JIIT MEMS DESIGN CENTER

The National Program on Micro and Smart Systems (NPMASS) , has been launched after the success of National Program on Smart Materials (NPSM), which was a unique program, working towards the basic aim of creating awareness in India about MEMS and Smart Systems. The NPMASS under Government of India was wholly supported by Defence Research & Development Organization (DRDO) through Aeronautical Development Agency (ADA), and was endorsed by the five departments DRDO, DOS, DST, CSIR and DIT. The co-ordinating institute was IISc Bangalore. The final closure report for the NPMASS Program was submitted in January 2015.

JIIT MEMS Design was set-up at JIIT in the year 2009 as a part of Institute's response to launch MEMS activity NPMASS program. The program centers on collaborative research efforts, related to MEMS and smart sensors, of the Department of Electronics and Communication Engineering and Department of Physics and Materials Science.

Under this project JIIT has been provided with three industry standard software packages namely CoventorWare (01 license) and MEMS Plus (01 license), Intellisuite 8.7 (01 license) and COMSOL Multiphysics (32 licenses). The hardware support for the project has been provided by the JIIT, which includes a dedicated Server, Vector Network Analyzer and twelve workstations. The departments involved promote the area of sensors and smart systems through independent departmental courses at UG/PG levels to involve students and faculties in developing MEMS related projects and research activities.

The research areas targeted by the MEMS group in JIIT are On-Chip RF Spiral Inductor Development, Sensor/MEMS Interface CMOS Analog Chip Design, SAW based Temperature/Gas Sensor design and Advanced and Smart Materials.

In the absence of required in-house comprehensive facilities for complete fabrication of MEMS/sensors, the short term strategy of the design centre is to focus on design, modeling and characterization of the test structures, outside foundries chosen as option for fabrication and packaging.

Prof. A. B. Bhattacharyya, (Emeritus Professor), directed the program of the centre in the past. The Center at JIIT is a Tier-2 organization working in close collaboration with Centre for Applied Research in Electronics (CARE), IIT Delhi .

Research work carried out in JIIT MEMS Design center are as follows:

1. Design, Characterization and Modeling of On-Chip Inductors on Silicon Substrate for RF Applications (NPMASS Program) – A test chip with inductor structures is prototyped using industry standard CAD design environment at commercial foundry Austria Micro Systems (AMS), Austria and characterization for the same carried out at CARE, IIT Delhi. The purpose of the work is the experimental characterization and modelling of crosstalk coupling effects of CMOS co-planar spiral inductors with accurate substrate modelling.

2. SAW Oscillator for Temperature/Gas Sensor. A withdrawal-weighted (ladder type) SAW Oscillator for temperature sensor has been designed for the centre frequency of 50 MHz. The design and layout has been completed.
3. Interface Circuitry Design for MEMS based Integrated Systems

MAJOR RESOURCES AVAILABLE IN AREA

SOFTWARE AVAILABLE:

SNO	NAME OF SOFTWARE	NO OF LICENSES	DATE OF PURCHASE
1	COVENTORWARE2010	01	MARCH 2010
2	INTELLISUITE V8.7	01	MARCH 2010
3	SYNOPSYS EDA TOOL	05	MARCH 2018
4	MENTOR GRAPHICS IC DESIGN ENVIRONMENT	15	MAY 2018

Team Members:

Faculty	Qualification/University	Area of Research
Prof R K Dwivedi	Ph.D (BHU, India)	Smart Materials, Mutliferroics, Lead free Piezoelectrics and Thin films for MEMS devices
Mr. ShivajiTyagi	M.Tech(JIIT, India)	Analog CMOS Integrated Circuit Design, CMOS-MEMS Devices, RFICs
Kirmender Singh	M.Tech(JIIT, India)	Analog CMOS design, MOSFET Compact Model.
ShrutiKalra	M.Tech(CDAC Noida, India)	CMOS Digital VLSI Design.

UG PROJECTS IN CENTER FOR MEMS DESIGN – COMPLETED

S.N.	Title of Thesis/ Dissertation/ Project	Names of Joint Supervisors	Enrol. No. & Name of the Student	Status
1.	Modeling of surface acoustic wave delay line	Prof A B Bhattacharyya	07102254 & Ashish Sharvana	Completed
2.	Parametric extraction of Quartz crystal equivalent circuit from impedance measurements	Prof A B Bhattacharyya	08102170 & IvneetParamjeet Singh Makkar	Completed
3.	Design and Modeling of SAW based temperature sensor using YZ-Lithium Niobate as substrate	Prof A B Bhattacharyya	08102179 & Indranil Sen	Completed
4.	Design and Modeling of SAW based temperature sensor using YZ-Lithium Niobate as substrate	Prof A B Bhattacharyya	08102200& Shishir Jain	Completed

SN.	Title of Thesis/ Dissertation/ Project	Names of Joint Supervisors	Enrol. No. & Name of the Student	Status
5.	Integration of SAW Device and Delay Line for the Development of Oscillator Based Temperature/Gas Sensor	Prof A B Bhattacharyya	09102289 & Ayush Jain	Completed
6.	Integration of SAW Device and Delay Line for the Development of Oscillator Based Temperature/Gas Sensor	Prof A B Bhattacharyya	09102293 & SambhavChandhok	Completed
7.	Theoretical Modeling and Simulation of MEMS Piezoelectric Energy Harvester	Prof R C Jain	10102214 & Rishabh Malhotra	Completed

PG PROJECTS IN CENTER FOR MEMS DESIGN – COMPLETED

SN.	Title of Thesis/ Dissertation/ Project	Names of Joint Supervisors	Enrol. No. & Name of the Student	Status
1.	Design and Modeling of RF Spiral Inductor	Prof A B Bhattacharyya	09305155 &VibhuSrivastava	Completed
2.	CMOS-Compatible Micromechanical Cantilever Beam Resonator Structure for Low Frequency Filtering Applications	Prof A B Bhattacharyya	10305180 & ShivajiTyagi	Completed
3.	Design and Modeling of RF Inductor/Transformer	Prof A B Bhattacharyya	10305179 & PallavieTyagi	Completed
4.	RF Interconnect Modeling	Prof A B Bhattacharyya	11302155 & Manuj Gupta	Completed
5.	RF Inductor Modeling, Parameter Extraction and layout	Prof A B Bhattacharyya	11302158 & Nikhita Gupta	Completed
6.	Modeling and Simulation of SAW Devices	Prof R C Jain	12302274 & Sneha Dixit	Completed
7.	Design and Analysis of MEMS based Logic Gates	Mr. Tanuj Chauhan	12305151 & DeekshaChandola	Completed
8.	Trans-regional Model Based Scalable MOSFET Model Upto Deep Submicron Technology and it's Application to basic	Mrs. ShrutiKalra	Kumar Ravi & 14317192	Completed

9.	MEMS based piezoresistive pressure Sensor	Prof. R.C. Jain	BickeyLohar& 14317176	Completed
10.	Design, modelling and simulation of Thin Film Bulk Acoustic resonator	Prof. R.C. Jain	Sohni Singh & 143161118	Completed
11.	Vibration Based Piezoelectric Energy Harvester	Prof. R.C. Jain	Pooja Mittal & 14317191	Completed
12.	Design and Modelling of Piezoresistive MEMS Resonator	Mr. ShivajiTyagi	Alka Rani & 14317194	Completed
13.	Bandgap Reference Circuit at 0.35um CMOS Technology	Mr. ShivajiTyagi	Vivechna Yadav & 14317183	Completed

Details of publications, patents and Process / Equipment / Software Developed

1. ShikharTewari, K. Singh, " Intuitive Design of PTAT and CTAT Circuits for MOSFET based temperature sensor using Inversion Coefficient based approach", IEEE 19th International Symposium on VLSI Design and Test(VDAT-2015), Institute of Technology, Nirma University, Ahmedabad, 26th -29th June 2015.

2. K. Singh, Paritosh Vyas, "Design Methodology of Standard Analog Circuit Block using EKV MOSFET Model and Validation using BSIM3v3 MOSFET Model", International Conference on Signal Processing and Communication, Jaypee Institute of Information Technology (JIIT), 16th - 18th March, 2015.

3. ShivajiTyagi, A B Bhattacharyya, "Analytical Modeling and Simulation of Low-Frequency Lorentz-Forced Transduced Micromechanical Cantilever Resonator ", International Conference on Signal Processing and Communication (ICSC-2015), pp 337-342, March 16-18, 2015

4. K. Singh , A. B Bhattacharyya " Analysis of Second-order Effect Components of Drain Conductance and Its Implication on Output Resistance of Wilson Current Mirror",   IEEE 28th International Conference on VLSI Design(VLSID), Bangalore, (sister conference of IEEE DAC, DATE) Jan 3rd -7th , 2015 .

5. A.B. Bhattacharyya, Indernil Sen, Shishir Jain, "Compact SAW Micromodel for SPICE and Verilog-A Simulation using Improved Crossed-Field Model", ISSS-2014, July 8-10, 2014, Bangalore (accepted).

6. Vijayeta Pal, R K Dwivedi, O P Thakur, "Effect of Neodymium substitution on structural and ferro electric properties of BNT ceramics", Material Research Bulletin, pp 189-196, 2014.

7. Kalra, S., "Effect of temperature dependence on performance of Digital CMOS circuit technologies," International Conference on Signal Processing and Communication (ICSC-2013) December 12-14, 2013, JIIT NOIDA, India.

8. PoonamGoel, A. B. Bhattacharyya, "DC Inductance Modeling of Coplanar Meander Inductor with Grounded Guard Ring", ISSS-2012, Jan 4-7, 2012, Bangalore.

9. Vijayeta Pal and R.K. Dwivedi,"Dielectric properties of La modified BNT Ceramics for MEMS applications", ISSS-2012, Jan 4-7, 2012, Bangalore.

10. A. B. Bhattacharyya, K. Singh , "Transconductance Component Analysis of EKV MOSFET Model for CMOS Analog Design at 0.18μ Technology Node",Sixth International Conference of Smart Material Structure and Systems(ISSS-2011) , Indian Institute of Science(IISC) Bangalore, Jan 4th -7th, 2012.

11. Rashiya Sharma, AnkurGoswamiArindamPhani, R. K. Dwivedi and GeetikaSrivastava,"Optimization of the design parameters of a piezoelectric actuator" , COMSOL Conference 2011, Nov 4-5, Bangalore.

12. Saxena P. K., "Modeling and simulation of HgCdTe based p+–n–n+ LWIR photodetector", Infrared Physics & Technology 54, pp. 25–33, 2011.
Saxena P. K., "An Improved Photoinduced Model for Silicon Based Microcantilever", Journal of Nanoelectronics and Optoelectronics, Volume 5, Number 3, December 2010, pp. 355-359(5).

Title	Funded Research Projects Annexure MEMS-1	Number of Publications Annexure MEMS – 2	PhD Theses supervised Annexure MEMS - 3 (Completed)	PhD Theses supervised Annexure MEMS - 3 (Ongoing)	M. Tech Theses Annexure MEMS - 4 (Completed)	M. Tech Theses Annexure MEMS - 4 (Ongoing)	B. Tech Major Projects Annexure MEMS - 5 (Completed)	B. Tech Major Projects Annexure MEMS - 5 (Ongoing)	Courses Annexure MEMS - 6
MEMS	Aeronautical Development Agency (ADA), Govt. of India Rs. 50 Lakhs 2009-2014 Mentor Graphics, India 6.6 Lakh 2011-2013	Peer reviewed Journals: International: 2 National: 0 Conferences: International: 2 National: 1	2	2	15	0	10	01	Interface IC Design for MEMS & Sensors Semiconductor Devices Microelectronic Devices Technology & Design Interface VLSI Circuit and System Design Microelectronics and MEMS Technology *Conference MOS-AK/GSA India 2012, International Workshop on Device Modeling for Microsystems was held on March 16-18, 2012