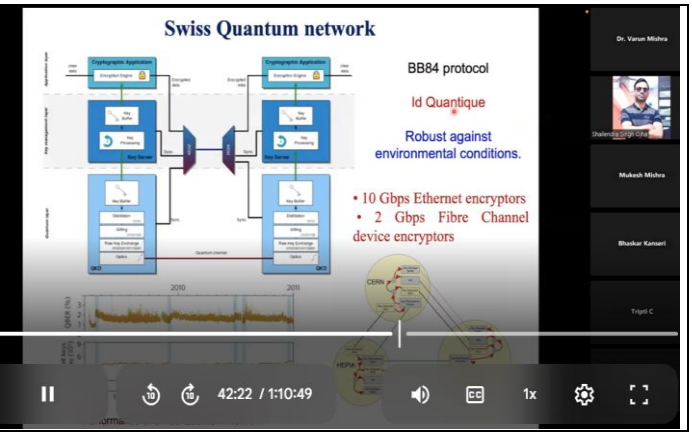
Report on Session: 8

Title: Quantum Secure Communication: Some Realisations
Expert: Dr. Bhaskar Kanseri, Associate Professor, IIT Delhi

Session 8 of the AICTE–ATAL Online Faculty Development Programme on *Emerging Frontiers in Quantum Technology and Communication* featured an expert talk on "Quantum Secure Communication: Some Realisations" delivered by Dr. Bhaskar Kanseri, Associate Professor, IIT Delhi.

The session focused on practical realizations of quantum secure communication systems. Dr. Kanseri discussed experimental setups, implementation aspects, and real-world demonstrations of quantum key distribution and secure quantum links. The talk bridged theoretical concepts with practical deployments, highlighting challenges and recent advancements in quantum security. The session was highly informative, enhancing participants' understanding of practical quantum secure communication systems.



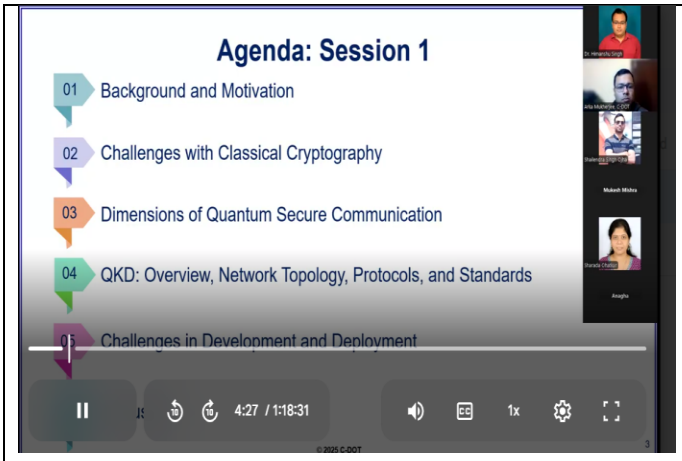


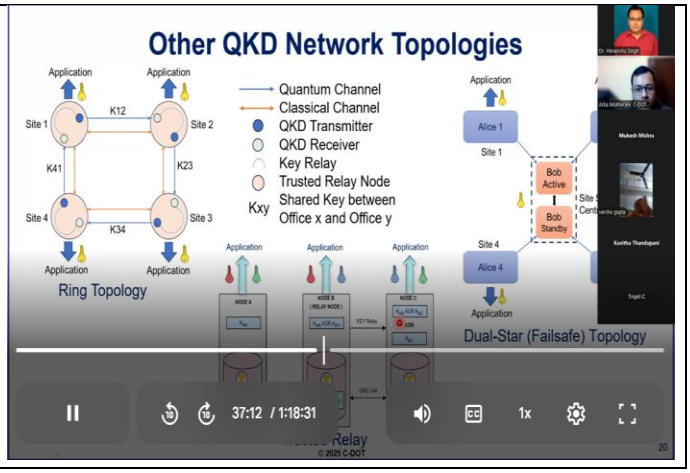
Report on Session: 9

Title: Intro. to Quantum Communication,
Expert: Mr. Arka Mukherjee, Scientist E, CDoT, New Delhi

Session 9 of the AICTE–ATAL Online Faculty Development Programme on *Emerging Frontiers in Quantum Technology and Communication* featured an expert talk on "Introduction to Quantum Communication" delivered by Mr. Arka Mukherjee, Scientist E, C-DOT, New Delhi.

The session provided a clear introduction to the fundamentals of quantum communication, covering basic principles, system components, and communication protocols. Mr. Mukherjee discussed the relevance of quantum communication in secure information transfer and highlighted ongoing developments and initiatives in the Indian quantum ecosystem. The talk was informative and well-structured, strengthening participants' foundational understanding of quantum communication technologies.



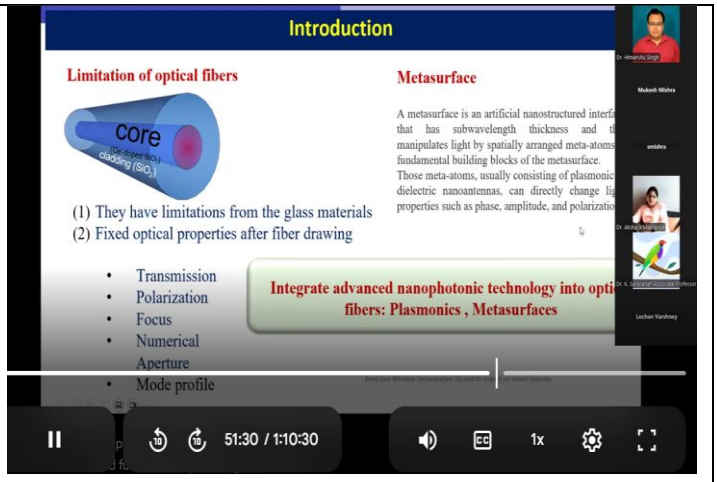


Report on Session: 10

Title: Quantum Sensing Materials,
Expert: Dr. Satyendra Kumar Mishra, Associate Professor SRCOM, CTTC, Castedefels Barcelona Spain

The session 10 focused on materials and physical principles enabling quantum sensing technologies. Dr. Mishra discussed advanced quantum materials, their sensing mechanisms, and applications in high-precision measurement, imaging, and next-generation sensors. The talk highlighted current research challenges and future opportunities in quantum sensing.

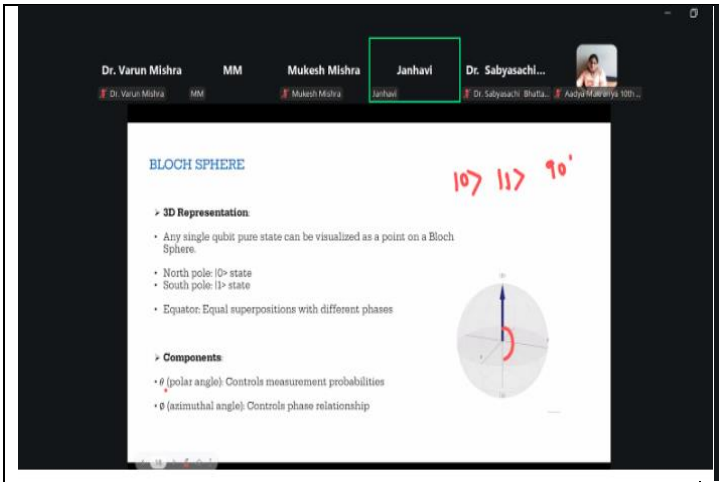
The session was insightful and enriched participants' understanding of material-driven advances in quantum sensing technologies.

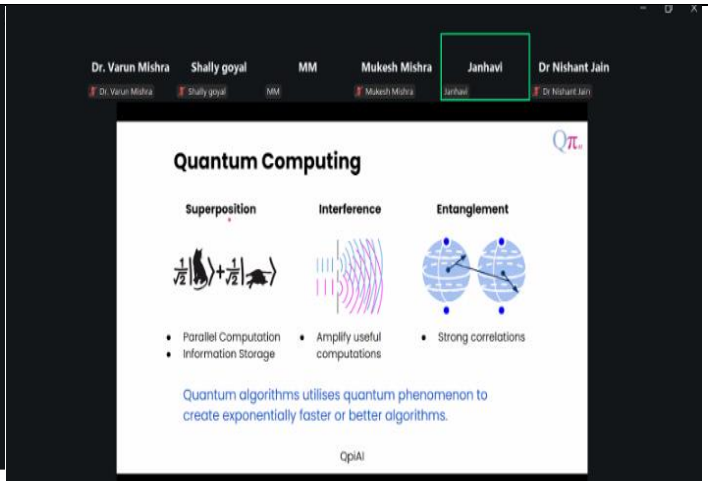


Report on Session: 11

Title: Quantum Computing
Expert: Ms. Jhanavi Hatwar, Quantum algorithm researcher at QpiAI Pvt. Ltd. Bangalore.

Session 11 of the AICTE–ATAL Online Faculty Development Programme on Emerging Frontiers in Quantum Technology and Communication featured an expert talk on "Quantum Computing" delivered by Ms. Jhanavi Hatwar. The session provided an overview of quantum computing fundamentals, including qubits, superposition, entanglement, and quantum circuits. Ms. Hatwar discussed the potential advantages of quantum computing over classical computing, current technological developments, and emerging applications. The talk offered valuable insights into the present status and future prospects of quantum computing. The session was informative and well-received, enhancing participants' conceptual understanding of quantum computing.



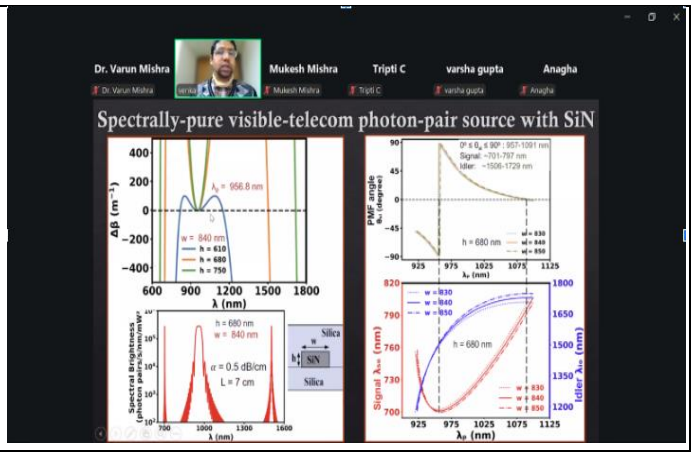


Report on Session: 12

Title: Quantum Communication over Telecom Fiber-optic Networks,
Expert: Dr. Vivek Venkataraman, Associate Professor, (IIT Delhi)

Session 12 of the AICTE–ATAL Online Faculty Development Programme on *Emerging Frontiers in Quantum Technology and Communication* featured an expert talk on "Quantum Communication over Telecom Fiber-Optic Networks" delivered by Dr. Vivek Venkataraman, Associate Professor, IIT Delhi.

The session focused on the implementation of quantum communication systems over existing telecom fiber-optic infrastructure. Dr. Venkataraman discussed system architectures, experimental demonstrations, and key challenges related to loss, noise, and scalability. The talk highlighted the potential of integrating quantum communication with conventional telecom networks for secure communication. The session was highly informative, providing participants with practical insights into real-world quantum communication deployments.



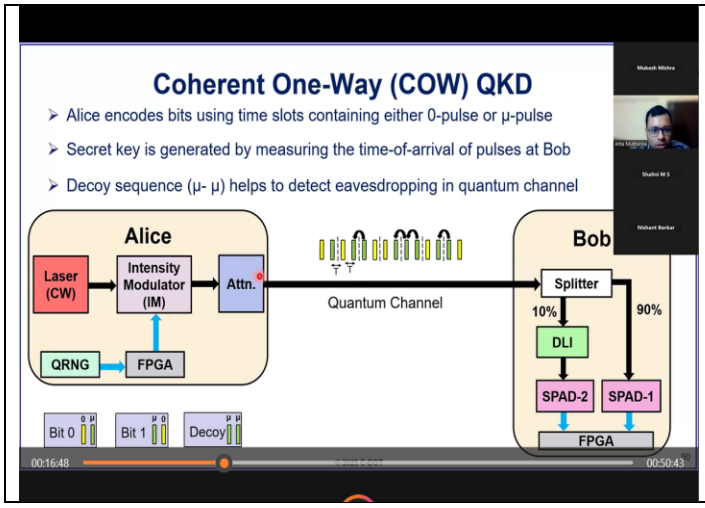
Report on Session: 13

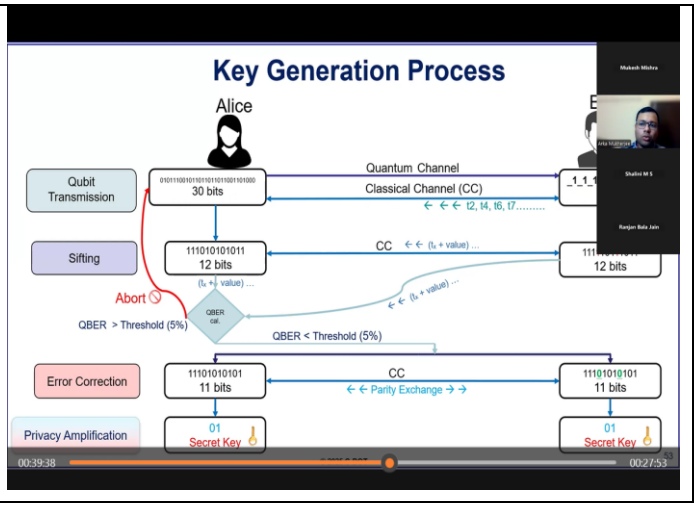
Title: QKD Protocols and QRNG,

Expert: Mr. Arka Mukherjee, Scientist E, CDoT, New Delhi

The session 13 covered key quantum key distribution (QKD) protocols and the principles of quantum random number generation. Mr. Mukherjee discussed the role of QKD in ensuring secure communication and explained practical aspects and applications of QRNG in cryptographic systems. The talk highlighted recent developments and implementation challenges in quantum security technologies.

The session was informative and well-received, strengthening participants' understanding of advanced quantum communication and security mechanisms.





Report on Valedictory Session

The Valedictory Session of the AICTE–sponsored ATAL Online Faculty Development Programme (FDP) on *"Emerging Frontiers in Quantum Technology and Communication"* was held successfully on 20 December 2025 in online mode. The six-day FDP was organized by the Department of Electronics Engineering, Madhav Institute of Technology & Science (MITS), Deemed University, Gwalior, during 15–20 December 2025. The session began with a warm welcome to all participants and dignitaries, followed by brief reflections on the successful completion of the FDP. The organizing team highlighted the academic rigor, interdisciplinary coverage, and relevance of the programme in addressing emerging trends in quantum technology and communication systems. The FDP featured **13 expert sessions** delivered by eminent academicians and industry experts, providing deep insights into quantum computing, quantum communication, quantum sensing, and future research challenges.

Dr. **Vandana Vikas Thakare**, FDP Coordinator, expressed sincere gratitude to the **AICTE–ATAL Academy** for sponsoring the programme and to the leadership of **MITS Deemed University** for their constant support. She also appreciated the valuable contributions of all resource persons whose expert lectures enriched the learning experience.

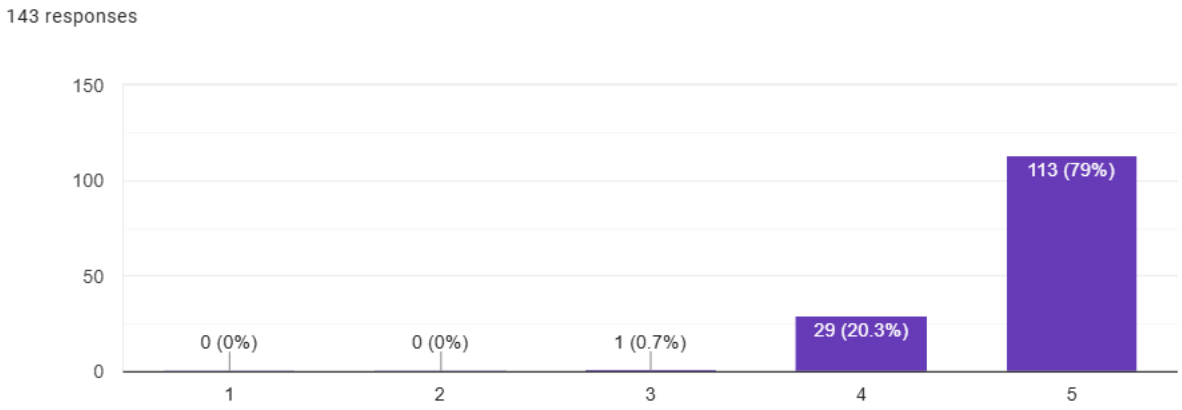
Dr. **Mukesh Kumar Mishra**, Co-Coordinator of the FDP, summarized the key learning outcomes and acknowledged the active participation, discipline, and enthusiasm shown by the participants throughout the programme. Compliance with **AICTE–ATAL guidelines**, including attendance, assessments, and feedback mechanisms, was also noted. The Valedictory Session concluded with a formal **vote of thanks** to the AICTE–ATAL Academy, expert speakers, organizing committee members, technical team, and participants. The programme ended on an optimistic note, encouraging participants to apply the acquired knowledge in teaching, research, and innovation in the domain of quantum technologies.

Feedback and Participant Response

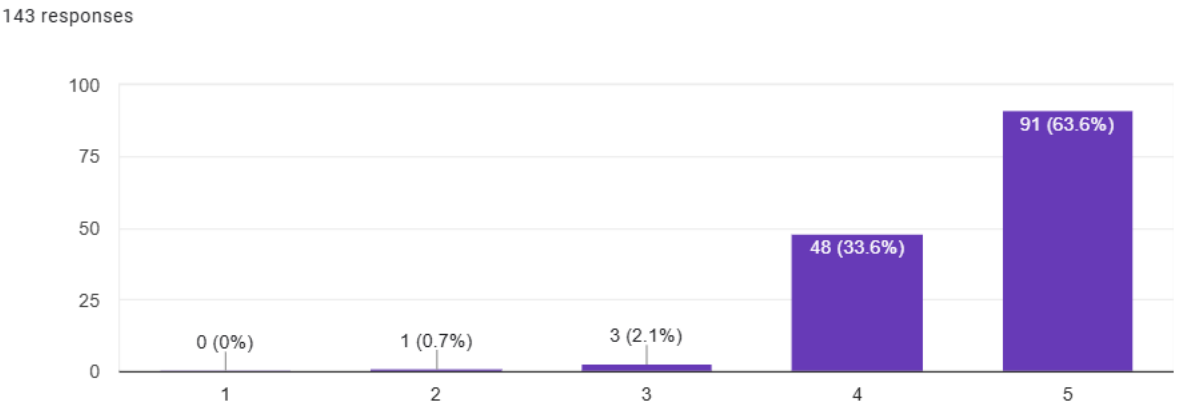
The programme received highly positive feedback from participants (The list of successful participants is provided in **Annexure–II**.). The sessions were widely appreciated for their clarity, relevance, expert delivery, and strong alignment with emerging research trends and industry requirements. Overall feedback for the FDP was very good, with a satisfactory ratio of **95.4%**. Participants actively engaged in all sessions and interacted meaningfully with the resource persons. The six-day programme comprehensively covered quantum fundamentals, quantum computing algorithms, quantum gates, quantum communication, applications, and emerging research directions in quantum computing and communication.

Feedback from the participants on the entire FDP

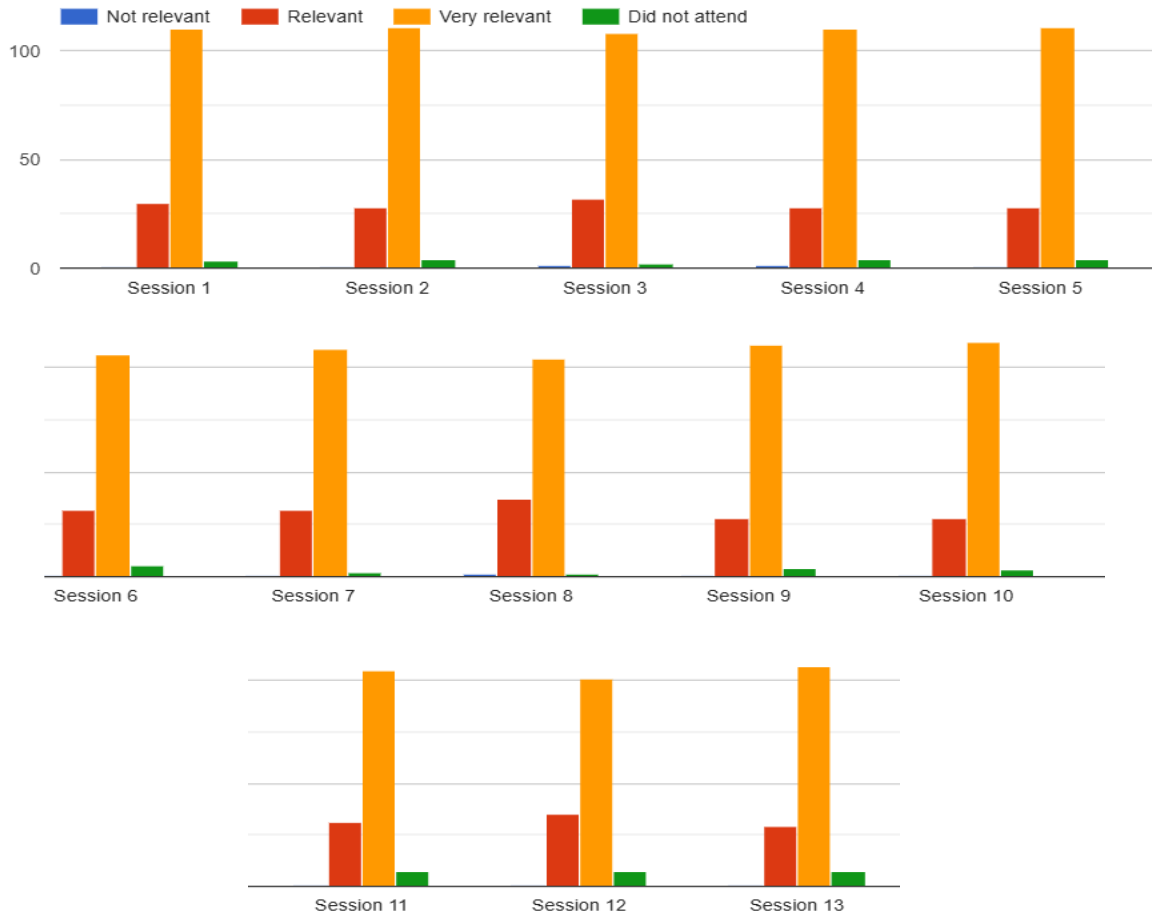
How satisfied were you with the event?



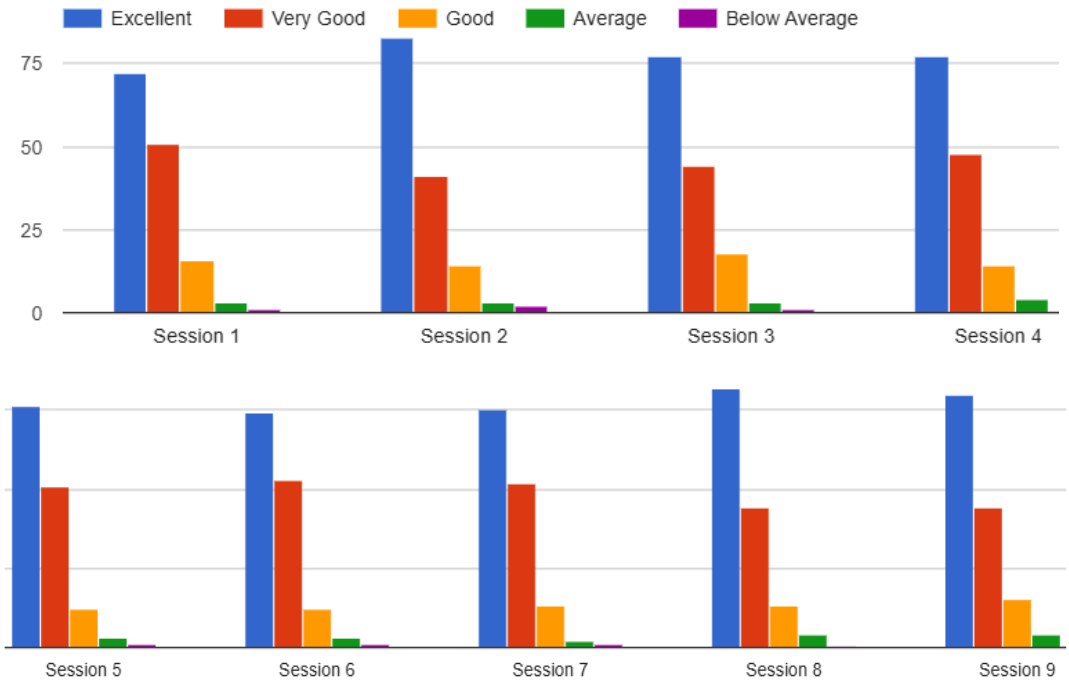
How relevant and helpful do you think it was for your job?

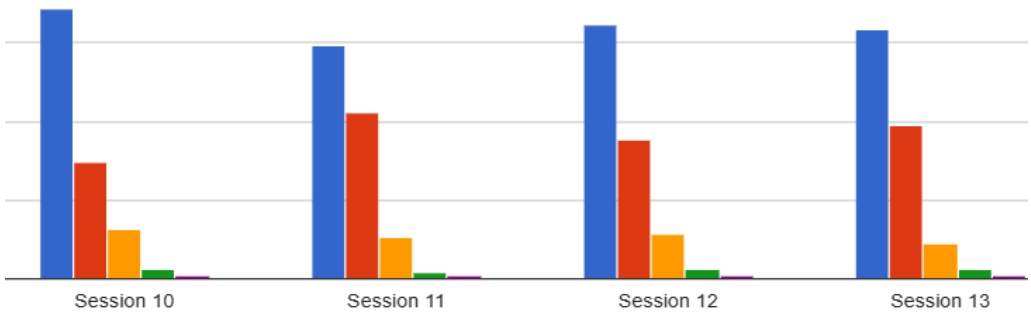


Which sessions did you find most relevant?

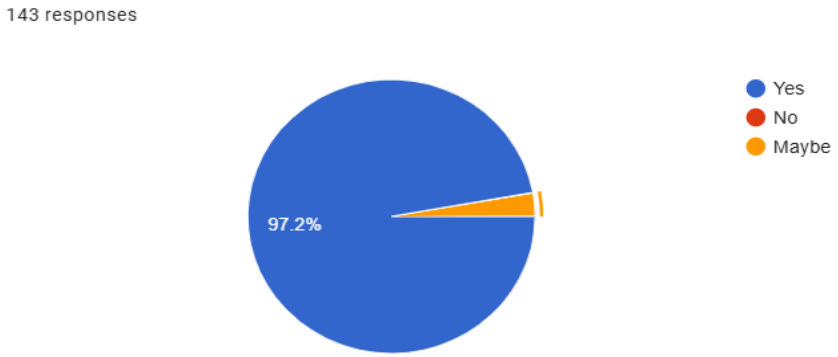


How was the interactions and discussion handled?

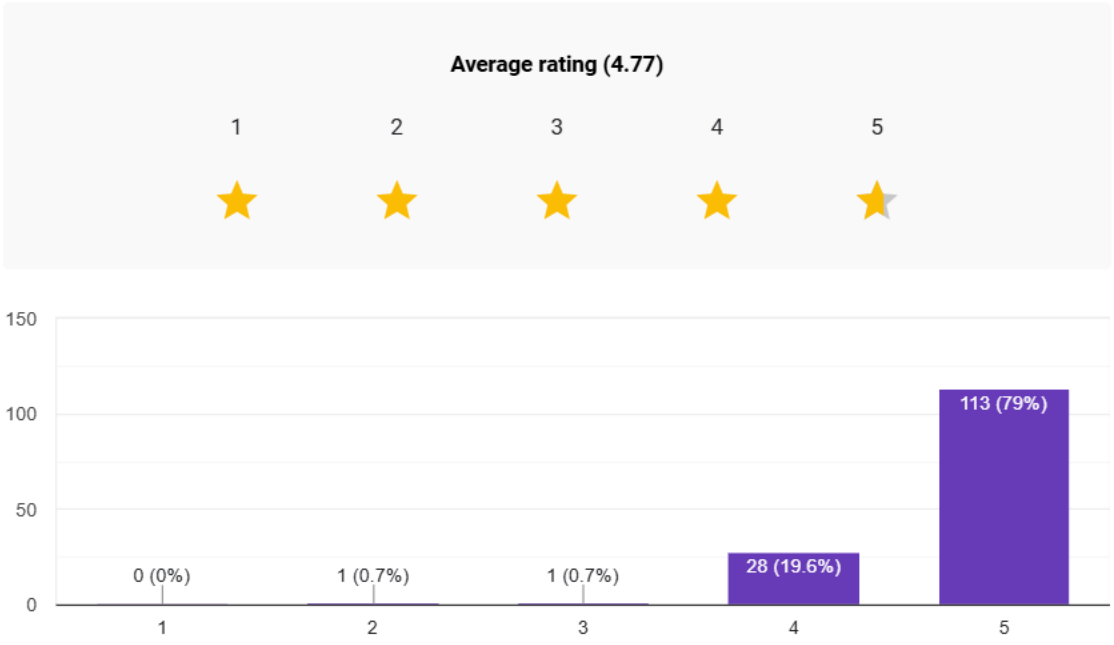




Would you recommend such ATAL FDPs to your colleagues



Overall rating of the FDP: (1 is lowest and 5 is higest)



Any additional comments regarding the sessions or overall agenda?

All the FDP are very excellent and helpful for research.
Well organised with expert speakers
Very good
The sessions were well organized, coordinated effectively , the experts were immensely knowledgeable and work presented was impressive. Special thanks to Dr. Mukesh Mishra sir for efficient coordination.
Very excellent
Excellent session are organised
Very well organised and excellent resource persons
THE SESSION WAS VERY INFORMATIVE, IT IS VERY HELPFUL
Informative session and excellent way of organising FDP by Team
Well Organized with the right experts
EXCELLENT SESSIONS
Overall good
Quite well organised and relavent content presented
Quantum Fundamentals
Well organized
I sincerely thank the FDP Coordinator and the entire faculty team for organizing such an informative and well-structured FDP. The sessions were insightful and enriched our knowledge both academically and practically.
Excellent
no
Little more break could have been given
very nicely coordinated and resource persons were appropriately arranged according to the title of FDP
Overall wise experience
Nil
Overall FDP was very well organised. All speakers were really good and knowledgeable.
Important knowledge about application
A Good FDP

Overall all good, but I think these sessions should be done on Saturday and Sunday so that we can involve more
It was nice and informative
Excellent
It will be helpful for future aspects.
Great experience to take part as participants to know about how the world of science and technology emerging in quantum physics
nil
It was quite informative
Excellent sessions
Very well organized sessions
THE ORGANIZERS HAVE GIVEN THEIR BEST TO BRING THIS FDP TO GOOD SUCCESS.
This FDP was informative
All good
If possible share the resources as well
It was well organized
Excellent speakers
Overall Good
Good sessions

Conclusion

The AICTE–ATAL FDP on *"Emerging Frontiers in Quantum Technology and Communication"* was successfully completed as per the approved schedule and guidelines of ATAL Academy. A total of **150 participants** appeared for the FDP quiz, out of which 142 participants successfully met the certification requirement of 70%**,** resulting in a 94.6% successful completion rate for the FDP.

The programme significantly contributed to capacity building, skill enhancement, and future readiness of faculty members and researchers in the domain of quantum communication and technologies. The organizing team expresses sincere gratitude to **AICTE ATAL Academy**, all esteemed resource persons, institutional leadership, and participants for their valuable support and cooperation in making the programme a grand success.

Annexure 1

List of participants appeared for Quiz conducted for the Certification

Emerging Frontiers in Quantum Technology and Communication

A total of **150 participants** appeared for the FDP quiz, out of which **142 participants successfully met the certification requirement of 70%**, resulting in a **94.6% successful completion rate** for the FDP.

S. No.	Name	Email	Institute Name	Score	Successfully Completed
1.	Dr. Aayushi Gautam	aayushi4march@gmail.com	Chandigarh Group of Colleges, Landran	**47 / 50**	Yes
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80.	Rajesh Bhaskarla	raajesh6@gmail.com	Vidya Jyothi Institute of Technology	**50 / 50**	Yes
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			Gwalior		
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Annexure 2

Media Coverage

दैनिक भास्कर

क्वांटम टेक्नोलॉजी से करियर की उड़ान विषय पर कार्यक्रम शुरू

ग्वालियर| माधव प्रौद्योगिकी एवं विज्ञान संस्थान डीम्ड विवि के इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग द्वारा एआईसीटीई—प्रायोजित अटल ऑनलाइन फैकल्टी डेवलपमेंट प्रोग्राम (एफडीपी) "क्वांटम प्रौद्योगिकी एवं संचार के उभरते आयाम" का शुभारंभ किया गया। कार्यक्रम में कुलपति डॉ. आरके पंडित एवं प्रो. वाइस चांसलर डॉ. मंजरी पंडित मौजूद रहीं।

नव भारत

एमआईटीएस में शुरु हुई राष्ट्रीय एफडीपी

नवभारत न्यूज

ग्वालियर,16 दिसंबर। प्रौद्योगिकी पर एआईसीटीई अटल एफडीपी का शुभारंभ माधव प्रौद्योगिकी एवं विज्ञान संस्थान, डीम्ड विश्वविद्यालय, ग्वालियर के इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग द्वारा एआईसीटीई-प्रायोजित अटल ऑनलाइन फैकल्टी डेवलपमेंट प्रोग्राम (एफडीपी) 'क्वांटम प्रौद्योगिकी एवं संचार के उभरते आयाम' का विधिवत शुभारंभ किया गया।

यह कार्यक्रम कुलपति डॉ. आर. के. पँडित एवं प्रो-वाइस चांसलर डॉ. मंजरी पँडित के संरक्षण, मार्गदर्शन एवं दूरदर्शी नेतृत्व में संचालित हो रहा है। उद्घाटन सत्र के दौरान डॉ. लक्ष्मी श्रीवास्तव, विभागाध्यक्ष, इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग ने एमआईटीएस-डीयू की शैक्षणिक एवं अनुसंधान उपलब्धियों को रेखांकित किया। कार्यक्रम की समन्वयक डॉ. वंदना विकास ठाकरे ने सभी अतिथियों एवं प्रतिभागियों का स्वागत करते हुए एफडीपी के उद्देश्यों एवं विषयवस्तु की जानकारी दी। अधिक जानकारी प्रदान करते हुए डॉ. मुकेश कुमार मिश्रा, एफडीपी के सह-समन्वयक ने कहा कि यह कार्यक्रम आईआईटी, अंतरराष्ट्रीय विश्वविद्यालयों, सी-डैक, सी-डॉट तथा अग्रणी उद्योग संगठनों के विशेषज्ञों को एक मंच पर लाता है, और इसमें क्वांटम सिमुलेटर्स, एल्गोरिथ्म तथा भविष्य की क्वांटम-सक्षम संचार प्रणालियों पर विशेष सत्र भी शामिल हैं। तकनीकी सत्र देश एवं विदेश के प्रतिष्ठित विशेषज्ञों द्वारा प्रस्तुत किए जा रहे हैं। उद्घाटन व्याख्यान 'क्वांटम सूचना सिद्धांत एवं संगणना' विषय पर प्रो. अरुण पति द्वारा दिया गया, जिन्हें व्यापक रूप से भारतीय क्वांटम कंप्यूटिंग का जनक माना जाता है। इसके बाद श्री लक्ष्य प्रियदर्शी द्वारा 'क्वांटम मशीन लर्निंग' पर उद्योग-उन्मुख सत्र प्रस्तुत किया गया। अंतरराष्ट्रीय विशेषज्ञ प्रो. टी. रत्नराजह (सैन डिएगो स्टेट यूनिवर्सिटी, अमेरिका) एवं डॉ. सत्येंद्र कुमार मिश्रा (सीटीटीसी, बार्सिलोना, स्पेन) क्रमशः 'फेडरेटेड क्वांटम लर्निंग' एवं 'क्वांटम सेंसिंग' पर व्याख्यान देंगे, जबकि आईआईटी दिल्ली के डॉ. भास्कर कंसेरी 'क्वांटम सुरक्षित संचार' विषय को संबोधित करेंगे। इस कार्यक्रम में देशभर से 175 शिक्षकों, शोधकर्ताओं एवं उद्योग पेशेवरों की उत्साहपूर्ण सहभागिता देखी गई है, जिससे क्वांटम प्रौद्योगिकियों के क्षेत्र में राष्ट्रीय स्तर पर अकादमिक सहयोग, अनुसंधान सहभागिता एवं नवाचार को मजबूती मिली है।

स्वदेश

एमआईटीएस में एआईसीटीई-अटल एफडीपी का शुभारंभ

ग्वालियर, न.सं.। माधव प्रौद्योगिकी एवं विज्ञान संस्थान (एमआईटीएस), डीम्ड विश्वविद्यालय के इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग द्वारा एआईसीटीई-प्रायोजित अटल ऑनलाइन फैकल्टी डेवलपमेंट प्रोग्राम (एफडीपी) क्वांटम प्रौद्योगिकी एवं संचार के उभरते आयाम का शुभारंभ किया गया। छह दिवसीय यह राष्ट्रीय स्तरीय एफडीपी 20 दिसंबर तक आयोजित की जाएगी।

कार्यक्रम कुलपति डॉ. आरके पंडित एवं प्रो-वाइस चांसलर डॉ. मंजरी पंडित के संरक्षण और मार्गदर्शन में आयोजित हो रहा है। उद्घाटन सत्र में इलेक्ट्रॉनिक्स इंजीनियरिंग विभागाध्यक्ष डॉ. लक्ष्मी श्रीवास्तव ने संस्थान की शैक्षणिक एवं अनुसंधान उपलब्धियों पर प्रकाश डाला। कार्यक्रम समन्वयक डॉ. वंदना विकास ठाकरे ने एफडीपी के उद्देश्यों की जानकारी देते हुए बताया कि इसमें क्वांटम मैकेनिक्स, क्वांटम कंप्यूटिंग, क्वांटम क्रिप्टोग्राफी, क्यूकेडी एवं सुरक्षित संचार प्रणालियों जैसे विषयों पर चर्चा की जा रही है। सह-समन्वयक डॉ. मुकेश कुमार मिश्रा ने बताया कि एफडीपी में आईआईटी, अंतरराष्ट्रीय विश्वविद्यालयों, सी-डैक, सी-डॉट एवं उद्योग जगत के विशेषज्ञ सहभागिता कर रहे हैं। प्रो. अरुण ने क्वांटम सूचना सिद्धांत एवं संगणना पर व्याख्यान दिया।

दैनिक सत्ता सुधार

प्रौद्योगिकी पर एआईसीटीई अटल एफडीपी का शुभारंभ

सत्ता सुधार ■ ग्वालियर

माधव प्रौद्योगिकी एवं विज्ञान संस्थान, डीम्ड विश्वविद्यालय के इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग द्वारा एआईसीटीई-प्रायोजित अटल ऑनलाइन फैकल्टी डेवलपमेंट प्रोग्राम (एफडीपी) क्वांटम प्रौद्योगिकी एवं संचार के उभरते आयाम का विधिवत शुभारंभ किया गया। यह छह दिवसीय राष्ट्रीय स्तरीय एफडीपी 15 से 20 दिसंबर तक आयोजित की जा रही है। यह कार्यक्रम कुलपति डॉ. आर.के.पंडित एवं प्रो वाइस चांसलर डॉ. मंजरी पंडित के संरक्षण, मार्गदर्शन एवं दूरदर्शी नेतृत्व में संचालित हो रहा है। उद्घाटन सत्र के दौरान डॉ. लक्ष्मी श्रीवास्तव, विभागाध्यक्ष, इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग ने एमआईटीएस-डीयू की शैक्षणिक एवं अनुसंधान उपलब्धियों को रेखांकित किया।

कार्यक्रम की समन्वयक डॉ. वंदना विकास ठाकरे ने सभी अतिथियों एवं प्रतिभागियों का स्वागत करते हुए एफडीपी के उद्देश्यों एवं विषयवस्तु की जानकारी दी। उन्होंने बताया कि यह एफडीपी क्वांटम मैकेनिक्स, क्वांटम कंप्यूटिंग, क्वांटम क्रिप्टोग्राफी, क्वांटम की डिस्ट्रीब्यूशन तथा सुरक्षित संचार प्रणालियों जैसे उभरते क्षेत्रों पर केंद्रित है। अधिक जानकारी प्रदान करते हुए डॉ. मुकेश कुमार मिश्रा एफडीपी के सह-समन्वयक ने कहा कि यह कार्यक्रम आईआईटी, अंतरराष्ट्रीय विश्वविद्यालयों, सी-डैक, सी-डॉट तथा अग्रणी उद्योग संगठनों के विशेषज्ञों को एक मंच पर लाता है, और इसमें क्वांटम सिमुलेटर्स, एल्गोरिथ्म तथा भविष्य की क्वांटम-सक्षम संचार प्रणालियों पर विशेष सत्र भी शामिल हैं। तकनीकी सत्र देश एवं विदेश के प्रतिष्ठित विशेषज्ञों द्वारा प्रस्तुत किए जा रहे हैं। उद्घाटन व्याख्यान क्वांटम सूचना सिद्धांत एवं संगणना विषय पर प्रो. अरुण पति द्वारा दिया गया, जिन्हें व्यापक रूप से भारतीय क्वांटम कंप्यूटिंग का जनक माना जाता है। इसके बाद श्री लक्ष्य प्रियदर्शी द्वारा क्वांटम मशीन लर्निंग पर उद्योग-उन्मुख सत्र प्रस्तुत किया गया। अंतरराष्ट्रीय विशेषज्ञ प्रो. टी. रत्नराजह (सैन डिएगो स्टेट यूनिवर्सिटी, अमेरिका) एवं डॉ. सत्येंद्र कुमार मिश्रा (सीटीटीसी, बार्सिलोना, स्पेन) क्रमशः फेडरेटेड क्वांटम लर्निंग एवं क्वांटम सेंसिंग पर व्याख्यान देंगे, जबकि आईआईटी दिल्ली के डॉ. भास्कर कंसेरी क्वांटम सुरक्षित संचार विषय को संबोधित करेंगे। इस कार्यक्रम में देशभर से 175 शिक्षकों, शोधकर्ताओं एवं उद्योग पेशेवरों की उत्साहपूर्ण सहभागिता देखी गई है, जिससे क्वांटम प्रौद्योगिकियों के क्षेत्र में राष्ट्रीय स्तर पर अकादमिक सहयोग, अनुसंधान सहभागिता एवं नवाचार को मजबूती मिली है।

द संघर्ष न्यूज़
हर वक्त आपके साथ

एमआईटीएस में प्रौद्योगिकी पर एआईसीटीई- अटल एफडीपी का शुभारंभ

द संघर्ष न्यूज़ ब्यूरो

ग्वालियर। माधव प्रौद्योगिकी एवं विज्ञान संस्थान–डीम्ड विश्व. विद्यालय, ग्वालियर के इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग द्वारा एआईसीटीईद्वप्रायोजित अटल ऑनलाइन फैकल्टी डेवलपमेंट प्रोग्राम (एफडीपी) "क्वांटम प्रौद्योगिकी एवं संचार के उभरते आयाम" का विधिवत शुभारंभ किया गया। यह छह दिवसीय राष्ट्रीय स्तरीय एफडीपी 15 से 20 दिसंबर 2025 तक आयोजित की जा रही है।

यह कार्यक्रम कुलपति डॉ. आर. के. पंडित एवं प्रो–वाइस चां. सलर डॉ. मंजरी पंडित के संरक्षण, मार्गदर्शन एवं दूरदर्शी नेतृत्व में संचालित हो रहा है। उद्घाटन सत्र के दौरान डॉ. लक्ष्मी श्रीवास्तव, विभागाध्यक्ष, इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग ने एमआईटीएस–डीयू की शैक्षणिक एवं अनुसंधान उपलब्धियों को रेखांकित किया। कार्यक्रम की समन्वयक डॉ. वंदना विकास ठाकरे ने सभी अतिथियों एवं प्रतिभागियों का स्वागत करते हुए एफडीपी के उद्देश्यों एवं विषयवस्तु की जानकारी दी। उन्होंने बताया कि यह एफडीपी क्वांटम मैकेनिक्स, क्वांटम कंप्यूटिंग, क्वांटम क्रिप्टोग्राफी, क्वांटम की डिस्ट्रीब्यूशन (फज़ड़े) तथा सुरक्षित संचार प्रणालियों जैसे उभरते क्षेत्रों पर केंद्रित है। अधिक जानकारी प्रदान करते हुए डॉ. मुकेश कुमार मिश्रा, एफडीपी के सह–समन्वयक ने कहा कि यह कार्यक्रम आईआईटी, अंतरराष्ट्रीय विश्व. विद्यालयों, सी–डैक, सी–डॉट तथा अग्रणी उद्योग संगठनों के विशेषज्ञों को एक मंच पर लाता है, और इसमें क्वांटम सिमुलेटर्स, एल्गोरिदम तथा भविष्य की क्वांटम–सक्षम संचार प्रणालियों पर विशेष सत्र भी शामिल हैं।

तकनीकी सत्र देश एवं विदेश के प्रतिष्ठित विशेषज्ञों द्वारा प्रस्तुत किए जा रहे हैं। उद्घाटन व्याख्यान "क्वांटम सूचना सिद्धांत एवं संगणना" विषय पर प्रो. अरुण पति द्वारा दिया गया, जिन्हें व्यापक रूप से भारतीय क्वांटम कंप्यूटिंग का जनक माना जाता है। इसके बाद श्री लक्ष्य प्रियदर्शी द्वारा "क्वांटम मशीन लर्निंग" पर उद्योग–उन्मुख सत्र प्रस्तुत किया गया। अंतरराष्ट्रीय विशेषज्ञ प्रो. टी. रूनराजह (सैन डिएगो स्टेट यूनिवर्सिटी, अमे. रिका) एवं डॉ. सत्येंद्र कुमार मिश्रा (सीटीटीसी, बार्सिलोना, स्पेन) क्रमशः "फेडरेटेड क्वांटम लर्निंग" एवं "क्वांटम सेंसिंग" पर व्याख्यान देंगे, जबकि आईआईटी दिल्ली के डॉ. भास्कर कंसेरी "क्वांटम सुरक्षित संचार" विषय को संबोधित करेंगे।

इस कार्यक्रम में देशभर से 175 शिक्षकों, शोधकर्ताओं एवं उद्योग पेशेवरों की उत्साहपूर्ण सहभागिता देखी गई है, जिससे क्वांटम प्रौद्योगिकियों के क्षेत्र में राष्ट्रीय स्तर पर अकादमिक सहयोग, अनुसंधान सहभागिता एवं नवाचार को मजबूती मिली है।

स्वदेश

एमआईटीएस में एआईसीटीई-अटल एफडीपी का शुभारंभ

ग्वालियर, न.सं.। माधव प्रौद्योगिकी एवं विज्ञान संस्थान (एमआईटीएस), डीम्ड विश्वविद्यालय के इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग द्वारा एआईसीटीई-प्रायोजित अटल ऑनलाइन फैकल्टी डेवलपमेंट प्रोग्राम (एफडीपी) क्वांटम प्रौद्योगिकी एवं संचार के उभरते आयाम का शुभारंभ किया गया। छह दिवसीय यह राष्ट्रीय स्तरीय एफडीपी 20 दिसंबर तक आयोजित की जाएगी।

कार्यक्रम कुलपति डॉ. आरके पंडित एवं प्रो-वाइस चांसलर डॉ. मंजरी पंडित के संरक्षण और मार्गदर्शन में आयोजित हो रहा है। उद्घाटन सत्र में इलेक्ट्रॉनिक्स इंजीनियरिंग विभागाध्यक्ष डॉ. लक्ष्मी श्रीवास्तव ने संस्थान की शैक्षणिक एवं अनुसंधान उपलब्धियों पर प्रकाश डाला। कार्यक्रम समन्वयक डॉ. वंदना विकास ठाकरे ने एफडीपी के उद्देश्यों की जानकारी देते हुए बताया कि इसमें क्वांटम मैकेनिक्स, क्वांटम कंप्यूटिंग, क्वांटम क्रिप्टोग्राफी, क्यूकेडी एवं सुरक्षित संचार प्रणालियों जैसे विषयों पर चर्चा की जा रही है। सह-समन्वयक डॉ. मुकेश कुमार मिश्रा ने बताया कि एफडीपी में आईआईटी, अंतरराष्ट्रीय विश्वविद्यालयों, सी-डैक, सी-डॉट एवं उद्योग जगत के विशेषज्ञ सहभागिता कर रहे हैं। प्रो. अरुण ने क्वांटम सूचना सिद्धांत एवं संगणना पर व्याख्यान दिया।

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17 दिसंबर 2025 बुधवार
पीपुल्स समाचार
बदलते जमाने का अखबार
ग्वालियर

अटल ऑनलाइन फैकल्टी डेवलपमेंट प्रोग्राम का शुभारंभ

पीपुल्स संवाददाता • ग्वालियर
मो.नं. 9644644430

माधव प्रौद्योगिकी एवं विज्ञान संस्थान डीम्ड विश्वविद्यालय के इलेक्ट्रॉनिक्स इंजीनियरिंग विभाग द्वारा क्वांटम प्रौद्योगिकी एवं संचार के आयामों पर विस्तृत चर्चा के लिए अटल ऑनलाइन फैकल्टी डेवलपमेंट प्रोग्राम (एफडीपी) कार्यक्रम का शुभारंभ किया गया। यह छः दिवसीय एफडीपी सोमवार से शनिवार तक आयोजित होगी।

यह एफडीपी कार्यक्रम कुलपति डॉ. आरके पंडित एवं प्रो-वाइस चांसलर डॉ. मंजरी पंडित के संरक्षण, मार्गदर्शन में संचालित हो रहा है। उद्घाटन सत्र के दौरान डॉ. लक्ष्मी श्रीवास्तव, विभागाध्यक्ष ने एमआईटीएस-डीयू की शैक्षणिक अनुसंधान उपलब्धियों को रेखांकित किया। कार्यक्रम की समन्वयक डॉ. वंदना विकास ठाकरे ने अतिथियों एवं प्रतिभागियों का स्वागत करते हुए एफडीपी के उद्देश्यों एवं विषयवस्तु की जानकारी दी। उन्होंने क्वांटम मैकेनिक्स, क्वांटम कंप्यूटिंग, क्वांटम क्रिप्टोग्राफी तथा उसकी सुरक्षित संचार प्रणालियों के उभरते क्षेत्रों की जानकारी दी। डॉ. मुकेश कुमार मिश्रा ने कहा कि यह कार्यक्रम आईआईटी, अंतरराष्ट्रीय विश्वविद्यालयों, सी-डैक, सी-डॉट तथा अग्रणी उद्योग संगठनों के विशेषज्ञों को एक मंच पर लाता है, और इसमें क्वांटम सिमुलेटर्स, एल्गोरिद्म तथा भविष्य की क्वांटम-सक्षम संचार प्रणालियों पर विशेष सत्र भी शामिल हैं। अंतरराष्ट्रीय विशेषज्ञ प्रो. टी.रबराजह एवं डॉ. सत्येंद्र कुमार मिश्रा फेडरेटेड क्वांटम लर्निंग एवं क्वांटम सेंसिंग पर अपना व्याख्यान देंगे। इस कार्यक्रम में देशभर से 175 शिक्षक, शोधकर्ता एवं उद्योग पेशेवर उपस्थित रहे।

Annexure 3

Quiz Questions with Answer key

S.No.	Question	Answer Key
1.	Q1. Which quantum gate is used to create a superposition state from $\|0\rangle$? a) Pauli-X gate b) Pauli-Z gate c) Hadamard gate d) CNOT gate Answer: c) Hadamard gate	C
2.	Q2. The Pauli-X gate is equivalent to which classical logic operation? a) AND b) OR c) NOT d) XOR Answer: c) NOT	C
3.	Q3. Which gate flips the qubit and also introduces a phase change? a) Pauli-X b) Pauli-Y c) Pauli-Z d) Hadamard Answer: b) Pauli-Y	B
4.	Q4. The CNOT gate performs which operation? a) Flips both qubits b) Flips target qubit always c) Flips target qubit if control qubit is $\|1\rangle$ d) Creates superposition Answer: c) Flips target qubit if control qubit is $\|1\rangle$	C
5.	Q5. Which quantum gate is its own inverse? a) Pauli-X b) Hadamard c) Pauli-Z d) All of the above Answer: d) All of the above	D
6.	Q6. Which property must all quantum gates satisfy? a) Linearity b) Reversibility c) Unitarity d) All of the above Answer: d) All of the above	D
7.	Q7. Which of the following is a widely used open-source quantum simulator developed by IBM B a) Cirq b) Qiskit	B

	c) Forest d) Strawberry Fields Answer: b) Qiskit	
8.	Q8. IBM Quantum Composer is primarily used for? a) Designing classical logic circuits b) Writing quantum programs only in Q# c) Graphical design and simulation of quantum circuits d) Quantum hardware fabrication Answer: c) Graphical design and simulation of quantum circuits	C
9.	Q9. Which of the following gates can be directly applied using IBM Quantum Composer? a) Classical AND gate b) Toffoli gate c) Hadamard gate d) All of the above Answer: c) Hadamard gate	C
10.	Q10. Which interface does IBM Quantum Composer provide to users? a) Command-line interface b) Text-only coding interface c) Drag-and-drop graphical interface d) Hardware control interface Answer: c) Drag-and-drop graphical interface	C
11.	Q11. Which quantum algorithm provides a speed-up for searching an unsorted database? a) Shor's algorithm b) Deutsch–Jozsa algorithm c) Grover's algorithm d) Simon's algorithm Answer: c) Grover's algorithm	C
12.	Q12. Shor's algorithm is mainly used for: a) Database search b) Solving linear equations c) Integer factorization d) Random number generation Answer: c) Integer factorization	C
13.	Q13. The security of BB84 protocol is based on: a) Computational hardness b) Quantum no-cloning theorem and measurement disturbance c) Classical encryption d) Shared secret key Answer: b) Quantum no-cloning theorem and measurement disturbance	B
14.	Q14. In BB84, how many polarization bases are used for encoding qubits? a) One b) Two c) Three d) Four Answer: b) Two	B
15.	Q15. Quantum sensing achieves higher sensitivity mainly by exploiting:	D

	a) Classical signal amplification b) Thermal noise c) Error correction codes d) Quantum superposition and entanglement Answer: d) Quantum superposition and entanglement	
16.	Q16. Which of the following is a common application of quantum sensing? a) Magnetic field measurement using NV centers b) Database optimization c) Email encryption d) Quantum key distribution Answer: a) Magnetic field measurement using NV centers	A
17.	Q17. Quantum random number generators rely on: a) Algorithmic randomness b) Pseudo-random sequences c) Pre-stored random tables d) Intrinsic quantum randomness from measurement outcomes Answer: d) Intrinsic quantum randomness from measurement outcomes	D
18.	Q18. Which physical process is commonly used in QRNGs? a) Clock jitter b) Single-photon detection at a beam splitter c) Thermal noise d) Hash functions Answer: b) Single-photon detection at a beam splitter	B
19.	Q19. Which technology is directly threatened by Shor's algorithm? a) Symmetric key cryptography b) Public-key cryptography (RSA, ECC) c) QKD d) QRNG Answer: b) Public-key cryptography (RSA, ECC)	B
20.	Q20. Which statement is TRUE regarding QKD and QRNG? a) QKD distributes keys securely, while QRNG generates true random numbers b) QRNG requires pre-shared keys c) Both depend on computational complexity d) Both replace classical networks completely Answer: a) QKD distributes keys securely, while QRNG generates true random numbers	A
21.	Q21. What does quantum superposition imply? a) A qubit can exist only in state $\|0\rangle$ b) A qubit switches rapidly between $\|0\rangle$ and $\|1\rangle$ c) A qubit can exist in a linear combination of $\|0\rangle$ and $\|1\rangle$ d) A qubit always collapses to $\|1\rangle$ Answer: c) A qubit can exist in a linear combination of $\|0\rangle$ and $\|1\rangle$	C
22.	Q22. Which experiment best demonstrates the principle of quantum superposition? a) Bell's inequality experiment b) Photoelectric effect c) Quantum teleportation	D

	d) Double-slit experiment Answer: d) Double-slit experiment	
23.	Q23. Quantum entanglement means that: a) Qubits behave independently b) Measurement outcomes are always predictable c) The state of one qubit depends on another, even at a distance d) Qubits lose coherence instantly Answer: c) The state of one qubit depends on another, even at a distance	C
24.	Q24. Which of the following is an advantage of quantum secure communication over classical cryptography? a) Higher data transmission rate b) Lower hardware cost c) Immunity to noise d) Security based on physical laws rather than computational complexity Answer: d) Security based on physical laws rather than computational complexity	D
25.	Q25. Entanglement-based QKD protocols mainly rely on which principle? a) Violation of Bell's inequality b) Heisenberg uncertainty principle c) Quantum superposition only d) Classical correlation Answer: a) Violation of Bell's inequality	A
26.	Q26. Which quantum principle ensures that an eavesdropper's presence increases the Quantum Bit Error Rate (QBER)? a) Heisenberg uncertainty principle b) Quantum entanglement c) Quantum superposition d) Quantum teleportation Answer: a) Heisenberg uncertainty principle	A
27.	Q27. Which operation is essential to convert a computational basis state into an equal superposition of all basis states in an n-qubit system? a) Phase gate on one qubit b) Hadamard gate on each qubit c) CNOT on adjacent qubits d) Pauli-X on all qubits Answer: b) Hadamard gate on each qubit	B
28.	Q28. Why does measuring one qubit of an entangled pair instantaneously define the state of the other qubit? a) Information travels faster than light b) The qubits exchange signals c) They are classically correlated d) The joint quantum state is non-separable Answer: d) The joint quantum state is non-separable	D
29.	Q29. Which statement correctly distinguishes classical correlation from quantum entanglement' a) Classical correlation violates Bell's inequality b) Entanglement produces correlations unexplained by local hidden variables c) Quantum entanglement exists only at short distances	B

	d) Classical correlation is stronger than entanglement Answer: b) Entanglement produces correlations unexplained by local hidden variables	
30.	Q30. In BB84 protocol, what is the main purpose of basis reconciliation (sifting)? a) To keep only bits measured in the same basis b) To amplify privacy c) To encrypt the key d) To remove noise completely Answer: a) To keep only bits measured in the same basis	A
31.	Q31. Why is a classical communication channel required in QKD protocols? a) To transmit quantum states b) To generate randomness c) To synchronize photon sources d) To perform basis comparison and error correction Answer: d) To perform basis comparison and error correction	D
32.	Q32. Which of the following attacks exploits imperfections in practical QKD hardware rather than quantum theory itself? a) Intercept–resend attack b) Photon-number-splitting attack c) Basis mismatch attack d) Side-channel attack Answer: d) Side-channel attack	D
33.	Q33. The main objective of Quantum Machine Learning is to: a) Replace classical machine learning completely b) Reduce dataset size using quantum compression c) Leverage quantum computation to accelerate or enhance learning tasks d) Implement neural networks on quantum hardware only Answer: c) Leverage quantum computation to accelerate or enhance learning tasks	C
34.	Q34. Which quantum property is most commonly exploited in QML to represent high-dimensional data efficiently? a) Quantum tunneling b) Quantum superposition c) Decoherence d) Measurement collapse Answer: b) Quantum superposition	B
35.	Q35. Variational Quantum Circuits (VQCs) are trained by: a) Pure quantum backpropagation b) Exhaustive search c) Quantum annealing d) Hybrid quantum–classical optimization loops Answer: d) Hybrid quantum–classical optimization loops	D
36.	Q36. Which classical ML model is most closely analogous to a Quantum Support Vector Machine (QSVM)? a) Decision Tree b) Naïve Bayes c) k-Means Clustering d) Support Vector Machine	D

	Answer: d) Support Vector Machine	
37.	Q37. Which challenge significantly limits near-term QML implementations on NISQ devices? a) Lack of quantum algorithms b) Infinite training time c) Excessive data availability d) Noise and decoherence Answer: d) Noise and decoherence	D
38.	Q38. The “barren plateau” problem in QML refers to: a) Hardware failure b) Exponential growth of qubits c) Vanishing gradients during training of variational circuits d) Measurement errors Answer: c) Vanishing gradients during training of variational circuits	C
39.	Q39. Which type of learning task is most commonly demonstrated using QML today? a) Reinforcement learning b) Regression c) Binary classification d) Time-series forecasting Answer: c) Binary classification	C
40.	Q40. Which library is widely used for implementing hybrid quantum-classical ML models? a) Scikit-learn b) TensorFlow only c) Cirq only d) PennyLane Answer: d) PennyLane	D
41.	Q41. One of the major future goals of quantum communication research is to: a) Replace classical networks entirely b) Eliminate the need for encryption c) Develop a global quantum internet d) Increase classical bandwidth only Answer: c) Develop a global quantum internet	C
42.	Q42. Quantum repeaters are essential for long-distance quantum communication because they: a) Amplify quantum signals b) Store classical keys c) Reduce computational cost d) Overcome photon loss and decoherence Answer: d) Overcome photon loss and decoherence	D
43.	Q43. The integration of quantum communication with 6G networks is mainly aimed at: a) Providing ultra-secure and resilient communication services b) Replacing classical modulation c) Increasing data rate only d) Reducing network latency to zero Answer: a) Providing ultra-secure and resilient communication services	A
44.	Q44. Which future application relies heavily on both quantum communication and quantum information mechanics?	D

	a) Classical cloud computing b) Blockchain mining c) Conventional IoT networks d) Distributed quantum computing Answer: d) Distributed quantum computing	
45.	Q45. In future quantum networks, entanglement swapping will primarily be used to: a) Generate random numbers b) Extend entanglement over long distances c) Perform error correction d) Encode classical data Answer: b) Extend entanglement over long distances	B
46.	Q46. Advances in quantum information mechanics are expected to contribute to: a) Classical encryption algorithms b) Better understanding and control of entanglement and decoherence c) Faster classical processors d) Elimination of measurement uncertainty Answer: b) Better understanding and control of entanglement and decoherence	B
47.	Q47. In quantum information mechanics, a qubit is mathematically represented as: a) A real-valued vector b) A probability distribution c) A normalized vector in a complex Hilbert space d) A Boolean variable Answer: c) A normalized vector in a complex Hilbert space	C
48.	Q48. Which operation preserves the total probability of a quantum state? a) Measurement b) Projection c) Unitary transformation d) Partial trace Answer: c) Unitary transformation	C
49.	Q49. The von Neumann entropy is a measure of: a) Classical uncertainty b) Quantum coherence c) Energy dispersion d) Quantum information content / mixedness Answer: d) Quantum information content / mixedness	D
50.	Q50. Quantum mutual information quantifies: a) Measurement error b) Energy exchange c) Only entanglement d) Total correlations (classical + quantum) between subsystems Answer: d) Total correlations (classical + quantum) between subsystems	D