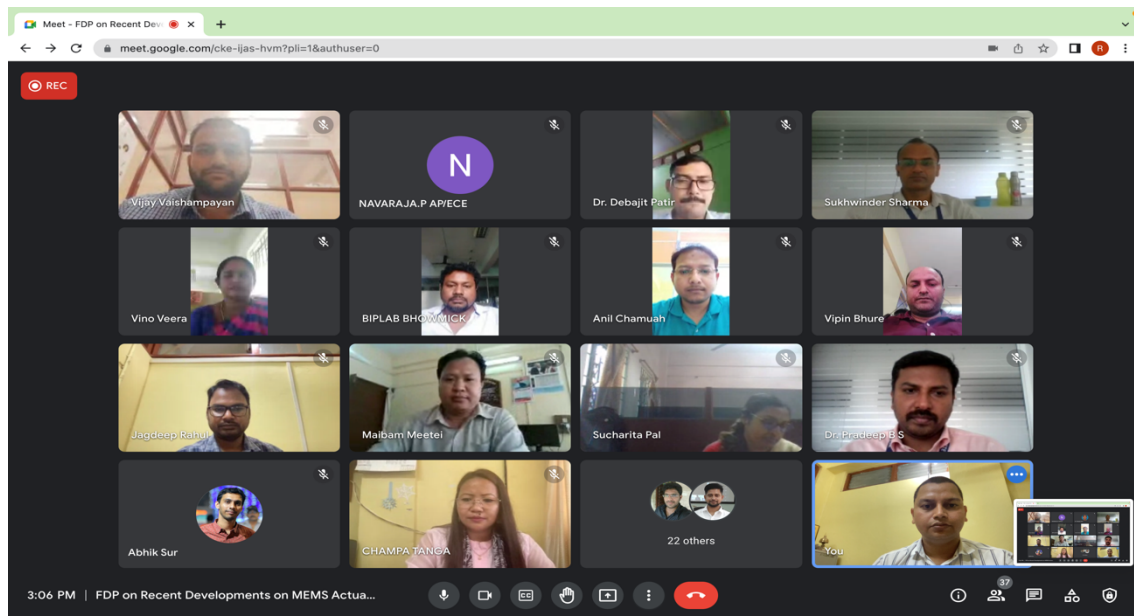


**“One Week Online Faculty Development Program on Recent Developments
on MEMS Actuators & Sensors”**



Sponsored By:

Rajiv Gandhi University, Doimukh



Submitted By:

Dr. Kurmendra,

Convenor of the Program,

Assistant Professor,

Department of Electronics & Communication Engineering

Rajiv Gandhi University (A Central University),

Rono Hills, Doimukh- 791112

Arunachal Pradesh, INDIA

May, 2022

Acknowledgements

Organizing Committee

Part: 1 Preface

1.1 Background

1.2 Objective

1.3 Brief About the Convener and Co-convener

1.4 Resource Persons

1.5 About the Sponsoring Agency

Part: 2 Session Wise Photo

2.1 Inaugural Session

2.2 Technical Sessions

2.3 Valedictory Session

Part: 3 Outcome of the Programme

Part: 4 Annexures

Annexure-I List of Participants

Annexure-II Programme Schedule

Annexure-III Media Coverage



Acknowledgments

First of all, I am indebted to the GOD Almighty for giving me an opportunity to excel in my efforts to complete this Faculty Development Program successfully.

I am extremely grateful to Prof. Saket Kushwaha, Hon'ble Vice-Chancellor, Rajiv Gandhi University for always encouraging and supporting to conduct these kinds of programs.

I feel honored and privileged to offer my gratitude to Prof. A. Mitra, Pro Vice-Chancellor, Rajiv Gandhi University for gracing the inaugural session.

My heartfelt gratitude to Prof. Sahin Ahmed, Dean, Faculty of Engineering and Technology, Rajiv Gandhi University, for his support in conducting this FDP.

I am also thankful to HoD i/c, ECE Department for his welcome address in the program.

I express and acknowledge the support received from Dr. Jagdeep Rahul, Co-convenor, Dept. of ECE, Rajiv Gandhi University and Coordinator, Ms. Champa Tanga, Assistant Professor, Dept. of ECE while whole duration of the FDP.

I express my heartfelt acknowledgment to all the resource persons who have agreed and delivered their lectures.

I would like to acknowledge the Support of M. Tech. Students of ECE who have helped throughout this FDP.

I will be failing in duty if I do not acknowledge the support of Faculty members, Research Scholars, Students and staffs during seminar.

Thanking You

Dr. Kurmendra

Organizing Committee

Sr. No.	Dignitaries	Role
1	Prof. Saket Kushwaha, Hon'ble Vice Chancellor, Rajiv Gandhi University, Doimukh	Chief Patron
2	Prof. A. Mitra, Pro- Vice Chancellor, Rajiv Gandhi University, Doimukh	Patron
3	Dr. N. T. Rikam, Registrar, Rajiv Gandhi University, Doimukh	Patron
4	Prof. Otem Padung, Finance Officier, Rajiv Gandhi University, Doimukh	Patron
5	Prof. Sahin Ahmed, Dean, Faculty of Engineering and Technology, Rajiv Gandhi University, Doimukh.	Patron
6	Dr. Kurmendra, Assistant Professor, Department of Electronics & Communication Enigneering, Rajiv Gandhi University, Doimukh.	Convenor
7	Dr. Jagdeep Rahul, Assistant Professor, Department of Electronics & Communication Enigneering, Rajiv Gandhi University, Doimukh.	Co-Convenor
8	Dr. Maibam Sanju Meetei, Assistant Professor & HoD i/c, Department of Electronics & Communication Enigneering, Rajiv Gandhi University, Doimukh.	Coordinator
9	Ms. Champa Tanga, Assistant Professor, Department of Electronics & Communication Enigneering, Rajiv Gandhi University, Doimukh.	Coordinator

1.1 Background

The NEP- 2020 focuses on interdisciplinary studies and research by involving multidisciplinary domains of engineering, science, and its application to social science.

Micro electro mechanical systems (MEMS) is an interdisciplinary domain as it involves concepts of various domains such as electronics, mechanical engineering, electrical engineering, mechatronics, and material science. The MEMS systems are built up and fabricated by integration of Sensors and Actuators that are capable of sensing and processing micron sized movements of mechanical elements. Nowadays, the integration of MEMS technology and complementary metal oxide semiconductor (CMOS) technology is widely being exploited for the design and development of advanced Microsensors and Systems. These advanced sensors and systems are finding widespread applications in automotive industries, consumer electronics, biosensing and biomedical, aerospace engineering, and defence systems.

The purpose of this FDP course is to give a broad introduction to the development trends and perspectives of the future sensors and MEMS/NEMS. It will provide participants with necessary fundamental knowledge and experience in the design and fabrication of MEMS and Microsensors. The topics include basic sensing and actuating principles, materials, fabrication technologies and electronics for MEMS and Microsensors. The course will also cover current literature, MEMS markets and applications. The course will be a combination of theory lectures, case studies and hands-on-training sessions using MEMS simulation software.

1.2 Objective

The Key objectives of this FDP are:

To provide a platform for participants to discuss on MEMS Actuators and Sensors with basics and Advance prospective

To explore the opportunities and Challenges in the area of MEMS Actuators and Sensors to offer insights into exciting advancements in technology.

The real-world implementation of Actuators & Sensors and to explore how they have changed our lives.

1.3 Brief About Convener and Co-convener



Convener

Dr. Kurmendra is working as Assistant Professor in the Department of Electronics and Communication Engineering of Rajiv Gandhi University (A Central University), Doimukh, Itanagar. He has received his Bachelor of Technology degree in ECE from Uttar Pradesh Technical University, Lucknow, Uttar Pradesh in year 2012 and Master of Technology degree in Microelectronics & VLSI Design from NIT, Silchar, Assam in year 2015. He has received Ph.D. Degree from NERIST, Nirjuli, Arunachal Pradesh.

He has served as Guest Faculty in the department of Electronics & Communication, MNNIT, Allahabad, India from July, 2015 to February, 2016. He has also served as JRF in Electronics Engineering Department, IIT(ISM) Dhanbad. He was conferred to "Outstanding Presenter Award" for his paper presentation in the international conference on Emerging Electrical energy, Electronics and Computing technologies 2019 (ICE4CT-2019). He has published more than 27 research articles in reputed journals and conferences. He has



Co-Convener

Dr. Jagdeep Rahul is working as Assistant Professor in the Department of Computer Science and Engineering of Rajiv Gandhi University (A Central University), Doimukh, Itanagar. He has received his Bachelor of Engineering degree in ECE from Bundelkhand University, Jhansi, U.P. in the year 2009. He completed his Master of Technology degree in VLSI Design from ABV-IIITM, Gwalior, M.P. in 2012. He completed his Ph.D. from Department of Computer Science and Engineering, Rajiv Gandhi University, Doimukh, Arunachal Pradesh.

1.4 Resource Persons

Prof. Roy Paily, Professor, Dept. of EEE, IIT Guwahati



Prof. Roy Paily received the B.Tech. degree in electronics and communication engineering from the College of Engineering, Trivandrum, India, in 1990, and the M.Tech. and Ph.D. degrees from the Indian Institute of Technology, Kanpur, India, and Indian Institute of Technology Madras, Chennai, India, in 1996 and 2004, respectively. He is a Professor (HAG) with the Department of Electronics and Electrical Engineering, Indian Institute of Technology Guwahati, India. Previously, he has held various positions such as Project Officer for DRDO and ISRO Projects at Dept. of Electrical Engineering, Indian Institute of Technology Madras from 07-04-1999 to 31-03-2004. Senior Design Engineer in Magnetic Head Division of Hard Disk Drive Unit at JTS Technology from 13-03-1996 to 15-03-1999. He was Head of Centre for Nanotechnology, IIT Guwahati from 14-06-2013 till 06-06-2018 and Currently, he is Heading the Department of Electronics and Electrical Engineering, IIT Guwahati. He is recipient of various national and international awards and have filed many patents. He is the member of various professional societies such as IEEE (Institute of Electrical and Electronics Engineers), IETE (The Institution of Electronics and Telecommunication Engineers), VSI (VLSI Society of India) and ISSS (Institute of Smart Structures and Systems). His research interests include VLSI devices/circuits and MEMS.

Dr. Kulwant Singh, Associate Professor, ECE, MANIPAL UNIVERSITY, JAIPUR



Dr. Kulwant Singh is working as an Associate Professor in the Department of Electronics and Communication Engineering (ECE) and Deputy Director, Entrepreneurship Cell (E-cell), Manipal University, Jaipur, Rajasthan, India. He also administrates departmental PhD activities and their coordination. Dr. Singh completed his M. Tech. degrees in Electronics Design and Technology from School of Engineering, Tezpur University, Tezpur in 2008,

followed by Ph.D in the field of MEMS Design and fabrication from NIT Calicut in January, 2015. He has more than 11 years of academic experience and 5 years R&D experience in semiconductor clean room environment for leading edge MEMS/VLSI technology from different reputed institutes. He acquired expertise in Micro & Nano electronics, device design and fabrication of MEMS/NEMS sensors. With the joint resources of NIT Calicut, IIT Bombay, CSIR-CEERI Pilani and MUJ, he has successfully demonstrated Prototype piezoresistive and piezoelectric pressure sensors based on inhouse developed technology in India. His research interest is interdisciplinary to find out innovative and cost-effective solutions of existing issues in the field of BioMEMS, Energy and self-powered functional system. As per his vision, his dream “FlexMEMS research center” is taking shape at MUJ. He is a regular reviewer of various journals from publication house IEEE, IOP, Springer, Elsevier and etc. He has published more than 60 research articles, edited one book published by AIP, USA and one conference proceeding published by IOP, UK. Additionally, He has delivered numerous expert lectures at different platforms. Other than his academic and research activity. In present, He is supervising more than 8 scholars in the area of BioMEMS, Energy storage device, and smart microsystem technology.

Prof. Sanket Goyal, Professor, BITS Pilani (Hyderabad Campus)



Sanket Goel (Senior Member, IEEE) received the B.Sc. degree in H-physics from Ramjas College, Delhi University in 1998, the M.Sc. degree in physics from IIT Delhi in 2000, and the Ph.D. degree in electrical & computer engineering from the University of Alberta, Edmonton, Canada in 2006, under the NSERC Fellowship. Dr Goel worked with Institute for Plasma Research (2000-2001) and Defence Bio-Engineering & Electro Medical Lab (DEBEL-DRDO) (2006). He did his postdoctoral work at Stanford University (2006-2008) under NIH fellowship, and led a public funded project at ASTAR, Singapore (2008-2011). Subsequently, he headed the R&D Department and worked as an Associate Professor with the University of Petroleum and Energy Studies (UPES), Dehradun, India (2011-2015). Since 2015, he is with the Electrical and Electronics Engineering Department, Birla Institute of Technology and Science (BITS) Pilani, Hyderabad Campus, Hyderabad, India, where he is currently a Full Professor. He has authored more than 200 publications, holds 14 patents (including one U.S.) to his credits and delivered more than 80 invited talks. He guided 4 postdoctoral fellows and 7 PhD scholars, while currently 20 PhD scholars are working for their PhD. His current research interests are developing intelligent sensors and

smart energy harvesting devices for various biomedical and energy applications. Dr Goel won several awards during the course of his career, including Dr C R Mitra Best Faculty Award in 2021, Fulbright-Nehru Fellowship in 2015, the Young Scientist Award in 2013, the Best Students Paper Award in 2005, and the Ph.D. Thesis Award in 2005. He is currently an Associate Editor of IEEE Transactions on NanoBioscience, IEEE Sensors Journal, IEEE Access and Applied Nanoscience, and holds visiting appointment with UiT, The Arctic University of Norway.

Dr. Pushparaj Singh, Associate Professor, IIT Delhi



Dr. Pushpapraj Singh is an Associate Professor in the Centre for Applied Research in Electronics (CARE) at Indian Institute of Technology (IIT) Delhi, India. He received the M. Tech. degree in Solid State Technology from the Indian Institute of Technology Madras, India, in 2007, and the Ph.D. degree in Microelectromechanical Systems (MEMS) from Nanyang Technological University Singapore, in 2012. After graduation, Dr. Singh has continued his research work as a Research Scientist in A*STAR Institute of Microelectronics (IME), Singapore while working on several MEMS related projects (Nanowire channel transistors, MEMS based switches and non-volatile memories, piezoresistive and acoustic wave pressure/force sensors, inertial sensors, miniaturized medical devices). He has authored more than 80 journals and refereed conference papers and has 3 issued and pending patents. Dr. Singh is reviewer for several international journals and was invited by many national and international conferences as a keynote lecturer and invited speaker. His current research interests include all kinds of MEMS/NEMS, Microsystems, Biochip and Nanofabrication Technologies, Nanoelectronics, Interconnects, and Flexible Electronics.

Dr. Koushik Guha, Assistant Professor (Grade-1), NIT Silchar



Dr. Koushik Guha is awarded Distinguished Faculty Award 2021 by NIT Silchar for his outstanding performance in teaching and research. Recently he has been awarded Institute of Smart Structures and Systems Young Scientist (ISSS, IISc Bangalore) 2021. He is an optimistic researcher and Assistant Professor (Grade-I) in the Department of Electronics and Communication Engineering, National Institute of Technology Silchar (An Institution of National Importance under Govt. of India). He has sound knowledge in MEMS/NEMS, VLSI system design, Analog circuit

design and VLSI. He is a great leader and team worker, leading successfully his department from long 11 years. He is now an Associate Dean of Students Welfare in NIT Silchar. He has been running National MEMS Design Centre in NIT Silchar with an uplifted passion. MEMS lab is helping illuminating in the department by support so many research scholars to pursue their work. His profound interest towards MEMS designing has made him as the one of the leading researchers not only in NIT Silchar but in the country with research articles in highly reputed Journals. He has published more than 100 papers in journals like IEEE, Springer, Elsevier etc. and conferences of international repute. He has authored around 15 book chapters and one book on “Noise in RF MEMS Switch: Modeling and Simulation”. Dr. Guha is a senior member of IEEE and is a member of many professional bodies like IET, SECI, FOSET, IIAM etc. Recently He has been nominated Fellow of Institution of Electronics and Telecommunication Engineers (IETE) and Institute of Scholars (InSc) Govt. of India. He has been an active and regular reviewer of (SCI/SCIE journals) and various IEEE hosted/sponsored conferences. Teaching is heart of Dr. Guha, he deals classes with exceptional sincerity and motivation. He believes in “students are builders of next world class technology”. He has received number of awards like “Sardar Vallabhbhai Patel National Reformer Award 2018”, “Outstanding faculty in engineering under VIFA 2018”, “Institute of Scholar Research Excellence Award 2020”, “Institute of Scholar Young Achievers Award 2020” to name a few. Dr. Guha has been involved in a no of R&D projects from various Govt. organizations like Special Manpower Development project from Meity, Govt. of India, Horizon 2020 funded International project with Tyndall National Institute of Ireland and has been associated with it since long time. Dr Guha is awarded two international patents on MODELING AND SIMULATION OF HETEROJUNCTION SOLAR CELL WITH PHOTONIC CRYSTAL ON PHOTOACTIVE MATERIAL and A SILICON ON INSULATOR BASED OPTICAL GAS SENSING DEVICE AND ITS FABRICATION PROCESS THEREOF. “Dr. Guha delivered many lectures in conferences, seminars, FDPs and training programs. He has produced 3 PhDs and currently supervising 8 no. PhD scholars in the field of MEMS and VLSI. His current research interests include mimicking human body functions using MEMS technology, RF MEMS, BIO-MEMS, MEMS energy harvesting, design and development of smart sensors for IoT, VLSI circuit design and optimization and many more.

Dr. Reshmi Maity, Associate Professor, Mizoram University, Aizwal



Reshmi Maity received the B.Tech. and M.Tech. degrees in radio physics and electronics from the University of Calcutta, Kolkata, India, in 2004 and 2006, respectively, and the Ph.D. degree in electronics and communication engineering from the National Institute of Technology, Silchar, India, in 2016. From 2004 to 2008, she was an Assistant Professor with the JIS College of Engineering (now JIS University), Kolkata. From 2008 to 2018, she was an Assistant Professor with the Department of Electronics and Communication Engineering, Mizoram University (A Central University), Aizawl, India. Since 2018, she has been an Associate Professor with the Department of Electronics and Communication Engineering, Mizoram University (A Central University). She is the author or

coauthor of more than 100 archival refereed publications. Her research interests include VLSI design, nanoelectronics, and MEMS.

Dr. Pradeep Kumar Rathore, Assistant Professor, NIT, Meghalaya



Dr. Pradeep Kumar Rathore is currently working as an Assistant Professor in the Department of Electronics and Communication Engineering at National Institute of Technology Meghalaya. He received his bachelor's degree in Electronics and Communication Engineering from North Eastern Regional Institute of Science and Technology (NERIST) in 2007 and Master's degree in Electronics Design and Technology from Tezpur University in 2009. Dr. Rathore obtained his PhD degree in CMOS-MEMS integrated pressure sensors from the Centre for Applied Research in Electronics (CARE), Indian Institute of Technology (IIT) Delhi in 2015. Dr. Rathore has been actively working in the field of MEMS based pressure sensors since 2008. He carried out his M.Tech. Dissertation work entitled "Fabrication of a membrane type double cavity vacuum-sealed micro sensor for absolute pressure based on front-side lateral etching technology" under the supervision of Dr. Jamil Akhtar, Chief Scientist at CEERI Pilani from 2008 to 2009. He continued to pursue his research in the field CMOS-MEMS Integrated Sensors and designed novel Current Mirror Integrated Pressure Sensors in his PhD Thesis under the supervision of Prof. B.S. Panwar at CARE, IIT Delhi. After joining at NIT Meghalaya, Dr. Rathore has continued to work in the same field and one of his Ph.D. students (Dr. Shashi Kumar) has successfully fabricated and tested both n- and p-channel MOSFET based current mirror integrated pressure sensors. Dr. Rathore have been granted a sponsored research projects on design and development of various CMOS-MEMS integrated pressure sensing structures from Indian Space Research Organisation (ISRO) under Sponsored Research (RESPOND) Scheme and Department of Science & Technology (DST) under Device Development Program. He has also completed one research project under INUP Program at IISc Bangalore. He has guided one Ph.D. student and six M.Tech. Students for their thesis works. Dr. Rathore has published more than 25 papers in SCI Journals and International Conferences till date and few are still under review. Apart from teaching and research, Dr. Rathore has also performed various responsibilities at NIT Meghalaya which includes Professor-In-charge of Centre for Technology Enabled Learning, Vice-President (Sports) - Student Activity Centre, Warden - NIT Boys Hostel, Coordinator of CCMT 2016 & 2017 for M.Tech. Admissions etc.

**Dr. Mithlesh Kumar,
Advanced Electrical Design Engineer,
Honeywell Technological Solutions Ltd. Bangalore.**



Dr. Mithlesh is currently working as Advanced Electrical Design Engineer at Honeywell Technological Solutions Ltd. Bangalore. His team works on the design and development of sensors for pressure and flow measurements. He has his B.Tech in Electronics and Communication Engineering from VTU Belgaum. Thereafter, he worked as Systems Engineer at Tata Consultancy Services Ltd. for 2 years. Later, he joined NIT Silchar to pursue masters in Microelectronics and VLSI Design. Here, he got an opportunity to work with Dr. Koushik Guha on RF MEMS switches, and developed interest in the field of MEMS. Thereafter, he joined PhD program at IIT Kharagpur and worked on "Capacitive Microdevices and Energy Harvesters" under the guidance of Prof. Siddhartha Sen. He has also worked as Research Associate at IIT Hyderabad with Prof. Ashok Kumar Pandey on a DRDO sponsored project "Design and analysis of high accuracy MEMS accelerometers and gyroscope for closed-loop sensing". He is associated with the Institute of Electrical and Electronics Engineers (IEEE) since 2013, and has co-authored 5 Journals and 3 International Conferences.

Dr. Santanu Maity, Assistant Professor, IEST, SHIBPUR



Dr. Santanu Maity has completed the Graduation in Electronics Engineering and the Master degree in radiophysics and electronics from Institute of Radio Physics and Electronics, Calcutta University, Kolkata, India, and the Ph.D. degree in Electronics and Computer engineering from the National Institute of Technology, Arunachal Pradesh, Yupia, India, in 2016. From 2009 to 2013, he was associated with different research laboratory such as IC Design and Fabrication Centre (Jadavpur University), Centre of Excellence for Green Energy and Sensor Systems (Indian Institute of Engineering Science and Technology), Centre of Excellence in Nanoelectronics (Indian Institute of Technology Bombay). From 2013 to 2017, he was an Assistant Professor with the Electronics and Computer Engineering Department, National Institute of Technology, Arunachal Pradesh. And also from 2017-

2019 he was an Assistant Professor with the Electronics and Communication Engineering Department, Tezpur Central University, Assam. Since 2019, he has been an Assistant Professor in the School of Advanced Materials Green energy and Sensor Systems, Indian Institute of Engineering Science & Technology, Shibpur. He is the author of more than 50 SCI articles and 9 book chapters. His research interests include solar cell, RF-MEMS, antenna, high-speed semiconductor devices, Fin-FET, semiconductor gas sensor.

Dr. Aditi, Senior Scientist, Microsystem Packaging Lab, CSIR- CEERI, Pilani.



Dr. Aditi is working as Senior Scientist at CSIR-CEERI, Pilani. She received the Ph.D. degree under the faculty of Engineering Sciences on “Design and Fabrication of MEMS Magnetometer” from Academy of Scientific and Innovative Research (AcSIR) in 2019. She started her research career on MEMS and micro-sensors, where she worked on the design and development of Inertial sensors, Ultrasonic transducers, Microcantilevers, Micromirrors etc. Fabrication techniques involved wafer bonding, UV-LIGA, dry and wet micromachining. She is Her main research interest and expertise is in the area of Microsensors development. Presently she is also working in the development of IR Emitter, Acoustic Sensor, Gyroscope, Piezo-accelerometer and LTCC based antennas. Dr. Aditi has published and presented over 20 research articles in reputed peer-reviewed journals and conferences.

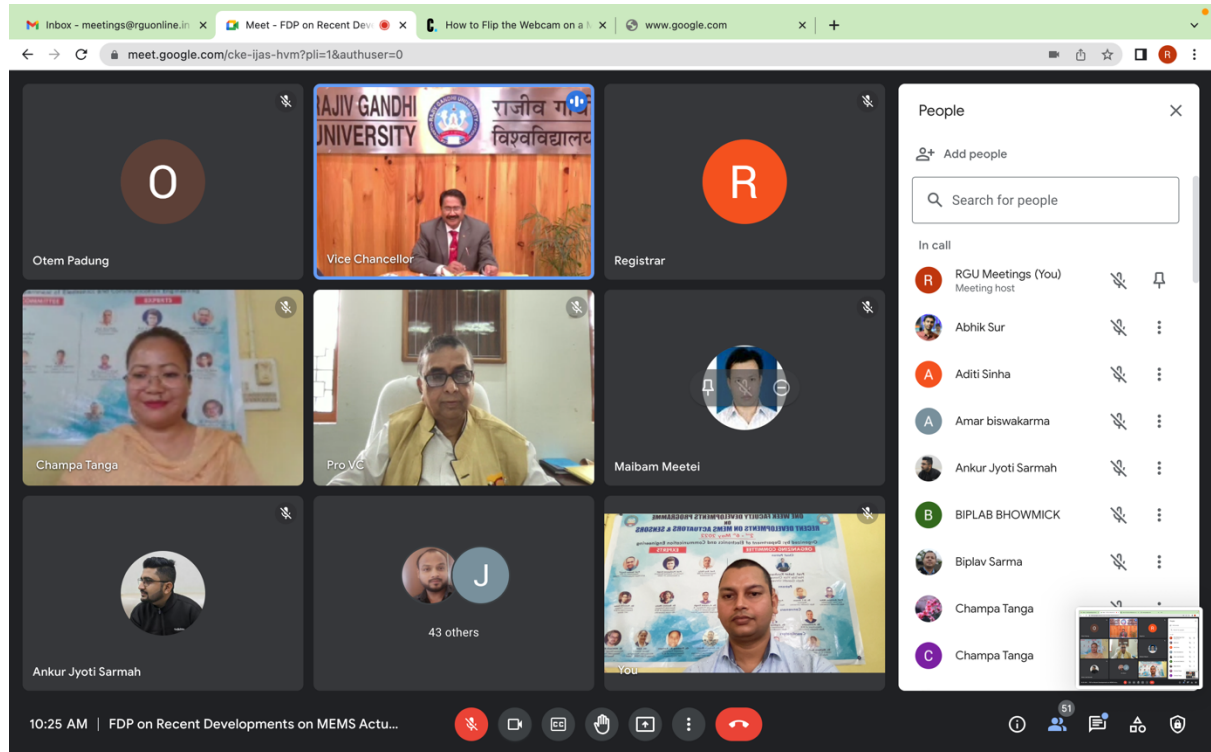
1.5 About the Sponsoring Agency

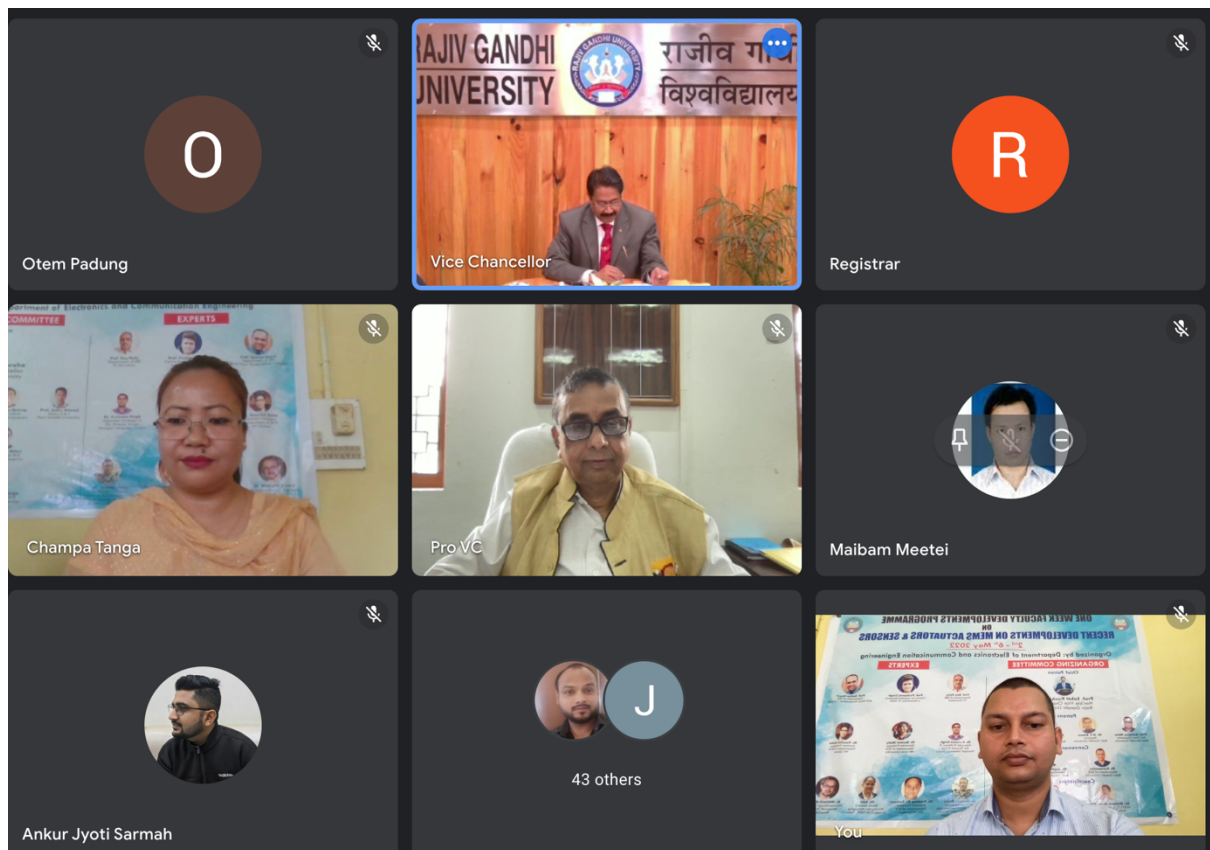
Rajiv Gandhi University (Formerly Arunachal University) is the Premier institution for Higher education in the state of Arunachal Pradesh. The University got academic recognition under section 2(f) from the University Grant Commission on 28th March 1985 and started functioning from 1st April 1985. It got financial recognition under section 12-B of the UGC on 25th March, 1994. Since then Rajiv Gandhi University has carved a niche for itself in the educational scenario of the country following its selection as a university with potential for excellence by a high level expert committee of University Grant Commission among universities in India. The university was converted into a central university with effect from 9th April 2007 as per the notification of Ministry of Human Resource Development (MHRD), Government of India. The University is located at the top of Rono hills on a picturesque tableland of 302 acres overlooking the river Dikrong. It is 6.5 Kms away from the national highway 52-A and 25 kms way from Itanagar, the state capital.



Part: 2 Session Wise Photo

2.1 Inaugural Session





2.2 Technical Session Photo

Meet - FDP on Recent Dev... x +

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REC Roy Pally is presenting

Sensors and Actuators

Sensors											
Movement			Environment			Optical sensors					
Accelerometers	Gyroscopes	Magnetometers	Pressure	Sound and ultrasonic	Gas	Humidity	Particles	Temperature	FTIR	Fingerprint	Hyperspectral
											ALS, RGB
											Microbolometers
											Vision
											3D sensing

Actuators											
Optical MEMS			Microfluidics			RF			Microstructures		
Micromirrors	Autofocus	Optical benches	Inkjet heads	Drug delivery	Biochips	Switch	Filter	Resonator	Microtips	Probes	Watch components
											µSpeakers
											Ultrasonic fingerprint

11:39 AM | FDP on Recent Developments on MEMS Actu...

Participants: Roy Pally, chandra mouli, Ankur Jyoti Sarmah, NAVARAJA.P APIECE, Saurabh Agarwal, Dr. Satyanarayana Tala..., Dr. Pradeep B S, 43 others, You.

Meet - FDP on Recent Dev... x

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REC Sanket Goel is presenting

Global F & W Electronics Market

Flexible Electronics Market (B\$US)

■ Asia Pacific ■ North America ■ Europe ■ South America ■ Middle East & Africa

By 2027

- US\$ 42.48 Bn
- CAGR → 7.45%

Wearable Electronics Market (B\$US)

By 2024

- US\$ 64 Bn
- CAGR → 19%

https://www.maximizemarketresearch.com/market-report/flexible-electronics-market/2156/ | https://www.globaldata.com/wearable-technology-key-driver-growth-mobile-health-says-globaldata/

Miniaturized Self-Sustained, Intelligent Sensors and Smart Energy Harvesters | [View Report](#) | 7 | BITS Pilani, Hyderabad Campus

Sanket Goel kenn sharma S N Chamatagoudar Tage Kunya 23 others You

9:45 AM | FDP on Recent Developments on MEMS Actua...

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- Amar biswakarma
- Anil Chamuah
- Ankur Jyoti Sarmah
- anu kathuria
- Ashaq Malik
- BIPLAB BHOWMICK
- chandra mouli
- Dr. Pradeep B S

Meet - FDP on Recent Dev... x

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REC Sanket Goel is presenting

1.3 LIG Mini-Device for EC Sensing

3D Printed Case with Microchannel

Ag/AgCl Coated LIG 3-Electrodes on Polyamide

Dopamine Sensing

$y = 0.0149x + 0.3414$
 $R^2 = 0.963$

Current (nA)

Concentration (nM)

LoD → 0.476 nM

Linear Range → 1 μ M to 10 mM

Excellent Reproducibility & Repeatability

Excellent Selectivity with Uric Acid, L-cysteine, Xanthine and Ascorbic Acid

~100 % recovery in Blood Serum and Synthetic Urine

• Mrunal D Wagh, Renuka H, P Sai Kumar, K Amreen, S K Sahoo and Sanket Goel, Microfluidic Biosensor with Integrated Electrodes Configuring Mxene over Laser Induced Graphene for Selective Electroanalytical Detection of Dopamine and Other Biochemicals (under review).

• An Electrochemical Microfluidic Device And A Process For Preparing The Same, Sanket Goel, S K Sahoo and Mrunal Wagh, Indian Patent, filed, 202111059663, Dec-21

Miniaturized Self-Sustained, Intelligent Sensors and Smart Energy Harvesters | [View Report](#) | 25 | BITS Pilani, Hyderabad Campus

10:08 AM | FDP on Recent Developments on MEMS Actua...

Sanket Goel kenn sharma Tage Kunya Vijeth H Puneet Mittal Smt.G.Kavitha Assista... S N Chamatagoudar 33 others You

Meet - FDP on Recent Dev... x

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REC Dr. Kulwant Singh is presenting

Continuation of Moore's Law

From Intel

Process Name	P856	P858	Px60	P1262	P1264	P1266	P1268	P1270
1st Production	1997	1999	2001	2003	2005	2007	2009	2011
Process Generation	0.25 μ m	0.18 μ m	0.13 μ m	90 nm	65 nm	45 nm	32 nm	22 nm
Wafer Size (mm)	200	200	200/300	300	300	300	300	300
Inter-connect	Al	Al	Al	Cu	Cu	Cu	Cu	?
Channel	Si	Si	Si	Strained Si	Strained Si	Strained Si	Strained Si	Strained Si
Gate dielectric	SiO ₂	SiO ₂	SiO ₂	SiO ₂	SiO ₂	High-k	High-k	High-k
Gate electrode	Poly-silicon	Poly-silicon	Poly-silicon	Poly-silicon	Poly-silicon	Metal	Metal	Metal

Introduction targeted at this time Subject to change

Intel found a solution for High-k and metal gate

2:34 PM | FDP on Recent Developments on MEMS Actua...

Likha Tadh Dr. Kulwant Singh Ankur Jyoti Sarmah Champa Tanga NAVARAJA.P APECE Vino Veera Taru Verma 22 others You

Meet - FDP on Recent Dev... x

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Prof. Pushparaj Singh is presenting

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To avoid an infinity mirror, don't share your entire screen or browser window. Share just a tab or a different window instead.

1:04 PM | cke-ijas-hvm

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Type here to search

37°C Sunny 13:04 03-05-2022

Prof. Pushparaj Singh Mir Saleem sanjai prasad Jagdeep Rahul 15 others You

People

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Search for people

In call

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- anu kathuria
- Dibyendu Chowdhury
- Dr. Pradeep B S
- Dr. Ravi Kumar
- Dr. Satyanarayana Talam
- Dr.T.THANGADURAI
- Jagdeep Rahul Meeting host

Chrome File Edit View History Bookmarks Profiles Tab Window Help

Meet - FDP on Recent Dev... x Home | KENDRIYA VIDYALAYA x Dr. Reshmi Maity.pdf - Google x PZflex - Google Search x

meet.google.com/cke-ijas-hvm?authuser=0

Pin yourself to your main screen

REC Reshmi Maity MZU is presenting

Squeeze Film Effect

Structure of Si_3N_4 CMUT

The 3-D plot of pressure profile Ψ with variation of membrane thickness and cavity height at the centre for bias of 40V

Vent of radius of $5\mu\text{m}$ at the centre

Vent of radius of $5\mu\text{m}$ at the edge

Recent Developments on MEMS Sensors & Actuators, 2nd-6th May 2022

2:47 PM | FDP on Recent Developments on MEMS Actua...

Participants: Reshmi Maity MZU, Raj Kumari, chandra mouli, Abhik Sur, Jagdeep Rahul, Champa Tanga, 17 others, You.

Meet - FDP on Recent Dev... x

meet.google.com/cke-ijas-hvm?pli=1&authuser=0

REC Dr. KOUSHIK GUHA is presenting

Introduction to MEMS Sensors and Actuators

When an airbag opens precisely and quickly, a skidding car recovers stability and traction, or a tilted smartphone screen rotates, it is a microelectromechanical system, or MEMS sensor, pulling the strings.

In a manner of speaking, they are the sensory organs of the technical world.

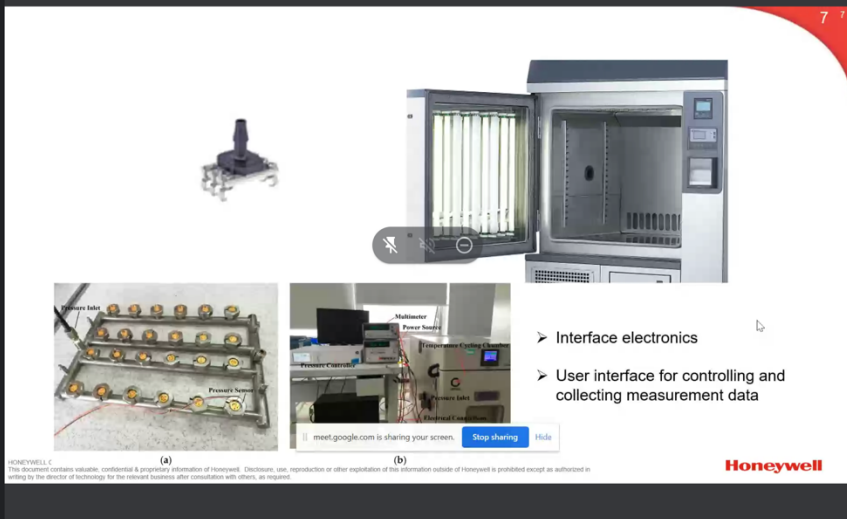
10:26 AM | FDP on Recent Developments on MEMS Actua...

Participants: Dr. KOUSHIK GUHA, Ashaq Malik, srikanth N, Ms. Poonam Yadav, Jagdeep Rahul, Puneet Mittal, Jayabharathy K, 30 others, You.

Meet - FDP on Recent Dev... x PolicyBazaar Car Insurance: In... x universal sompo general insur... x Car Insurance: Buy/Renew Car... x +

meet.google.com/cke-ijas-hvm?authuser=0

REC Mithlesh Kumar is presenting



Interface electronics

User interface for controlling and collecting measurement data

Honeywell

1:17 PM | FDP on Recent Developments on MEMS Actu...

Participants: Mithlesh Kumar, Jagdeep Rahul, Dr. Pradeep B S, Taru Verma, Arvind Kumar, Anil Chamuah, PRABAKAR D, 20 others, Dr. Avisankar Roy (outside Rajiv Gandhi University) joined.

Meet - FDP on Recent Dev... x +

meet.google.com/cke-ijas-hvm?pli=1&authuser=0


REC Pradeep Kumar is presenting

What is MEMS Technology?

Micro-Electro-Mechanical Systems (MEMS) is a technology that can be defined as miniaturized mechanical and electro-mechanical elements (i.e., devices and structures) that are made using the techniques of microfabrication.

The functional elements of MEMS are miniaturized structures, sensors, actuators and microelectronics

MEMS devices can vary from relatively simple structures having no moving elements, to extremely complex electro-mechanical systems with multiple moving elements under the control of integrated microelectronics.



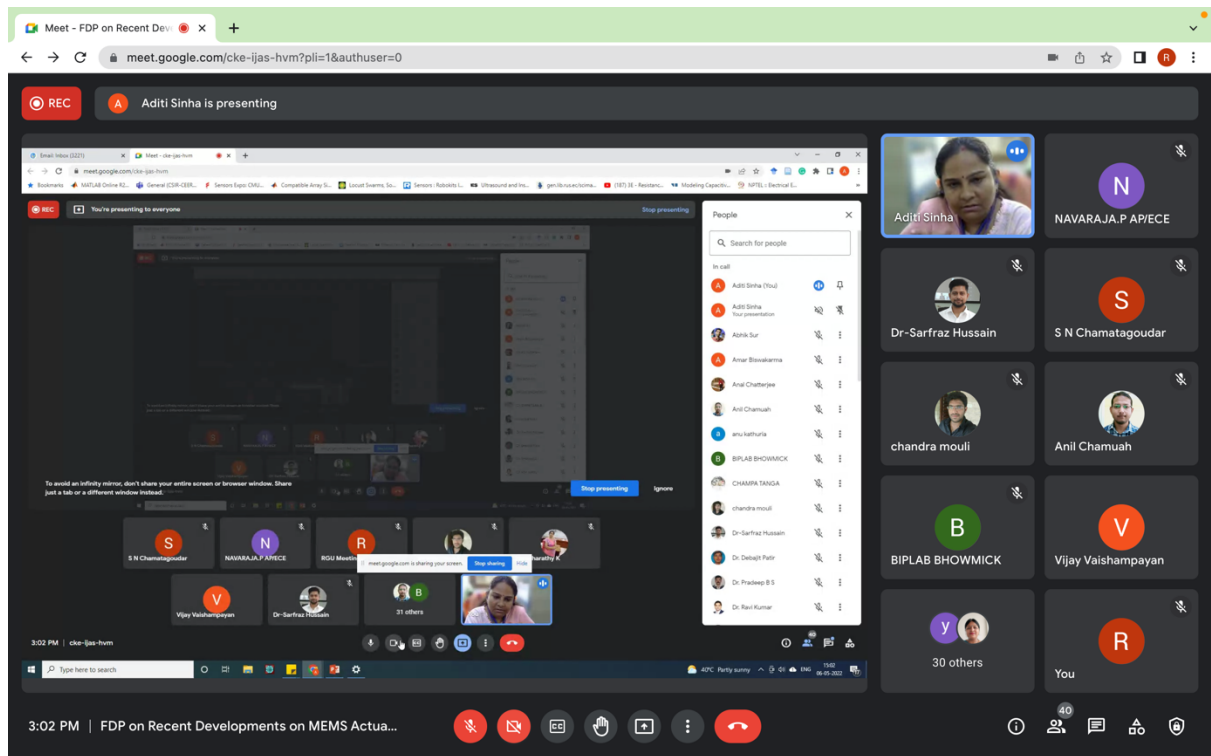
Components of MEMS

MicroSensors MicroActuators

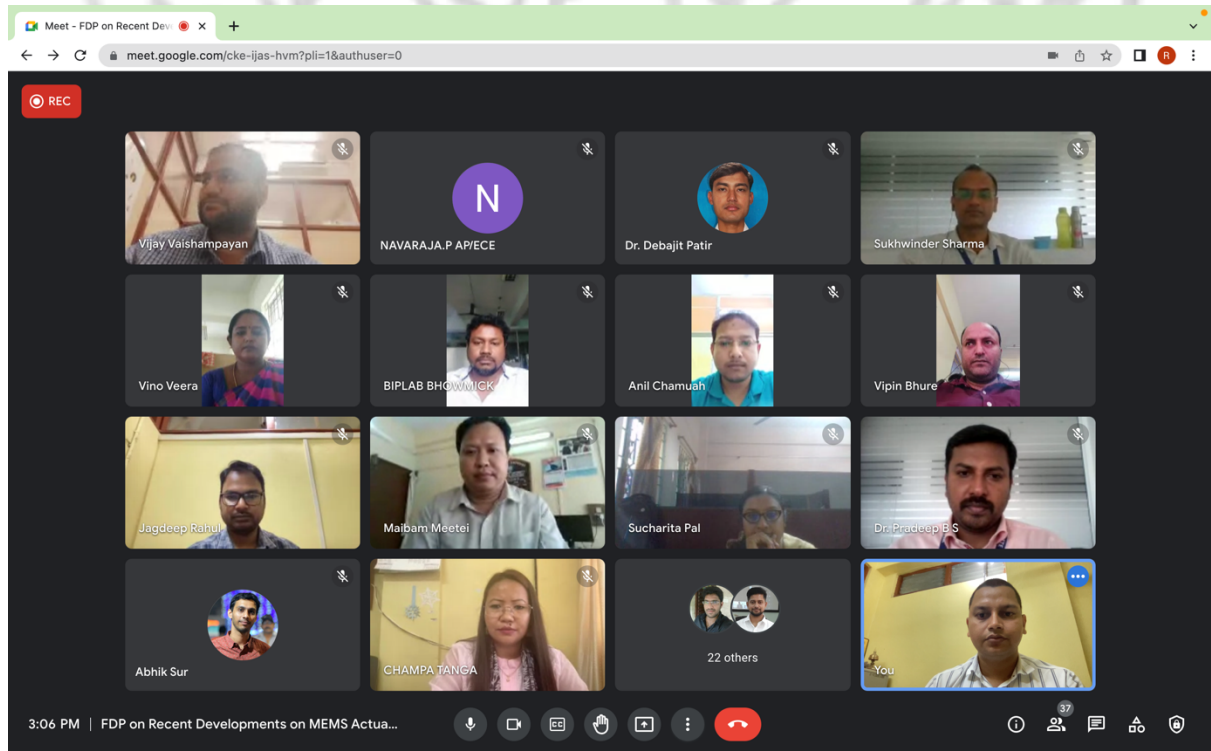
MicroElectronics MicroStructures

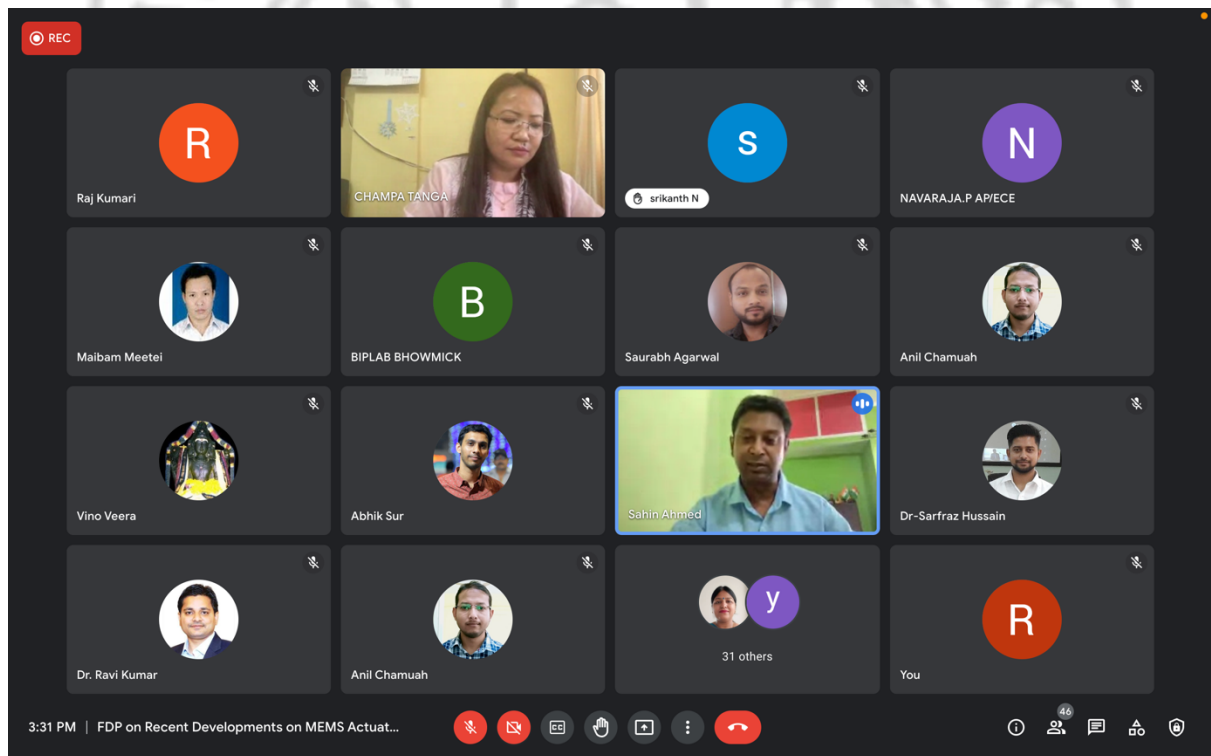
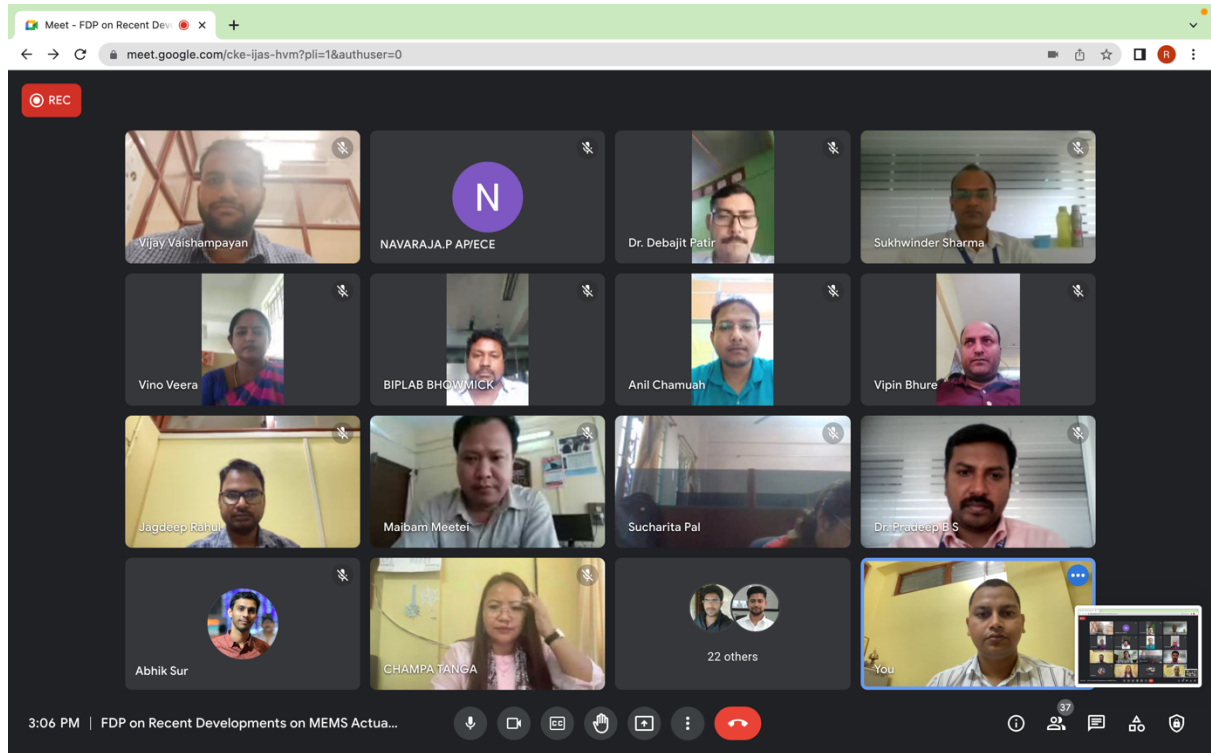
10:13 AM | FDP on Recent Developments on MEMS Actu...

Participants: Pradeep Kumar, Sucharita Pal, NAVARAJA.P APECE, Jayabharathy K, srikanth N, Dean-Examinations M..., Dr. Debajit Patir, 23 others, You.



2.3 Valedictory Session Photo





Part: 3 Outcome of the Program

After attending this seminar, faculties, Research scholars and Students have been equipped with a strong basics and innovative ideas in the domain of MEMS Actuators and Sensors which will help Faculties to carry out research in developing actuators and sensors. Research Scholars and Master degree students will be able to take projects in MEMS Actuators and Sensors.

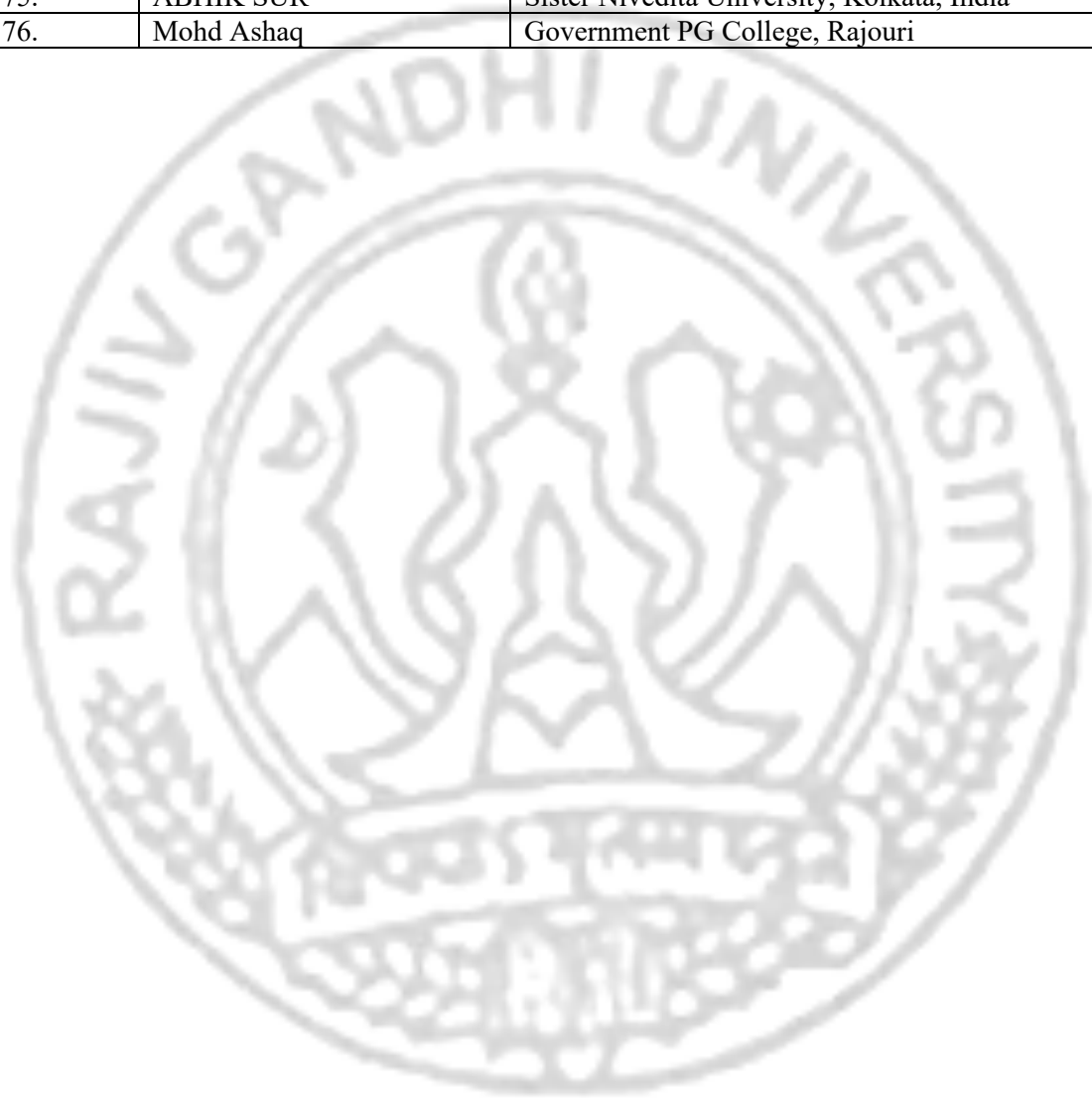


ANNEXURE-I**LIST OF PARTICIPANTS**

Sl. No.	Name	Affiliation
1.	Tasher Ali Sheikh	Residential Girls' Polytechnic, Golaghat, Assam
2.	RUSNI KIMA MANGANG	NERIST, Nirjuli, Arunachal Pradesh
3.	Imran Khan Mansuri	Govt. Higher Secondary School Jawar
4.	YAWAR ALAMGEER	Lalit Narayan Mithila University, Darbhanga, Bihar
5.	MARJOHN V. ANISLAG	Surigao State College of Technology - Mainit Campus, Magpayang, Mainit, Surigao del Norte
6.	Ancy A	Lourdes Matha College of Science and Technology, Thiruvananthapuram, Kerala
7.	Sachin Mahendru	Faculty of Allied Health Science, SGT University, Gurugram
8.	Anil Chamuah	University of North Bengal, Darjeeling, West Bengal
9.	Champa Tanga	DEPT OF ECE, RGU, DOIMUKH
10.	Imran Khan Mansuri	Gandhi Chok Jawar
11.	Kanav Gupta	ICFAI University, H. P.
12.	Mohd Saleem Mir	JKIMS A. S. College
13.	M.NANDHINI	REC KALVI NAGAR , THONDAMUTHUR, VIRALIYUR
14.	Satyanarayana Talam	Lakrieddy Bali Reddy College of Engineering (A), Mylavaram, Krishna
15.	Biplav Sarma	Indian Institute of Technology Guwahati
16.	Debajit Patir	Department of Physics, Silapathar Science College, Silapathar
17.	CHETHANA K Y	BMS College of Engineering
18.	G S AISWARIYA THANKACHI	UNIVERSITY COLLEGE OF ENGINEERING KARIAVATTOM Trivandrum
19.	Sarfraz Hussain	ECE Department, MITS, Madanapalle
20.	Yogeshkumar Jethabhai Patel	Sankalchand Patel University
21.	Vinay Kumar Nassa	Sharad Institute of Technology College of Engineering Ichalkaranji Kolhapur, Maharashtra
22.	Sathisha	Mangalore Institute of Technology & Engineering, Badaga Mijar, Moodbidri, Mangalore
23.	AISWARYA KANNAN	SRM TRP ENGINEERING COLLEGE, SAMAYAPURAM, IRUNGALUR
24.	V VINODHINI	UNIVERSITY COLLEGE OF ENGINEERING ARIYALUR
25.	Pinaki Satpathy	Haldia Institute Of Technology, Haldia, Midnapore
26.	Gagan Manocha	Government College Chhachhrauli
27.	Saurabh agarwal	COT, GBPUA&T University, Pantnagar
28.	S V KIRANMAYI SRIDHARA	ADITYA COLLEGE OF ENGINEERING & TECHNOLOGY, SURAMPALAM
29.	M.kaivalya	Aditya college of Engineering & Technology, ADB road, Surampalem
30.	Gajendra Singh	Faculty of Allied Health Science, SGT University, Gurugram
31.	Muktabai Babasaheb Shinde	Sanjivani Arts Commerce and Science College Kopergaon

32.	Kavita Goura	CSE Dept. , CBIT, Gandipet, Hyderabad
33.	Anal Chatterjee	Barrackpore Rastraguru Surendranath College, West Bengal
34.	T.THANGADURAI	THANTHAI HANS ROEVER COLLEGE, PERAMBALUR
35.	Dhruba Kr Mandal	Bharat Electronics Limited, Tezpur, Assam
36.	Anu Kathuria	TITS,Bhiwani
37.	VIPIN SHANKARRAO BHURE	G H Raison Institute of Engineering and Technology Nagpur
38.	Harshada Gavnath Naikwadi	Sanjivani Arts,Commerce & Science College Kopargaon
39.	P.Navaraja	Mahendra Institute of Technology, Namakkal
40.	KOUSIK MAITI	Indian Institute of Technology Roorkee, Roorkee
41.	suraya Mubeen	CMR Technical Campus, Hyderabad, Medchal
42.	Raj Kumari	NIT Hamirpur (H.P.) 177005 India
43.	Avjeet Singh	Galgotias University, Greater Noida, Uttar Pradesh
44.	poonam yadav	Galgotias University, Greater Noida, Uttar Pradesh
45.	Rajesh Kumar	Department of ECE, NERIST
46.	N.SRIKANTH	SASI INSTITUTE OF TECHNOLOGY & ENGINEERING , TADEPALLIGUDEM
47.	Sukhwinder Sharma	Mangalore Institute of Technology & Engineering, Moodabidri
48.	G. Senthilkumar	SCSVMV Deemed to be University, Enathur, Kanchipuram, Tamilnadu, India
49.	Puneet Mittal	Mangalore Institute of Technology & Engineering, Moodabidri
50.	Utpal Nandi	Vidyasagar University, Rangamati, Paschim Medinipur
51.	Nyari Taji	RGU, Doimukh
52.	Vijay Vaishampayan	IIT Ropar , Punjab
53.	K. Jayabharathy	CENTRAL POLYTECHNIC COLLEGE, Tharamani, Chennai
54.	Dibyendu Chowdhury	ICARE Complex, HIT Campus, P.O HIT, Hatiberia, Haldia, West Bengal
55.	Avisankar Roy	Haldia Institute of Technology, Haldia
56.	S.Priyadharshini	Prathyusha Engineering College, thiruvallur
57.	Prerna Verma	Vivek College of Education, Bijnor
58.	BIPLAB BHOWMICK	Asansol Engineering College, Vivekananda Sarani, Asansol, West Bengal
59.	SUCHARITA PAL	ASANSOL ENGINEERING COLLEGE, ASANSOL, WEST BENGAL, INDIA
60.	NABAM NAGA	RGU, Doimukh
61.	S. N. Chamatagoudar	WIT Solapur
62.	Pradeep B S	Mangalore Institute of Technology & Engineering, Moodabidri, Mangalore
63.	Tage Kunya	RGU DOIMUKH
64.	Likha Tadh	RGU DOIMUKH
65.	Vijeth	Department of Physics, Nagaland University, Lumami
66.	Ankur Jyoti Sarmah	Assam Engineering College, Assam
67.	Jagdeep Rahul	Department of Electronics and Communication Engineering, RGU
68.	DURGACHANDRAMOULI	Aditya college of engineering and

	YENUGU	technology,surampalem
69.	Dimpi Paul	Department of Physics, Patharkandi College, Patharkandi, Karimganj, Assam
70.	Arvind Kumar Prajapati	VIT-AP, University, Amaravati, Andhra Pradesh
71.	Amar Bahadur Biswakarma	Rajiv Gandhi University (RGU), Doimukh, Arunachal Pradesh
72.	Ravi Kumar	Chaudhary Bansi Lal University, Bhiwani
73.	Haresh Kumar Sharma	SGT University, Gurugram
74.	D. Prabakar	SRM Institute of Science and Technology, Tamil Nadu
75.	ABHIK SUR	Sister Nivedita University, Kolkata, India
76.	Mohd Ashaq	Government PG College, Rajouri



ANNEXURE-II Program Schedule

One Week Online Faculty Development Program

on

Recent Developments on MEMS Sensors & Actuators

2nd – 6th May, 2022

PROGRAM SCHEDULE

Link for Joining All the Sessions including Inaugural and Valedictory Sessions:

<https://meet.google.com/cke-ijas-hvm>

Inaugural Ceremony		
Time	Day and Date	
10:00 AM – 11:15 AM	Monday, 2 nd May 2022	<ul style="list-style-type: none">Welcome Address by HoD, ECE Department (10:00 AM – 10:05 AM)About the program by Convenor- FDP (10:05 AM – 10:10 AM)Address by Dean, Faculty of Engineering & Technology (10:10 AM – 10:20 AM)Address by Finance Officer, Rajiv Gandhi University (10:20 AM – 10:30 AM)Address by Registrar, Rajiv Gandhi University (10:30 AM – 10:40 AM)Address by Pro Vice Chancellor, Rajiv Gandhi University (10:40 AM – 10:50 AM)Address by Hon'ble Vice Chancellor, Rajiv Gandhi University (10:50 AM – 11:10 AM)Vote of Thanks by Co-convenor -FDP (11:10 AM – 11:15 AM)

Technical Sessions			
Day / Date	Technical Session-1	Break	Technical Session-2
Day-1 02/05/22 (Monday)	Prof. Roy Paily, Dept. of EEE, IIT Guwahati (11:30 AM to 01:30 PM)	Lunch Break	Dr. Kulwant Singh, Dept. of ECE Manipal Univeristy, Jaipur (02:30 PM to 04:30 PM)
Day-2 03/05/22 (Tuesday)	Prof. Sanket Goyal, Dept. of EEE, BITS Pilani (Hyderabad Campus) (09:30 AM to 11:30 PM)	Lunch Break	Prof. Pushparaj Singh, CARE, IIT Delhi (01:00 PM to 03:00 PM)
Day-3 04/05/22 (Wednesday)	Dr. Koushik Guha, Dept. of ECE, NIT Silchar (10:00 AM to 12:00 PM)	Lunch Break	Dr. Reshmi Maity, Dept. of ECE, Mizoram University (01:00 PM to 03:00 PM)

Day-4 05/05/22 (Thursday)	Dr. Pradeep Kr. Rathore, Dept. of ECE, NIT Meghalaya (10:00 AM to 12:00 PM)	Lunch Break	Dr. Mithlesh Kumar, Honeywell Pvt. Ltd., Bangalore (01:00 PM to 03:00 PM)
Day-5 06/05/22 (Friday)	Dr. Santanu Maity, IEST, Shibpur (10:00 AM to 12:00 PM)	Lunch Break	Dr. Aditi, Microsystem Packaging Lab, CSIR- CEERI, Pilani (01:00 PM to 03:00 PM)

Valedictory Ceremony		
Time	Day and Date	<ul style="list-style-type: none"> Welcome Address by Ms. Champa Tanga, ECE Department (03:00 PM – 03:05 PM) Concluding remarks on FDP by Convenor- FDP (03:05 PM – 03:10 PM) Feedback from Participants (03:10 PM – 03:25 PM) Word from Dean, Faculty of Engineering & Technology (03:25 PM – 03:35 PM) Vote of Thanks by Co-convenor -FDP (03:35 PM – 03:40 PM)



ANNEXURE-III

NEWSFLASH

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GENERAL

FDP on 'recent development on MEMS actuators and sensors' begins

RONO HILLS, May 2: A Faculty Development Program (FDP) on 'Recent Development on MEMS Actuators and Sensors' has started at the Department of Electronics & Communication Engineering, Rajiv Gandhi University today, which will continue till 6th May.

The inaugural session was hosted by Champa Tanga, Deptt of ECE, RGU.

The Convener of the program, Dr Kurmendra briefed about the FDP. RGU Vice Chancellor Prof Saket Kushwaha, in his address, emphasized on developing highly efficient sensors for agricultural application which could impact on society and makes farmer's life easy.

Prof Amitava Mitra, RGU Pro Vice Chancellor, said that the current program is highly appreciable because sensors are very much important components in developing future technologies.

The Registrar and finance officer of RGU, Dr N T Rikam and Prof Otem Padung also spoke about the importance of organizing such programs. Prof Sahin Ahmed, Dean, Engineering and Technology, also spoke.

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May

>

3

>

RGU conducts faculty development programme

RGU conducts faculty development programme

May 3, 2022

RONO HILLS, May 02: A week-long faculty development program on recent development on MEMS actuators and sensors, began at the electronics and communication engineering department of Rajiv Gandhi University (RGU) here, on Monday which will continue till May 6 next.

Vice Chancellor Prof Saket Kushwaha while addressing the inaugural session, emphasised on developing highly efficient sensors for agricultural application which could impact on society and makes farmer's life easy.

Pro VC Prof Amitava Mitra in his deliberations said that the current program is highly appreciable because sensors are very much important components in developing future technologies.

Varsity Registrar and Finance officer, Dr N T Rikam and Prof Otem Padung also spoke about the importance of organizing such programs. Prof Sahin Ahmed, Dean of Engineering and Technology, also spoke, a communiqué informed here.

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Orientation programme for students held

Guv, CM greet people on Eid >

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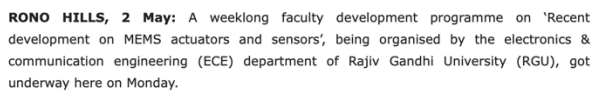
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May 3, 2022

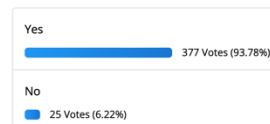


During the inaugural session, RGU Vice Chancellor Prof Saket Kushwaha emphasised on "developing highly efficient sensors for agricultural application, which could impact on society and make farmer's life easy," while Pro-VC Prof Amitava Mitra said that the programme "is highly appreciable because sensors are very much important components in developing future technologies."

RGU Registrar Dr NT Rikam, ECE HoD Dr Maibam Sanju, Prof Otem Padung and Engineering & Technology Dean Prof Sachin Ahmed also spoke.



Govt should immediately regulate prices of essential commodities.

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Media Coverage Links

1	Arunachal Times	https://arunachaltimes.in/index.php/2022/05/03/faculty-development-prog-at-rgu/
2	Arunachal Observer	https://arunachalobserver.org/2022/05/03/rgu-conducts-faculty-development-programme/
3	Eco of Aruanchal Pradesh	http://echoofarunachal.in/news_details.php?nid=16601
4	The Arunachal Poineer	http://m.thearunachalpioneer.com/Arunachal-Pradesh/RGU-programme-on-electronics/11/9923/f/

