

## **Welcome to ESE Research Interviews 2017**

Dear prospective research student:

Thank you for applying for a research student position in our department. The interviews will be held on June 5-9, 2017, in two sessions, beginning at 9 AM and 2 PM on each day. The exact date and session of your interview will be communicated to you via a call letter.

Please print out and fill out the attached Option Form (see Page 4), and bring it with you when you arrive here for your interview.

Our interview tests the candidates' aptitude and suitability for research in the areas chosen by them, and also their proficiency in the related background subjects. The attached note (see Page 2) gives more information about the interview process at ESE. Please use it to prepare well for the interview process.

Please visit the webpages of various faculty to know about our research activities.

Very best wishes,

Joy Kuri  
Chair  
Department of Electronic Systems Engineering  
Indian Institute of Science  
Bangalore 560012

## **Research Interview Process at ESE**

1. Each candidate is asked to submit a completed Option Form when he/she reports to the department office (see Page 5 for the form). The candidate should have indicated the area of his/her interest in the form. The area should be one of the "Main Research Areas" in the table on Page 3.

2. Each Main Research Area consists of a number of sub areas as mentioned in the table on Page 3. A candidate could mention a few sub areas in the option form to indicate her/his interest in the particular topics. Mentioning sub areas in the option form is not mandatory.

3. Each Main Research Area also has a corresponding set of background subjects which are grouped as Math and Core subjects (see the table on Page 3). Each candidate is expected to have prepared two Math subjects and two Core subjects from her/his area. The candidate should have indicated these four subjects in the option form .

a. The candidate is first asked questions from both the Math subjects chosen by her/him . For candidates with BE/BTech/M Sc/MCA as the qualifying degree, the questions are at the level of undergraduate engineering mathematics. The candidates with M E/M Tech are expected to be more proficient in the chosen subjects. These questions do not involve lengthy calculations, but test the basics, and the ability to think "on one's feet".

b. If the candidate performs satisfactorily in the first part of the interview, she/he is asked questions from the chosen Core subjects. These questions are from the topics of undergraduate study for the candidates with BE/BTech/M Sc/MCA as the qualifying degree, and from the topics of post-graduate study for the candidates with M E/M Tech. The questions aim to explore the candidate's understanding of fundamental concepts and clarity of thinking, rather than descriptive, system-level knowledge.

Both parts of the interview carry due weightage in selection.

Main research area	Sub-area	Background subjects
<p>Semiconductor devices, materials, bio-MEMS</p>	<p>Nanoelectronic device modelling: First principles based atomistic modelling, quantum transport, density functional theory, band structure modelling (tight binding, k.p etc.), Non equilibrium Green's function formalism, compact modelling, hardware based device modelling, Neural networks.</p> <p>Carbon nanotube and graphene transistor design, manufacturing and testing, exploration of novel 2D materials for "beyond CMOS" device options, Device reliability, On-chip electrostatic discharge (ESD), protection device and circuit design, ESD simulations and device modelling, Beyond CMOS ESD research, LD MOS and Drain-extended MOS desing for system-on-chip applications, GaN HEMT device design and manufacturing</p> <p>Microsystems and Biomedical Devices: Flexible sensors, microsensors, microfluidic devices, and microelectromechanical systems, all lately with an emphasis on cancer diagnosis, therapeutics, e-nose, and biomedical device technologies. These efforts are multidisciplinary and combine expertise from different fields of technical study.</p>	<p>Maths: Differential equations, numerical techniques for equation solving, matrix theory.</p> <p>Core: Basics of solid state physics, semiconductor devices and MOSFET.</p> <p>Basic understanding of microfabrication technology and aptitude towards design, simulation and fabrication of microengineered devices for biomedical applications. Knowledge of design tools like SolidWorks, Catia, Pro E will be an advantage.</p> <p>Good MATLAB and C programming skill will be an advantage.</p>
<p>Power conversion, renewable energy</p>	<p>Multi-level inverters, PWM techniques, Alternate Energy Systems - Micro-Hydel, Grid-Connection, DC and AC Micro-grids, Legged Locomotion, Dynamic Magnetics and Bond Graph Modelling, Intelligent Controls, Sensors and Actuators based on Smart Materials, Power Delivery, Signal Integrity Issues, High-speed Signal Transmission, Sources and Signal Conditioning</p>	<p>Maths: Linear Algebra, Complex Numbers, Vector Calculus, Differentiation and Integration, Transforms and all related topics</p> <p>Core: Electrical circuits, magnetics, transformers, electrical machines, OP-AMPs, instrumentation and process control, electro-mechanical devices, signal processing, related physics, related mechanics and kinematics</p>

<p>Signal and information processing, VLSI circuit design</p>	<p>Information theory, coding, signal processing and VLSI architectures for physical data storage and multi-dimensional channels, neural networks and learning systems, quantum information processing, music signal processing</p> <p>ASIC/FPGA digital VLSI design, analog IC design, brain inspired algorithms towards neuromorphic circuits, spike-based signal processing</p>	<p>Maths: Real Analysis, Linear Algebra, Matrix Analysis, Linear Optimization, Convex Optimization, Probability Theory and Random Processes</p> <p>Core: Information and Coding Theory, Signal processing.</p> <p>Basics of Digital and Analog VLSI circuits. Programming in MATLAB/Python. An interest in how the brain works is essential.</p>
<p>Networked embedded systems, communication networks</p>	<p>Modelling, analysis and control of the Internet, Energy harvesting systems, Wireless access networks, Wireless ad hoc networks, Wireless sensor networks, Data centre networks, Cyber-physical systems, Social networks,</p>	<p>Maths: Real Analysis, Linear Algebra, Matrix Analysis, Linear Optimization, Convex Optimization, Probability Theory and Random Processes</p> <p>Core: Computer networks, Communication networks, Wireless networks, Wireless communication</p>

### Option Form

1. Name of the candidate:
2. Application number:
3. Programme of interest: (PhD only / M. Tech (Res) only / both)
4. Academic achievements: (include research publications):

<b>Main research area (exactly one of the four given in the table above)</b>	<b>Sub-area (optional)</b>	<b>Background subjects (two Maths and two core subjects from the corresponding pool)</b>