Report on

Emerging Trends and Future Applications of Microelectronics & MEMS

Faculty Development Programme

from

20th to 25th June, 2019

Organized by

Department of Electronics & Communication Engineering

Sree Chitra Thirunal College of Engineering

Pappanamcode, Thiruvananthapuram, Kerala

Funded by

APJ Abdul Kalam Technological University

Kerala

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From

Nisha Jose K,
Assoc. Professor
Dept. of ECE
SCTCE

Aparna P.R
Asst. Professor
Dept. of ECE
SCTCE

To
The Dean (Academics)
APJ KTU, Tvm

Sir
Sub: Reimbursement of expenditure for KTU sponsored FDP conducted by SCTCE

We had obtained sanction for conducting an FDP entitled "Emerging Trends and Future Applications of Microelectronics and MEMS" vide KTU proceedings dated KTU/JD (ACADEMICS)/2223/2019 dated 16.04.2019 (Course no 24). The program has been held from 20 th-25th June 2019 in the Department of Electronics & Communication Engineering, SCT Engineering College, Tvm. We are hereby attaching details of the above program including audited statement of accounts and original bills of expenditure.
Steps may please be taken for sanctioning and reimbursing the expenditure of the above program to the account of CCE, SCTCE, SBI Account No 67000581338, SBI SCT Engineering College Branch, IFSC code : SBIN0070851, Tvm.

19/5/2020
Trivandrum

Nisha Jose K, Aparna P.R.
Course Coordinators

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Executive Summary

A KTU sponsored Faculty Development Program (FDP) on "Emerging Trends and Future Applications of Microelectronics and MEMS" was conducted from 20 th-25th June 2019 in the Department of Electronics & Communication Engineering, SCT Engineering College, Trivandrum with an objective to provide an exposure to the faculty members, research scholars and masters' students in the above field. A total of 24 faculty members, including 16 external participants attended the course, which included expert talks from eminent personalities from national level reputed institutions. The program was conducted as per sanction obtained from KTU vide KTU proceedings dated KTU/JD (ACADEMICS)/2223/2019 dated 16.04.2019 (Course no 24).

Inaugural Session

The event was inaugurated by Principal, Dr.Prabhakaran Nair, in presence of all HODs and Deans. The FDP Coordinator, Nisha Jose K welcomed all dignitaries, participants and resource persons. Dr.Libish T.M., HoD (ECE), informed about the importance of MEMS design, in the modern era of Electronics. Prof. P. Mohanachandran Nair, who had arrived from Sarabhai Institute of Engineering and Technology appreciated that the event included expert talks from various reputed institute and industry, such IISc Bangalore, IIST and ISRO. Aparna P.R, FDP coordinator, expressed sincere thanks to everyone.

Concluding Session and feedback session

Most of participants expressed appreciation of the course contents and expertise of the resource persons. Suggestions were given for improvements in future. Feedback forms were collected from participants. Certificates and training material were distributed to the participants.

1. Background and objective of the course

Course Topic: Emerging Trends and Future Applications of Microelectronics and MEMS

Micro-Electrical Mechanical Systems, or MEMS, is a technology that consists of electronic components, sensors, mechanical actuators, and structures that are built on a micro and nano scale. Microelectronic technology is the integration of electronic components and MEMS devices in a functioning circuit or product.

The objective of the course was to introduce the various technologies, applications and emerging trends for research in realm of Microelectronics and MEMS to the participants.

2. Course Outcomes

The participant must be able to

- Review the design principles of MEMS
- Understand the microelectronic fabrication and packaging techniques for MEMS

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- List the applications and emerging trends in the fields of microelectronics and MEMS

3. Participants

Faculty members from KTU affiliated engineering colleges

4. Methodology

Lectures, Interactive sessions, Case studies and Seminars by experts from industry

5. Overview of Course Contents

20.6.2019. FN

Design Trends in MEMS: Nisha Jose K, Department of EC, SCTCE

A broad introduction to microelectronic systems and MEMS sensors. The topic was designed to give a comprehensive introduction to how the microelectronics industry has been affected by the implementation of MEMS technology and MEMS sensors. The talk included examples of the history of MEMS devices, the applications of MEMS devices, and reviewing current events to highlight new devices and emerging MEMS technologies.

20.6.2019. AN

Optoelectronics &Optical MEMS (MOEMS): Dr Sooraj, Dept of Avionics, IIST

Optical MEMS comprises advanced techniques to manipulate light with superior precision and speed to realize compact yet versatile optoelectronic systems. This lecture covered the necessary theory, basic practical aspects, and the device and system concepts for these closely related fields such as microoptics , propagation of light, diffractive optics and holograms, effects of real micro optical elements in an optical path, system concepts, micro fabrication of optical microstructures.

21.06.2019 FN

Nanostructure based Gas Sensors: Dr Palash Kumar Basu, Dept of Avionics, IIST

The development of solid state gas sensors based on micro transducers and nanostructured sensing materials is the key point in the design of portable measurement systems able to reach sensing and identification performance comparable with analytical ones. The technology involves development of the sensing material, but also the choice of the transducer mechanism and its structure, in the electrical characterization of the performance and in the design of suitable measurement setups. This lecture included the most recent advances and overview in design and measurements for applications in gas sensors, along with their relevant features and technological aspects, characterization and measurements methodologies; gas sensor based systems and applications.

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21.06.2019 AN

Microelectronics : Dr Ajayan K. R, C.E.T.

Microelectronics deals with the designing and manufacturing of micro-level electronic designs and components made up of semiconductor materials.

The lecture focussed on chip design and IC fabrication. The topics covered include: modelling of microelectronic devices, basic microelectronic circuit analysis and design, physical electronics of semiconductor junction and MOS devices, relation of electrical behaviour to internal physical processes, development of circuit models, and uses and limitations of various models.

22.06.2019 FN

Industrial visit to IIST could not be arranged due to non-completion of renovation works at the labs. A distinguished lecture by an eminent scientist at the fabrication facility in IISc Bangalore was arranged instead.

MEMS and IC Fabrication Technology : Dr Y PrabhakaraRao, IISc Bangalore

MEMS requires a basic understanding of IC fabrication technology, or microfabrication, the primary enabling technology for the development of MEMS. The major steps in IC fabrication technology which are film growth, doping, lithography, etching, dicing, and packaging were discussed in this lecture.

The lecture included video demonstrations of fabrication facility in IISc Bangalore.

22.06.2019 AN

MEMS/ NEMS and their aerospace applications : Dr Sreelal, VSSC, ISRO

Nano- and micro-electromechanical systems (NEMS/MEMS) are useful for applications ranging from chemical sensors and relays to logic devices. This lecture included the design of MEMS accelerometers, gyroscopes, electrostatic actuators, and microresonators; interfacial engineering for NEMS/MEMS; magnetic nanoparticles, spin electronic materials and sensors, Flexible substrates for electronics, sensors, and energy conversion platforms; Nanofabrication and nanopatterning technologies, including self-assembly for device fabrication.

24.06.2019 FN

In the absence of Prof. Shajahn E.S, C. E.T., who was expected to handle a lab session on Introduction to MEMS Design Software, following class was arranged, about practical issues in MEMS interfacing.

MEMS Interface Electronics : Dr Anoop C.S., Dept of Avionics, IIST

MEMS Interface Electronics deals with the combination of sensors, actuators and signal conditioning circuits, so that the micromechanical system configuration is complete. This lecture dealt with various aspects of the output signals coming from the transducers before processing and after processing, how signals are fed to actuators

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etc. Sensor signals are not digital in nature, requiring the analog to digital conversion before further processing with the help of either micro controller or microprocessor.

24.06.2019 AN

Reduced order modelling of MEMS: Dr.Boby Philip, Dept of EE, SCTCE

This lecture dealt with the dynamics of MEMS, represented by partial-differential equations (PDEs) and associated boundary conditions. The method to treat these distributed-parameters problems is to reduce them to ordinary-differential equations (ODEs) in time and then solve the reduced equations either numerically or analytically.

25.06.2019 FN

Nanomechanical Sensors and MEMS accelerometers :Dr.SeenaV, Dept of Avionics, IIST

This talk dealt with MEMS accelerometers which are one of the simplest but also most applicable micro-electromechanical systems. MEMS accelerometers are indispensable in automobile industry, computer and audio-video technology. The talk included the capacitor accelerometers, working and applications and also a quite extensive description of MEMS fabrication. Finally, several research topics were discussed.

25.06.2019 AN

Radio Frequency MEMS : Nisha Jose K, Dept of EC, SCTCE

This talk focused on the modeling, design, technology and applications of RF Micro-Electro-Mechanical Systems (MEMS) and how RF MEMS technology benefits the fields of intelligent communication systems, radars and sensors. The lecture included electromechanical models for RF MEMS devices through analytical techniques. The high potential of RF MEMS on building a variety of reconfigurable high-frequency components and systems were subsequently presented in detail.

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ANNEX A-1 : Programme Schedule

Date							
20/06/2019 Thursday	***Inauguration, Design Trends in MEMS* (9.00-9.30am)**	TEA BREAK	***Design Trends in MEMS* (9.30-12.30)**	LUNCH BREAK	***Optoelectronics & Optical MEMS (MOEMS)* (1.30-3.00pm)**	TEA BREAK	***Optoelectronics & Optical MEMS (MOEMS)* (3.00-4.30pm)**
	Ms.Nisha Jose K, SCTCE		*Ms.Nisha Jose K, SCTCE*		*Dr. Sooraj, IIST*		*Dr. Sooraj, IIST*
21/06/2019 Friday	***Nanostructure based Gas Sensors* (9.30-10.30am)**		***Nanostructure based Gas Sensors* (10.30-12.30)**		**Microelectronics (2-3.00pm)**		**Microelectronics (3.00-5.00pm)**
	Dr.Palash Kumar Basu, IIST		*Dr.Palash Kumar Basu, IIST*		*Dr. Ajayan K R, CET*		*Dr. Ajayan K R, CET*
22/06/2019 Saturday	***MEMS and IC Fabrication Technology* (9.30-10.30am)**		***MEMS and IC Fabrication Technology* (10.30-12.30)**		***MEMS/NEMS and their Aerospace Applications* (1.30-3.00pm)**		***MEMS/NEMS and their Aerospace Applications* (3.00-4.30pm)**
	Dr. Y P PrabhakaraRao, IISc		*Dr. Y P PrabhakaraRao, IISc*		*Dr.Sreelal, VSSC*		*Dr.Sreelal, VSSC*
24/06/2019 Monday	***MEMS Interface Electronics* (9.30-10.30am)**		***MEMS Interface Electronics* (10.30-12.30)**		***Reduced Order Modelling of MEMS* (1.30-3.00pm)**		***Reduced Order Modelling of MEMS* (3.00-4.30pm)**
	Dr. Anoop C S, IIST		*Dr. Anoop C S, IIST*		*Dr. Boby Philip, SCTCE*		*Dr. Boby Philip, SCTCE*
25/06/2019 Tuesday	***Nano mechanical Sensors and MEMS Accelerometers* (9.30-10.30am)**		***Nano mechanical Sensors and MEMS Accelerometers* (10.30-12.30)**		***Radio Frequency MEMS* (1.30-3.00pm)**		***Radio Frequency MEMS*, (3.00-4.30pm) *Test , Feedback Concluding session* (4.30-5.30pm)**
	Dr. Seena, IIST		*Dr. Seena, IIST*		*Ms.Nisha Jose K, SCTCE*		*Ms.Nisha Jose K, SCTCE*

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ANNEX A-2:
List of Participants from KTU Affiliated Colleges
A : List of External Participants

1. Biji G

Govt Engineering College Bartonhill

2. Sreejith A R

St.Thomas College Of Engineering And Technology,

Chengannur

3. Hitha P S

AdiShankara Institute Of Engineering And Technology,

Kalady

4. Darsana S

College Of Engineering,

Chengannur

5. Sajitha.P

Lourdes Matha Science And Technology

6. Jinju Joy

Lourdes Matha College Of Science And Technology

7. Bincy Louis

Lourdes Matha College Of Science And Technology

8. Sreelekshmi R C

Lourdes Matha College Of Science And Technology

9. Anupama A S

Sarabhai Institute Of Science & Technology

10. Deepambika V A

LBS Institute Of Technology For Women

11. Rahul R

John Cox Memorial CSI Institute Of Technology

12. Nithin B R

John Cox Memorial CSI Institute Of Technology

13. S Chandrasekharan Nair

Sarabhai Institute Of Science & Technology

14. Abhilash V Nair

LBS Institute Of Technology For Women

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15. Dr.Pmc Nair

Sarabhai Institute Of Science & Technology

16. Sreejith B J

KTU

B : List of Internal Participants

1. Dr.Libish T.M.

SCTCollege Of Engineering

2. Jisu Elsa Jacob

SCT College Of Engineering

3. Sajeer M

SCT College Of Engineering

4. Asha S

SCT College Of Engineering

5. Jayasudha J.S.

SCT College Of Engineering

6. Nelwin Raj N. R.

SCT College Of Engineering

7. Reshmi Krishnan S

SCT College Of Engineering

8. Preetha V H

SCT College Of Engineering

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ANNEX A-3
List of Coordinators & Technical Assistants

1. Centre Coordinator

Dr.K.Prabhakaran Nair
The Principal
SCTCE

2. Course Coordinators

1. **Nisha Jose K**
Associate Professor
SCT College of Engineering
Pappanamcode

2. **Aparna P.R.**
Assistant Professor
SCT College of Engineering
Pappanamcode

3. Technical Assistants

Jayakumar R
Trade Instructor
SCT College of Engineering
Pappanamcode

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ANNEX A-4
List of Resource Persons

1. Dr. Sooraj

Assistant Professor,

Dept. Of Avionics,

Indian Institute of Space Science and Technology

2. Dr. Palash Kumar Basu

Associate Professor,

Dept. of Avionics,

Indian Institute of Space Science and Technology,

Trivandrum

3. Dr. Ajayan K R

Associate Professor,

Dept of ECE,

College of Engineering

Trivandrum

4. Dr. Y P Prabhakara Rao

Visiting Scientist,

Indian Institute of Science (IISc),

Bangalore

5. Dr. Sreelal Sreedharan Pillai

Engineer-SG,

Section Head SED?DSG

VSSC, Trivandrum-695022

6. Dr. Anoop C S

Assistant Professor,

Dept. of Avionics,

Indian Institute of Space Science and Technology (IIST),

Trivandrum

7. Dr. Boby Philip

Associate Professor,

Electrical Engineering Division,

SCT College of Engineering,

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8. Dr. Seena V

Associate Professor,

Dept. of Avionics,

Indian Institute of Space Science and Technology,

Trivandrum

9. Ms. Nisha Jose K

Associate Professor,

Dept of ECE,

SCT College of Engineering,

Pappanamcode, Tvpm

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ANNEX A-5

List of Distinguished Officials of College present in the programme during inauguration

1. Dr.K.Prabhakaran Nair
   The Principal
   SCTCE
2. Dr.Libish T M

Head of the Department

Dept. Of ECE, SCTCE

3. Dr.Jayasudha J S

Dean (Academic, R & D)

SCTCE

4. Prof. Sarathchandradas

Dean P.G. Studies

SCTCE

5. Dr.R.Ajith

Dean Student Affairs

SCTCE