About Indian Institute of Technology Delhi

IIT Delhi is one of the oldest technological institutes in India. The institute has nearly 35 academic units that imparts knowledge on Engineering, Science, Design, Social Science, among others. IIT Delhi has been instrumental in providing solutions to the technological and societal problems through its academic and research activities.

About SPARC

The Scheme for Promotion of Academic and Research Collaboration (SPARC) aims at improving the research ecosystem of India’s Higher Educational Institutions by facilitating academic and research collaborations between Indian Institutions and the best institutions in the world from 28 selected nations to jointly solve problems of national and/or international relevance.

About Arizona State University

ASU, a public metropolitan research university on five campuses across the Phoenix metropolitan area and four regional learning centers throughout Arizona, was established in 1885. ASU is one of the largest public universities by enrollment in the U.S. and offers over 350 majors to undergraduate students and more than 100 graduate programs leading to masters and doctoral degrees.

About Honeywell

Since mid-1980’s, Honeywell has manufactured Spectra fibers (UHMWPE fibers) in its Colonial Heights, VA., facility. In late 1980s, Honeywell’s Shield technology was invented and patented. Honeywell added fiber lines in the 1990s and 2000 and the plant has increased its capacity through process improvements and additional investments.

About of the Course

The course objectives are to introduce computational tools for ballistic materials along with associated manufacturing techniques. Hands-on training of computational tools will be a major part of the course.

Learning Outcomes

- Understanding of manufacturing techniques for composites and ceramics.
- Appreciation of computational tools for simulation of composite and ceramics materials.

Course Faculty

The following faculty members and technical experts will deliver lectures during the course.

Prof. Naresh Bhatnagar, Department of Mechanical Engineering, IIT Delhi

Prof. Subramaniam D. Rajan, School of Sustainable Engineering and the Built Environment, Arizona State University, USA

Dr. Ashok Bhatnagar, Fellow, Honeywell International Inc., USA

Prof. N. M. Anoop Krishnan, Department of Civil Engineering, IIT Delhi

Dr. Hemant Chouhan, Project Consultant, JATC-DRDO, IIT Delhi

Loukham Shyamsunder, PhD student, School of Sustainable Engineering and the Built Environment, Arizona State University, USA

Target Audience

The course is designed for post-graduate students, scientists working in the field of ballistics and personnel working in ballistic and related industrial establishments.

Prerequisites

An understanding of (a) manufacturing and mechanics of FRP composites and ceramic materials, and (b) Fundamentals of finite element method and model building.

Venue: Lecture Hall Complex, COE- Personal Body Armour, IIT Delhi

The course has limited seats to offer which will be allotted based on first come first serve.
Course plan

<table>
<thead>
<tr>
<th>Day</th>
<th>Forenoon (3 hrs)</th>
<th>Afternoon (3 hrs)</th>
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<tbody>
<tr>
<td>1 (4 Dec)</td>
<td>Introduction to high velocity impacts - projectiles, defeating threats, gathering data from impact events and case studies.</td>
<td>Introduction to LS-DYNA for Impact Analysis Part 1 - Examples using LS-PrePost and LS-DYNA.</td>
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<tr>
<td>2 (5 Dec)</td>
<td>Using finite element analysis for design by analysis - components of a model for impact analysis and case studies.</td>
<td>Introduction to LS-DYNA for Impact Analysis Part 2 – Composite modeling of simple systems</td>
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<tr>
<td>3 (6 Dec)</td>
<td>Composite material testing equipment and methods. Part 1</td>
<td>Experiments with UTM/SHPB/Shock tube</td>
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<tr>
<td>4 (9 Dec)</td>
<td>Constitutive modeling for composites</td>
<td>Introduction to LS-DYNA for Impact Analysis Part 3 – Composite modeling of impact events</td>
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<tr>
<td>5 (10 Dec)</td>
<td>Composite material testing equipment and methods. Part 2 – Case study involving T800/F3900 unidirectional composite</td>
<td>LS-DYNA MAT213 constitutive model – architecture and theory, verification and validation (V&amp;V)</td>
</tr>
<tr>
<td>6 (11 Dec)</td>
<td>LS-DYNA UMAT - FORTRAN programming, simple V&amp;V, constitutive modeling of UHMWPE.</td>
<td>Failure modeling of composite materials – challenges and opportunities.</td>
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<tr>
<td>7 (12 Dec)</td>
<td>Design, manufacture and testing of commercial UHMWPE.</td>
<td>Vacuum Compression Molding</td>
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<tr>
<td>8 (13 Dec)</td>
<td>Ceramics modelling-Introduction to Peridynamics</td>
<td>Peridynamics-Hands on</td>
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<tr>
<td>9 (16 Dec)</td>
<td>Tying Lagrangian explicit FEA with Peridynamics.</td>
<td>Water jet machining of composites</td>
</tr>
<tr>
<td>10 (17 Dec)</td>
<td>Improving manufacturability of UHMWPE hard panels using testing and regression analysis.</td>
<td>Experiments with Gas Gun on molded armor plates</td>
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Contacts:

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Course Fees
Students (PG only): 10,000
Government Lab Scientist: 40,000
Industry Personnel: 60,000

Registration link
https://forms.gle/RvjPueu41L1RRyiA9

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