**DEPARTMENT OF
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ENGINEERING
INDIAN INSTITUTE OF SCIENCE
BANGALORE 560012**

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भारतीय विज्ञान संस्थान
बेंगलूरु - 560012

INFORMATION ON ECE MID-YEAR RESEARCH INTERVIEWS 2020-2021

December 21, 2020

Dear Student,

We congratulate all candidates selected to be interviewed for admission to the research programme at ECE, IISc. Our department is one among the top ECE departments in the country with faculty members who have rich academic and industry experience from leading universities and companies. The research programme at ECE, IISc, gives the student an opportunity to solve challenging problems that will impact the development of future technologies.

Unfortunately, the department had to set thresholds for inviting candidates for the interview. These thresholds were decided based on Institute/Government guidelines. A cumulative academic metric based on marks scored from 10th standard examination onwards, was used for M.E./M.Tech. qualified candidates. We hope everyone would understand that we can not schedule interviews for everyone interested. All shortlisted candidates would have received a letter from our Admissions Office inviting them to an **online video-interview** at a specific session during **January 4-8, 2021** for admission to our research programme (PhD only). That letter would also have specified the day and the session (forenoon/afternoon) for research interview. This message is specifically for these candidates, to inform them about the interview procedure in our department, so that they can prepare well.

1. **Fill and submit Google form:** You must indicate your research area preferences, basic mathematics topics for interview, and other information, through the Google form link sent to you in the email from Mr Srinivasa Murthy in the ECE department, IISc. Information about research areas and basic mathematics topics for interview are given below. **You must fill and submit this Google form before 12 noon on Monday, December 28, 2020.**
2. **Choice of research areas:** A list of research areas in which research admissions will be made, and the faculty who will take students in these areas are given in the next page of this document. You have to indicate your first and second preferred research areas based on your research interests in the Google form. **Kindly note that we will not be considering you for admission to any other research area during this cycle of interview.**
3. **Choice of two areas of basic mathematics for your interview:** Candidates will be examined on their analytical ability in **two** of the following areas of basic mathematics:
    - Calculus and Differential Equations
    - Matrix Analysis and Linear Algebra
    - Fourier, Laplace, and z-Transforms
    - Probability Theory and Random Processes
    - Discrete Mathematics (combinatorics, graphs).
   You have to indicate these two areas in the Google form.

4. **Nature of the interview:** The problems posed will not involve lengthy calculations, but will test the basics, and the ability to think "on one's feet". Candidates may also be asked questions in their preferred area of research or any related area. These questions will be from topics of undergraduate study and topics of post-graduate study (as applicable). The nature of the questions will be to explore the student's clarity of thought and depth of understanding of the topics, rather than descriptive system level knowledge.

5. **Highlights of the online video-interview procedure:**
    a. The online video-interview will be conducted using **Google Meet**. You will be informed of your scheduled interview time on the session/day of your interview by **December 31, 2020,** through email. You will receive an email with the Google Meet invite, just before your scheduled interview time.
    b. Once you join the online interview meeting, there will be an initial verification by the interview committee, followed by the technical part of the interview.
    c. You are advised to choose a well-lit space and keep your laptop/tablet/mobile phone in a stable position so that the interview committee can see you well. Also, keep enough blank white papers and a black/blue pen to write your answers and show it in front of your camera for the committee to see.

6. After the interview, candidates have the option to change the priority order of the departments that they had indicated in their application form.

Please contact office.ece@iisc.ac.in if you have any queries.

With best wishes,

KJ VINOY
CHAIR, ECE

List of Research Areas (January 2021)

Candidates have to indicate their first and second preferences from the following six research areas (A,B,C,D,E,F) by entering these preferences in the Google form shared in the email.

A. Communication and Networks:

Current research in this area encompasses a broad range of topics covering the theory and practice of communication systems and networks.
Example of research topics include (but are not limited to):

- 5G and beyond, next-generation communications and networking; multi-user/massive MIMO OTFS; ultra-low latency; massive machine-type communications, signal processing for communications, visible light communications; optical networks;
- information theory, coding theory (including codes for big data storage, codes for DNA-based data storage, and network coding);
- distributed computing, communication networks (modeling, analysis, optimization and control); communications and network protocols;
- machine learning and distributed decision-making.

We use mathematical tools based on probability and statistics, random processes, linear algebra, real and complex analysis, detection and estimation, optimization, statistical physics etc.

Faculty willing to guide: A. Chockalingam, B. Sundar Rajan, Navin Kashyap, Parimal Parag, Sundeep Chepuri, Rahul Singh, Vaibhav Katewa

B. Signal Processing:

Current research in Signal Processing encompasses a broad range of topics covering signal, image and video processing. The research approach in this domain includes the design of algorithms for various applications and their theoretical and/or experimental analysis on real world benchmarking datasets.
Some example research topics, classified as techniques and applications, include:

- Techniques: compressive and sparse sensing; sparse signal processing; distributed signal processing; graph signal processing; distributed computing, deep learning; convex and non-convex optimization; machine learning
- Applications: internet of things (IoT); massive machine-type communications;

We use mathematical tools based on matrix theory, stochastic processes, optimization theory, and statistics. The candidates should have basic computer programming skills.

Faculty willing to guide: A. Chockalingam, B. Sundar Rajan, Parimal Parag, Sundeep Chepuri, Rahul Singh

C. Microelectronics:

Research topics currently on offer:

- Nanotransistors with Si, III-V, 2D materials (Graphene, TMD), spintronics, novel memory, CMOS sensors, ultra-low power devices.
- Semiconductor optoelectronic devices, 2D valleytronics, photodetectors and IR detectors, solar cell

Faculty willing to guide: Kausik Majumdar

D. RF & Microwaves :

Research topics currently on offer:

- Computational electromagnetics, Solutions to Maxwell's equations: finite difference time domain method, finite element method; EMI/EMC for high frequency circuit
- Beam steering antenna arrays and metasurfaces for 5G communications and beyond, Microwave sensing and imaging systems
- Radar circuits and systems

Faculty willing to guide: K. J. Vinoy, Debdeep Sarkar

E. Photonics:

Research topics currently on offer:

- Photonic integrated circuits, Optoelectronics, Nanophotonics, Bio photonics & Microscopy, Quantum Information Technology

Faculty willing to guide: Varun Raghunathan

F. Cyber – Physical Systems:

Research topics currently on offer:

- Hybrid systems, co-design, Networked and distributed control, large scale IoT (Internet of Things) test beds, distributed computing architectures/Robotics

Faculty willing to guide: Vaibhav Katewa, Rahul Singh