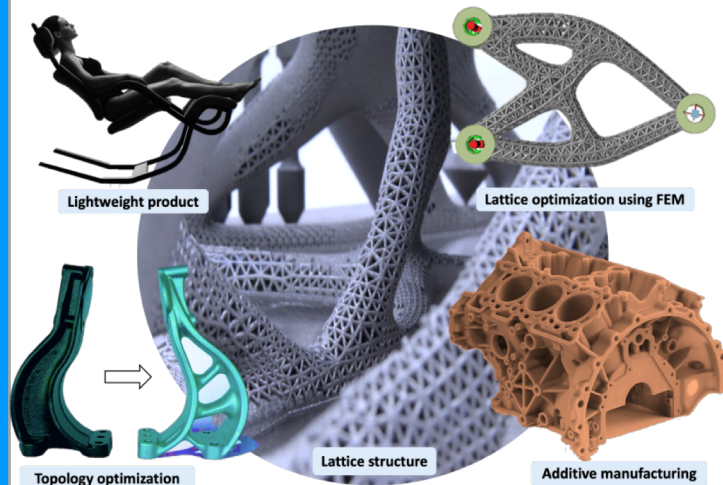


# One week workshop on Topology Optimization and Additive Manufacturing: FEM & Applications

3 - 9 June 2019



## Coordinators

Prof. Santosh Kumar & Dr. Om Prakash  
Department of Mechanical Engineering, IIT  
(BHU), Varanasi-221005

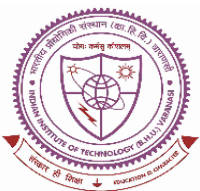
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Contact: 9140875035, 9816661166

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## Organized by

Department of Mechanical Engineering  
Indian Institute of Technology (IIT) (BHU)  
Varanasi-221005



## COURSE OBJECTIVE:

The cut-throat competition for light weight product with minimum cost puts designers and engineers under huge pressure to new product design development with optimization. Product topology optimization using Finite Element Method (FEM) optimizes material layout within a given design space, for a given set of loads, boundary conditions and manufacturing constraints with the goal of maximizing the performance of the system. Once the component design is finalized, it needs to be manufactured as a prototype first. This course aims at providing hands-on skills to product development and FEM analysis of the components of product at concept stage for light weight and efficient components. Furthermore, with the advent of new technology such as 3D printing (Additive Manufacturing), wherein any complex shape can be printed easily, topology optimization becomes even more imperative. At the end of this course, participants will be able to optimize and manufacture components during the theory & practice sessions.

## COURSE CONTENT:

### DAY 1

**AM & CAD:** Overview on product development process, Metal and Bio additive manufacturing, Rapid Prototyping techniques: SLA, SLS, FDM, 3DP, LOM, SGC, Product Lifecycle Management, CAD: 2D and 3D geometry generation techniques.

### DAY 2 & 3

**Concept of Product Design & Development:** Process & methodology, tools & Teams, customer needs, product function & structure, benchmarking & engineering specifications: portfolios and the architecture, concepts and morphological Evaluation, scoring & embodiment principles etc. Design for robustness & optimization:

**FEM Theory:** Finite element discretization, Weighted residual methods: Galerkin, Collocation methods; Weak form, Rayleigh Ritz method.

**Loads and Constraints:** Boundary conditions, various types of supports such as fixed, pin and roller joints, fasteners and joints, techniques for applying loads and constraints on hole centre etc.  
**Connections:** Techniques for modelling fasteners: nuts and bolts, screws etc., joints, generating various types contacts such as bonding, sliding etc.

**Static Analysis:** Modelling and comparing FEM results with theories for problems like critical stress, von Mises stress, calculating stress concentration factor, designing within factor of safety, running animation etc.

**Dynamic Analysis:** Design based on vibration analysis, how to extract mid-surfaces from solids, extracting structures natural frequencies (normal modes), fix and free modal analysis

### DAY 4 & 5

**Topology Optimization:** theoretical background, Shape Controls: How to apply manufacturing constraints such as draw directions and symmetry, how to apply draw directions (single, split and extrusion), how to apply stamping as additional manufacturing constraints etc.

**Minimization Objective:** Maximize stiffness or minimize mass; Optimization with various constraints such as frequency, stress, gravity, thickness and minimum factor or safety constraint.

**Lattice Structure Optimization:** Fit new free-form solid geometry on the optimized design, poly NURBS, Lattice structure optimization modelling techniques

**Additive Manufacturing:** Basic concept, evolution & Advantages, process chain & technology, Design for AM, process selection, Post processing & Application, Future of AM & product development & digital entrepreneurship

**DAY 6 & 7 :** Visits to Lab and local sightseeing

### WHO CAN ATTEND:

- Students/faculty/engineers from Civil, Mechanical, Structural, Automotive, Electrical, Construction, Aerospace, Biomedical etc. can attend.
- This course is not just a course, it is a skill building program. Anyone interested to enhance their skill in the CAE domain, are welcome to participate.

### CERTIFICATE:

A certificate of completion of the course would be issued to all the participants.

### LOCATION:

Varanasi Railway Station is well connected to almost all parts of the India. Also it is well connected via Air to Delhi, Mumbai, Kolkata, Hyderabad, and Bengaluru. There are frequent flight services from New Delhi. The Institute is located in the south of the Varanasi city and about 7 km away from Varanasi Railway Station and 30 km from the Babatpur (Varanasi) airport. Taxis, Auto-rickshaws, are available as transport.

### IMPORTANT DATES:

Early bird registration: before **1<sup>st</sup> May 2019**.

Last date of registration: **20<sup>th</sup> May 2019**

*Enquires should be addressed to:*

Prof. Santosh Kumar, Deptt. of Mech. Engg., IIT(BHU), Varanasi – 221 005

E-mail : [stccfdem@gmail.com](mailto:stccfdem@gmail.com)

### ACCOMMODATION:

Shared accommodation in the IIT guest house will be provided on payment basis.

### REGISTRATION FEE:

#### Before 1<sup>st</sup> May 2019

- IIT BHU student: Rs. 2000/-
- Non-IIT BHU student : Rs. 5,000/-
- Faculty member : Rs.10,000/-
- Industry professional: Rs. 14,000/-

#### After 1<sup>st</sup> May

- IIT BHU student: Rs. 3000/-
- Non-IIT BHU student : Rs. 7,000/-
- Faculty member : Rs.14,000/-
- Industry professional: Rs. 18,000/-

### REGISTRATION PROCESS:

- Send an email to [stccfdem@gmail.com](mailto:stccfdem@gmail.com) with the subject line STC19. Mention the list of participants interested to attend the course.
- Depending upon the seat availability, a provisional confirmations though email will be sent within 2 hour.
- After receiving email confirmation, kindly pay ONLINE within a week **OR** speed post the registration fee (Cheque/DD in favour of: **Registrar, IIT (BHU)**), payable at Varanasi, U.P) to the address given below
- Mention your name, designation (student, faculty or industry professional) address, mobile number and email id on the back of the DD/Check. The same information should also be sent as email. In case of many participants with a single DD/Cheque, use a separate sheet of paper to mention participants details. **There is no separate registration form.**
- If registration fee is paid via online transfer, the participant should inform the transaction details/proof of money transfer via email. Kindly mention participant's name in the remark section during the bank transaction.

### Address:

Write "Topology Optimization & Additive Manufacturing" on the top of the envelope and send Cheque /DD to the following address:

Prof. Santosh Kumar, Deptt. of Mech. Engg., IIT (BHU), Varanasi, U.P, India-221005

### ONLINE REGISTRATION FEE PAYMENT:

Name of account: **IIT (BHU)-Main Account (Special Fund)**

**Account holder name: Registrar, IIT (BHU)**

Bank name: **State Bank of India**

Branch: **IT-BHU**, Branch code: **11445**

Account No.: **32778803937**

Account type: **Current**

IFS Code: **SBIN0011445**

### EVALUATION AND GRADING:

There is will be continuous evaluation of each participants during the course on the understanding of the concepts and skills.

- A overnight assignment will be given to the participants whose evaluation will be done next day morning.

### COMMITTEES:

**Patron:** Hon'e Prof. P. K. Jain, Director, IIT (BHU)

### Organizing/Advisory committee, IIT (BHU)

Prof. Santosh Kumar

Dr. Om Prakash Singh

Dr. Md. Imtiyaz Ahmad

Dr. A P Harsha

Dr. SK Mahto

Dr. R Tyagi