

## IMPORTANCE AND SCOPE

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.

## KEY TOPICS TO BE ADDRESSED

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

## SPEAKERS

Faculty / domain experts from IIT, Kharagpur

## EXPERIMENTS

Use of HFSS and ADS simulation tool for antenna simulation and design. Familiarity with microwave measuring instruments including return loss and radiation pattern measurements.

### Course Schedule

9 am to 5 pm with 1 hour lunch break each day.

## Short term course on “Metamaterials and Applications” December 14-20, 2017

### Registration Form

Name \_\_\_\_\_

Designation \_\_\_\_\_

Sex (M/F) \_\_\_\_\_

ORGANIZATION \_\_\_\_\_

Highest academic qualification \_\_\_\_\_

Address \_\_\_\_\_

Phone / Fax \_\_\_\_\_

Email (Compulsory) \_\_\_\_\_

Accommodation required Yes / No \_\_\_\_\_

Sharing / Single (Tick as appropriate)

Details of bank draft / electronic transfer:

Amount Rs \_\_\_\_\_

Draft No. / Transaction No. : \_\_\_\_\_

Dated: \_\_\_\_\_ Issuing Bank & Branch: \_\_\_\_\_

Date:

Place: \_\_\_\_\_ Signature

Recommendation and forwarding from the  
Organization:

Signature with seal of the  
Head of the Organization

## General Information

Situated at a distance of 130 km from Kolkata, Kharagpur welcomes you with its green, calm and quiet campus, away from the din and bustle of city life. In winter, Kharagpur is particularly pleasant with bright flowers all around with a mild and comfortable climate. Historically, IIT Kharagpur started its journey in the "Hijli Detention camp". Presently it houses a science and technological museum known as the Nehru Museum of Science and Technology. Also, the scenic township of Digha on the sea beach is only 120 km away from Kharagpur.

## 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.

## COURSE COORDINATOR

Prof. Bratin Ghosh

### Mailing address:

Prof. Bratin Ghosh

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Communication Engineering,  
Indian Institute of Technology,  
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pandaarabinda@gmail.com

Phone : +91-3222-283534

Mobile No. +91-9831064495

Fax: +91-3222-255303/283534

### 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: 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. Course fee includes breakfast/lunch/tea/snacks.

### Eligibility for Participation

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

### How to apply

Interested persons may apply in the form given herewith alongwith the registration fee in the form of demand draft drawn in favour of '**CEP-STC, IIT Kharagpur**', payable at Kharagpur or through **electronic transfer**. Bank information for electronic transfer is provided in the attached document. **The application should be sent to the mailing address of the course coordinator latest by December 4<sup>th</sup>, 2017.** The total number of seats in this course is limited to 25. In view of the limited seats, selection will be made on first come first serve basis.

### Course fee for Students:

#### Fees paid on or before 20<sup>th</sup> November, 2017

Individual: Rs.9,000/- (Rupees nine thousand only)

Group (3 individuals or more): Rs. 8,000/- per individual (Rupees eight thousand only)

#### Fees paid after 20<sup>th</sup> November, 2017

Individual: Rs. 11000/- (Rupees eleven thousand only)

Group (3 individuals or more): Rs. 10,000/- per individual (Rupees ten thousand only)

### Course fee for Industry :

#### Fees paid on or before 20<sup>th</sup> November, 2017

Individual: Rs. 18,000/- (Rupees eighteen thousand only)

Group (3 individuals or more): Rs. 17,000/- per individual (Rupees seventeen thousand only)

#### Fees paid after 20<sup>th</sup> November, 2017

Individual: Rs. 20000/- (Rupees twenty thousand only)

Group (3 individuals or more): Rs. 19,000/- per individual (Rupees nineteen thousand only)

### Course fee for Teachers/Others :

#### Fees paid on or before 20<sup>th</sup> November, 2017

Individual: Rs. 13,000/- (Rupees thirteen thousand only)

Group (3 individuals or more): Rs. 12,000/- per individual (Rupees twelve thousand only)

#### Fees paid after 20<sup>th</sup> November, 2017

Individual: Rs. 15,000/- (Rupees fifteen thousand only)

Group (3 individuals or more): Rs. 14,000/- per individual (Rupees fourteen thousand only)

Course fee includes lecture notes and refreshments during the course.

## Short term course

On

**“Metamaterials and Applications”**

**December 14 -20, 2017**

*A Continuing Education Programme of  
Indian Institute of Technology*

*Kharagpur*

*Prof. Bratin Ghosh*



**Organized by**

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

**The details of our Bank Account to enable electronic payment**

01.	Authority holding the Account	:	Dean, CE, IIT, Kharagpur
02.	Name of the Account as appearing in the Bank Account	:	CEP-STC
03.	Bank Account Number	:	9556 220 000 2955
04.	Name of the Bank	:	SYNDICATE BANK
05.	Branch Name	:	SRIC, IIT KHARAGPUR
06.	Address of Bank	:	SRIC, IIT KHARAGPUR Dist.: PASCHIM MEDINIPUR State : WEST BENGAL PIN : 7 2 1 3 0 2
07.	M I C R Code of the Bank	:	7 2 1 0 2 5 1 0 3
08.	I F S C Code of the Bank	:	S Y N B 0 0 0 9 5 5 6
09.	SWIFT Code of the Bank	:	S Y N B I N B B 1 2 0
10.	Nature of Bank	:	Non-SBI Bank
11.	P A N	:	A A A J I 0 3 2 3 G
12.	Contact person Phone Number E-mail Address	:	Dean, CE, IIT, Kharagpur : 03222 – 282111, 03222 – 282033 : deance@hijli.iitkgp.ernet.in

I hereby declare that the particulars given above are correct & complete to the best of my knowledge.

Date : 02/01/2017.

A. Goswami

Signature with Office seal  
Dean

Continuing Education  
Indian Institute of Technology  
Kharagpur-721302

Certified that the particulars given above are correct & complete as per records held with the Bank.

For SYNDICATE BANK

*2/1/17*

Signature of the Authorized Official of the Bank with seal