REPORT of STTP on

"Recent Advances in RF and Microwave Engineering"

Date and Venue

With the support of Commissionrate of Technical Education (CTE) and IETE, Ahmedabad the Electronics and Communication Engineering department, L.D College of Engineering, Ahmedabad had organized a one week short term training programme on **"Recent Advances in RF and Microwave Engineering"** during 21st -25th November 2016 at Bhaskaracharya hall, Block No. 9, EC Department, L.D. College of engineering, Ahmedabad.

Lab Session Venue-Language Lab (Room no-2010), Annexe building, L.D College of Engineering, Ahmedabad.

Learning Objectives

The programme was intended for the people interested in RF and microwave. Its objective was to present

- A basic study of fundamentals of RF and MW.
- An overview of recent advances in RF and MW.
- Design challenges at RF, MW and mm waves. Recent MW and mm wave circuit and IC technologies.
- The evolution of different mobile generations and 4G LTE technology.
- Different antenna parameters and latest measurement techniques.
- Latest techniques and applications in satellite communication and remote sensing.
- A method for the analysis and design of antenna through HFSS.
- Different navigational systems and IRNSS & GAGAN.

STTP Organizing Committee

- Patron- Dr. G.P Vadodaria (Principal, L.D College of Engineering)
- Convenor-Prof. Usha Neelakantan (HoD EC, L.D College of Engineering)
- Coordinators
    - Dr. M.V Shah (Professor, LDCE)
    - Dr. A.B. Nandurbarkar (Associate Professor LDCE)
- Co-coordinators
    - Prof. K.G Vaghela (Associate Professor LDCE)
    - Prof. P.J Bhrambhatt (Associate Professor LDCE)

STTP Team

The duty chart of STTP team is attached as Annexure-1.

Expert Speakers

The members of training team were invited from reputed organizations, research and academic institutes such as ISRO, PRL, Reliance Jio, entuple, DAIICT, NIRMA University,

and VGEC, Chandkheda. The speakers were Dr. K.R Parmar (Ex-Joint director CTE & HoD EC Sect-28, Gandhinagar), Mr Nilesh Desai (Deputy Director SNAA-SAC:ISRO), Dr. Dhaval Pujara (Professor Nirma University), Shri C.N Rao (Scientist-Engineer G-SAC:ISRO), Dr. Jayesh Pabari (Scientist-PRL), Dr. R.A. Thakkar (Professor & HoD EC-VGEC chandkheda), Dr. Sanjeev Gupta (Dean R&D-DAIICT), Dr. K.G Maradia (HoD EC-GEC Gandhinagar), Mr. Harshvadhan Jani (Reliance JIO Infocomm Ltd.), Dr. R.K Malaviya (Secretary ATMS), Shri A.K Sisodiya (Retired Scientist-ISRO) and Mr. Kush Parikh (Design Engineer RF-Entuple).

STTP Course contents

Day 1

- Registration & Inauguration
- Fundamentals of RF Design
- Advanced RF, Microwave and Digital Technologies for Space Payloads
- Hands on Session in HFSS

Day 2

- Visit to wonderland of RF and Microwave
- mm wave technology development for ISRO's sensors
- Hands on Session in HFSS

Day 3

- Recent Advances in Microwave Remote Sensing for Planetary Surface Study
- CMOS-PLL Design
- Hands on Session in HFSS

Day 4

- Challenges and Design Issues in RF and Microwave Engineering
- Massive MIMO
- 4G-LTE Mobile Wireless Technology
- Demonstration of NAVIC Receiver

Day 5

- Use of Microwave and Antenna Measurement Technologies
- Satellite Based Navigation Systems in India
- Quiz Session
- Feedback by participants
- Valedictory Function

Participants:

The STTP was attended by government polytechnic, government engineering colleges, self-financed institutes, and industry persons. There were total 45 participants from all over Gujarat. The list is attached as Annexure-2. The participants had a chance to present the

outcomes and recommendations from STTP through the oral feedback as well as written feedback. The written feedback is attached as Annexure-3.

The STTP

The STTP was opened at 8:30 with registration. The participants received there STTP kit from the registration desk. The session was opened by a small inauguration function where there were distinguished guests present at the dais. Dr. S.B Sharma (Director R&D Indus University) was the guest of honour, followed by Mr. V.K Jain (Secretary IETE, Ahmedabad), honourable Dr. G.P Vadodaria (Patron (STTP), Principal, LDCE), Prof. Usha Neelakantan (Convener (STTP)-HoD EC, LDCE), and Dr. M.V Shah (Coordinator (STTP)-Professor EC, LDCE). The inauguration function started with the remembrance of almighty God and motivational speeches by all present at the dais.

DAY 1

The first session of STTP was rightly started with the lecture session by Dr. K.R. Parmar on "Fundamentals of RF Design". This lecture gave the participants a background of the RF & microwave. Here he discussed about the RF basics its trade-offs and basic applications.

The second session was by Mr. Nilesh Desai (Deputy Director SNAA-SAC:ISRO) on "Advanced RF & Microwave and Digital Techniques for Satellite Payload". The lecture gave the participants insight of recent advances in RF & MW and its applications in Satellite payload. He made the participants aware of latest technologies used in satellites such as SSPA, MMIC, HMIC, SoC, Photonic, active antennas, LTCC, MEMS etc.

The third session was a hands on session in HFSS by Mr. Kush Parikh (Design Engineer RF-Entuple). It was a very interesting session where he introduced the participants to HFSS also stepwise explained the design of patch antenna at 2.25 GHz. All the participants actively designed the antenna.

DAY 2

Second days first session was by Dr. Dhaval Pujara where he took all the participants to the "Wonderland of RF & Microwave". In this lecture he started with the Maxwell's equations which most of the people dread with. Then he very interestingly explained the history of RF & MW starting with Maxwell to J.D Kraus. He also stressed upon the importance of microwave, its applications and challenges.

The second session was on "mm Wave Technology Development for ISRO's Sensors" by Mr. C.N Rao. In this session he discussed about the problems of using conventional Hybrid ICs at mm wave and took on mm wave transition from coax to microstripline, microstrip to waveguide, bondwire modelling etc.

The third session was lab session on HFSS where Mr Kush Parikh taught optimization by parametric analysis and then optimization. He also explained the design of circular waveguide and conical horn antenna at 10 GHz.

DAY 3

The third day started with the lecture session by Dr. Jayesh Pabari on "Recent Advances in MW Remote Sensing for Planetary Surface Study". He discussed about the optical remote

sensing and microwave remote sensing. He basically took upon the analysis of the measured data which requires the knowledge of many domains. He also touched upon the parameters that are measured such as spectral, spatial, temporal, and polarization signatures. He then explained about the microwave Brightness temperature, china moon mission and GIS.

The second session was taken up by Dr R.A. Thakkar on "CMOS PLL Design". Though RF & MW was not his area of expertise he beautifully explained about the basic PLL, CMOS PLL, its design and the challenges in its designing. He discussed about the latest technology i.e. FinFET. He also explained the types of CMOS PLLs such as charge pump PLL, Digital PLL and Hybrid PLL. He also discussed design of charge pump PLL and its challenges.

The third session was last hands on session on HFSS where the participants were taught to design the reflector antenna with horn feed at 10 GHz.

DAY 4

The first session was by Dr Sanjeev Gupta on "Challenges & Design Issues in RF and MW Engineering". In this session he explained the real time challenges that he faced in the design of some applications which he had developed when he worked with SAMEER. Then he gave very interesting applications of RF & MW in about all the fields such as Aerostat, Water level in water-tanks, MW disinfection system, paper dryer etc. He also explained the behaviour of resistor, capacitor and inductor at MW frequencies.

The second session was taken by Dr. K.G Maradia on "Massive MIMO: A Potential Technology for 5G Wireless Communication Systems". The session was on one of the applications of RF & MW. In this session the speaker explained about MIMO, OFDM and Massive MIMO. A lot of research is going on in 5G and technologies for 5G. Massive MIMO is one of the key technology to be used in 5G. It was very informative session.

The third session was delivered by industry person Mr. Harshvadhan Jani from Reliance Jio infocom Ltd. on "4G-LTE Mobile Wireless Technology". In the lecture he discussed about the evolution of mobile technology from 1G to 4G, the technologies involved in 4G and implementation of 4G.

The 4th session was on the demonstration of NAVIC receiver developed by SAC ISRO. The receiver previously named as IRNSS has been renamed by honourable Prime Minister Mr. Narendra Modi as NAVIC (Navigation with Indian Constellation). It was donated to EC department L.D College of Engineering by SAC-ISRO on the occasion of Engineer's Day.

DAY 5

The 5th day started with a session on "Use of Microwave and Antenna Measurement Technologies" by Dr. R.K Malaviya. He graced all participants with his vast knowledge in the field of Antenna testing and measurement. He started with the Antenna parameters, three different ranges of antenna and then explained about antenna test ranges. He discussed all pros and corns of each test range and explained why we are moving to near field region measurements. He then discussed about the latest antenna testing methods such as Multiprobe near field systems. He also introduced gravitationally sensitive antennas and problems in its measurement.

The 2nd session was by Shri A.K. Sisodiya on "Satellite Based Navigation Systems in India". He has been instrumental in the development of India's regional navigational system IRNSS aka NAVIC and GAGAN. He started with different navigation techniques. Then he explained about GPS, its applications and limitations. He cited the requirement of regional navigation system and then explained about IRNSS and GAGAN in detail.

Valedictory

Prof. J.P. Vaishnav and Prof. J.V Dave were the chief guests for the Valedictory session. Along with the chief guests the dais was shared by Mr. V.K Jain, Dr. G.P Vadoraria and Prof. Usha Neelakantan. All present at the dais shared their experiences and motivated all the participants.

Then there was a quiz session for all the participants to quantify the effectiveness of the STTP. All the participants actively took part in the quiz and were rewarded with chocolates. After the quiz all participants were asked to give oral as well as written feedbacks. Overall the feedback was positive and encouraging.

Certificates of participation were awarded to the participants by the honourable guests along with a CD containing all the study material and Group photograph for memory.

Outcomes of STTP

The participants

- Learnt RF & MW fundamentals, its history, and its applications.
- Learnt to identify the RF & MW design challenges.
- Got aware with advances in RF & MW and its applications in satellite communication
- Got conversed with latest IC technologies for MW and mm wave and mobile technologies.
- Learnt about the NAVIC receiver functioning.
- Learnt to design and simulate different antennas and waveguides.

Suggestions

Overall all the participants were happy with the conduction of STTP in this area, which is rarely taken up. There were few suggestions from the participants.

- One of the participant from EQDC suggested to include the ICE standards for testing of RF & MW components.
- Some of the participants suggested to conduct more such STTPs.
- One of the participants suggested to have 2 weeks training programme to cover all topics.