

Maharaja Surajmal Institute of Technology
Electronics and Communication Engineering

Detailed Report on Expert Talk by Prof. Neeru Rathee on Basic Tools of Engineering Research: Filters and Their Applications

Event Details

- Topic: Basic Tools of Engineering Research: Filters and Their Applications*
- Speaker: Prof. Neeru Rathee, Professor and Head, ECE Department
- Date: Saturday, 07th December 2024
- Time: 9:00 AM to 10:00 AM
- Venue: Seminar Hall No. 206 (2nd Floor)

Introduction:

The Department of Electronics and Communication Engineering organized an expert lecture as part of its initiative to enrich the academic and research capabilities of students and faculty members. The session was delivered by Prof. Neeru Rathee, an esteemed academician with significant contributions to engineering research and applications. The talk was aimed at introducing fundamental tools of engineering research with a focus on filters and their varied applications in modern technology. –



Key Highlights of the Lecture

1. Introduction to Filters

Prof. Rathee began the session by explaining the concept of filters as essential tools in signal processing. She emphasized their importance in isolating or modifying specific components of a signal to meet desired outcomes.

Key terminologies discussed included:

- Passband: The range of frequencies allowed by the filter without attenuation.
- Stopband: The frequencies attenuated or blocked by the filter.
- Cutoff Frequency: The boundary between passband and stopband where signal power is halved.
- Bandwidth: The range of frequencies that the filter processes without distortion.

These foundational concepts set the stage for a detailed understanding of filter design and applications.

2. Types of Filters

Prof. Rathee categorized filters based on construction and frequency response, elaborating on their specific roles:



a) Based on Construction:-

Passive Filters: Utilize basic electrical components like resistors, capacitors, and inductors. These do not require an external power source and are suitable for simple filtering tasks.

Active Filters: Include active elements like transistors or operational amplifiers. These are more versatile and capable of amplifying signals.

b) Based on Frequency Response:

- Low-Pass Filters: Allow frequencies below a certain threshold while attenuating higher frequencies.
- High-Pass Filters: Opposite of low-pass filters, allowing only higher frequencies.
- Band-Pass Filters: Permit frequencies within a specific range while blocking others.
- Band-Reject Filters: Block frequencies within a range and allow others to pass.

The discussion was supported by diagrams and circuit layouts, which helped participants visualize the structural and functional differences between these filters.---

3. Applications of Filters: Prof. Rathee demonstrated the wide-ranging utility of filters in diverse fields, including:

- **Communication Systems**: Noise suppression and prevention of aliasing during signal transmission.
- **Audio Systems**: Treble and bass separation for improved sound quality in speakers.
- **Electronics**: Smoothing power supply outputs by removing ripples through low-pass filters.
- **Medical Devices**: Enhancing clarity in ECG and other diagnostic signals.

She also discussed specific examples, such as band-pass filters in radio tuners for isolating a desired frequency and notch filters for removing narrowband interference. The speaker identified limitations of analog filters, such as susceptibility to noise and interference, physical space constraints, and the difficulty in making real-time adjustments. To address these challenges, digital filters were highlighted as a modern alternative capable of greater precision and flexibility.



Prof. Rathee also touched upon advanced topics, including:

Pole-Zero Analysis: Understanding filter behavior in the frequency domain.

Roll-Off Rate: The rate at which signal attenuation occurs beyond the cutoff frequency.

All-Pass Filters: Their role in maintaining amplitude while adjusting phase relationships, particularly in audio production and signal correction.

Prof. Neeru Rathee's extensive knowledge of the subject was evident throughout the lecture. She used a balanced mix of theoretical explanations and practical demonstrations to engage the audience. Her ability to simplify complex topics ensured that the session catered to participants with varying levels of expertise. The inclusion of real-world applications and interactive Q&A sessions added value to the talk, keeping the audience actively involved.

Conclusion

The expert lecture by Prof. Neeru Rathee on *Basic Tools of Engineering Research: Filters and Their Applications* was a resounding success. It not only provided a comprehensive understanding of filters but also underscored their critical role in modern technology. The session served as an excellent platform for learning, inspiring attendees to further explore the subject in their academic and research endeavors.

The department extends its gratitude to Prof. Neeru Rathee for sharing her expertise and making the session an enriching experience for all.