

**Short Term Course  
on  
Metamaterials –Design and Applications**

**27<sup>th</sup> November to 1<sup>st</sup> December, 2018**

*A Continuing Education Program of Indian Institute of Technology Kharagpur*



**Organized by  
Department of Electronics and Electrical Communication  
Engineering  
Indian Institute of Technology  
Kharagpur – 721 302, India**



# Metamaterials –Design and Applications

## Objective :

Current research on microwave techniques and applications increasingly focus on novel and engineered materials to fulfill the stringent needs of modern communication. In this respect, metamaterials have played a significant and dominant role in size reduction and performance enhancement of microwave devices including both antennas and guided wave components.

Though the concept of opposing phase and group velocities in a periodic structure has been known to the microwave community, the application of the technology to the design of novel microwave devices has been relatively recent. In one domain, metamaterials have enabled us to very significantly enhance the extent of miniaturization of microwave antennas while maintaining or exceeding their efficiency to close to the physically attainable 'Chu Limit'. The course would focus on the techniques and concepts behind the significant size-reduction of such antennas for planar and non-planar structures.

In addition, metamaterial-based designs have been used for the directivity enhancement of antennas using the mu-near-zero or epsilon-very-large effects. The magnetic resonator behavior under parallel incidence condition can be utilized to realize the enhanced gain characteristic. However, from the perspective of miniaturized antenna with reduced superstrate height, the normal incidence condition is more attractive. Unit cells exhibiting electric resonance are particularly useful to achieve this goal. The course would as such focus on the design and characterization of such metamaterial topologies leading to the development of efficient directive antennas.

Metamaterial-based structures have also been used to overcome traditional limitations of microwave structures like inadequate broadside performance of leaky wave antennas or to mitigate enhanced mutual coupling effects with reduction in element spacing in antenna arrays. In addition, design of metamaterial-loaded guided wave structures with reduced wave interaction at higher frequencies would also be addressed. The course would also focus on the development of efficient radar absorbing materials with reduced thickness, high absorption and wider sensitivity to a large range of incident angles.

## Course Content:

- Metamaterial design and analysis
- Miniaturized metamaterial antennas
- Gain enhanced metamaterial antennas
- Leaky wave metamaterial antennas
- Metamaterial Cloaks
- EMI / EMC
- Dielectric resonator antennas
- Guided wave structures with metamaterials
- Radar absorbing materials based on metamaterials
- Microwave passive components
- Microwave transitions

## Experiments:

- Use of HFSS, CST and ADS simulation tool for antenna simulation and design.

## Eligibility for Participation:

Teachers from Colleges / Institutions / Universities. Scientific Officers / Instructors / Technical Assistants / Research Scholars / Under Graduate and Post Graduate Students / Participants from Industries.

## Course fee :

- For Students: Rs.12,000/- (including all taxes)
- For Industry: Rs. 24,000/- (including all taxes)
- For Teachers/Others: Rs. 20,000/- (including all taxes)

## Accommodation & food:

Limited shared accommodation is available in the Institute guest houses VGH (*Visveswaraya Guest House*) on personal payment basis. The charges are as follows: **VGH:** Daily charges: Rs.400/- (Single Occupancy) for D/B AC Rooms and Rs. 600/- (Double Occupancy) for D/B AC Rooms; Rs.250/- (Single Occupancy) for D/B Non AC Rooms and Rs.300/- (Double Occupancy) for D/B Non AC Rooms; Rs.150/- per bed for 3 & 4 bedded Non AC rooms. On prior intimation we will try to arrange accommodation with the above charges. **Accommodation charges would have to be paid on personal payment basis. Breakfast and lunch are included in the course fee.** Course fee includes lecture notes and refreshments during the course.

## How to apply:

The course fee can be paid online through IIT Kharagpur web-portal by following the steps given below ( candidates applying in a group can however pay their fees offline through demand draft drawn in favour of 'CEP-STC, IIT Kharagpur', payable at **Kharagpur**.)

- Candidates paying online should apply by clicking "**APPLY for CEP Events**" under the "**EVENTS**" section in the Institute website [www.iitkgp.ac.in](http://www.iitkgp.ac.in).
- Click on **How to Apply** at the top the page.
- Follow the instructions given there for signing up and editing your profile.
- Scroll down to the course "Short Term Training Program on Metamaterials – Design and Applications".
- Click on the "**Apply Now**" Button and follow point no. 6 mentioned in the instruction page available at the **How to Apply** link.

**Course Coordinator**  
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**Important dates : Last date for receiving application: November 12, 2018**

## Connectivity:

Kharagpur is an important railway junction and is well connected to all parts of the country by rail service (SER). Numerous local & express trains are available from Howrah. The Institute is approximately 5 Kms from the Kharagpur railway station with the bus stand adjacent to the railway station. Rickshaws (Rs. 80), auto-rickshaws (Rs. 80) and taxis (Rs.140) are available from the railway station.