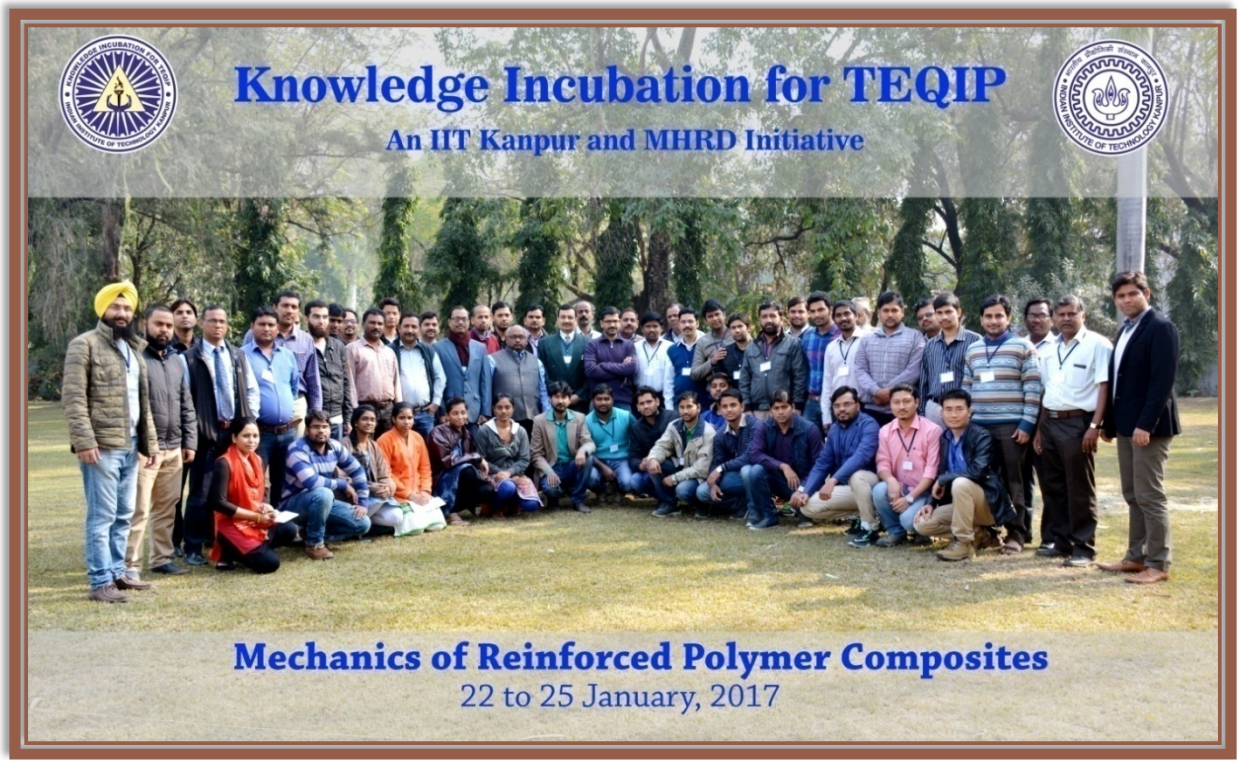
KNOWLEDGE INCUBATION FOR TEQIP, IIT KANPUR

# TEQIP School on Mechanics of Reinforced Polymer Composites

**January 22 - 25, 2017**




The 4 day school on **Mechanics of Reinforced Polymer Composites was** held at IIT Kanpur. It emphasised on the fundamentals of theoretical and experimental mechanics of reinforced polymer composites. From this school, participants got an exposure to the mechanics of reinforced polymer composites at macro as well micro levels and insights into experimental mechanics. The school also aimed at initiating short and long term association of students and faculty members from participating institutes with IIT Kanpur through internships, project appointments, possible PhD and post-doctoral positions, etc. This school was an excellent opportunity for the students who wish to explore or make career in the area of composite materials and structures.

The school also had hands-on session for both theoretical and experimental parts for better insight into the subject. Laboratory session was arranged for finite element modeling of laminated structures for static analysis using a commercial finite element software package. Experimental laboratory sessions introduced the participants about the processing and fabrication techniques available at IIT Kanpur.

## Topics Discussed

- Processing, Manufacturing and Fabrication
- Composites for societal applications
- 3D Constitutive relations and Planar constitutive relations
- Micromechanics of unidirectional fibre composites
- First-ply failure theories and damage mechanisms in unidirectional laminated composites
- Damage mechanics of unidirectional laminated polymeric composites
- Ensuring Structural Integrity of Composites
- Classical laminated plate theory and higher order shear deformable plate theories
- Buckling of laminated plate like structures
- Composite Aircraft Structures: A Design Perspective
- Experimental mechanics, fracture mechanics of laminated composites
- Machining of Composites
- High strain rate testing of composites, etc.

## Lab session

- Experimentation, characterization in composites, lab facilities
- Modeling of laminated structures using commercial finite element packages, static analysis, micromechanical analysis.

## List of Speakers

- Dr. Ramesh Sundaram,  National Aerospace Laboratories, Bangalore
- Dr. GN Dayananda, National Aerospace Laboratories, Bangalore
- Dr. PM Mohite, Department of Aerospace Engineering, IIT Kanpur
- Dr. Alfia Bano, Department of Civil Engineering, NIT Raipur
- Dr. CS Upadhyay, Department of Aerospace Engineering, IIT Kanpur
- Dr. Rajesh Kitey, Department of Aerospace Engineering, IIT Kanpur
- Dr. J Ramkumar, Department of Mechanical Engineering, IIT Kanpur
- Prof. P Venkitanarayanan, Department of Mechanical Engineering, IIT Kanpur

## Workshop Organizer:

**Dr. P M Mohite**
**Department of Aerospace Engineering,**
**IIT Kanpur**

# PARTICIPATING INSTITUTES

| Institute | Number of Participants |
|---|---|
| NIT, Jamshedpur | **2** |
| Panjab University Chandigarh | **1** |
| MNNIT Allahabad | **5** |
| HBTU, Kanpur | **6** |
| AMU | **9** |
| MMMUT, Gorakhpur | **2** |
| IFTM, Moradabad | **1** |
| IIT Roorkee | **2** |
| ADCET, Ashta | **1** |
| North Eastern Regional Institute of Science & Technology | **5** |
| UCEK , J N T University, Kakinada | **8** |
| FET, MJP Rohilkhand University | **1** |
| NIT Jalandhar | **1** |
| Government College of Engineering, Chandrapur | **1** |
| M.L.V Textile & Engineering College | **2** |
| Thapar University, patiala | **2** |
| UIET MDU Rohtak | **3** |
| Sreenidhi Institute of Science & Technology | **2** |
| Government College of Engineering, Salem Tamil Nadu | **3** |
| PSG College of Technology, Coimbatore, TamilNadu | **1** |
| Cambridge Instittute of Technology, Ranchi | **4** |
| BIET Jhansi | **1** |
| **Total** | **63** |

# Workshop Schedule

## January 22, 2017

| Time | Event |
|---|---|
| **8:30 – 9:00 AM** | **Registration** |
| **9:00 – 9:15 AM** | **Inauguration of School** |
| **9:15 – 11:15 AM** | **Invited Talk: Processing, Manufacturing and Fabrication.** *Dr. Ramesh Sundaram, NAL, Bangalore* |
| **11:15 – 11:30 AM** | **Tea Break** |
| **11:30 – 1:30 PM** | **Invited Talk: Composites for societal applications** *Dr. GN Dayananda, NAL Bangalore* |
| **1:30 – 2:30 PM** | **Lunch Break** |
| **2:30 – 4:15 PM** | **3D Constitutive relations and Planar constitutive relations** *Dr. PM Mohite, IIT Kanpur* |
| **4:15 – 4:30 PM** | **Tea Break** |
| **4:30 – 5:30 PM** | **Micromechanics of unidirectional fibre composites.** *Dr. PM Mohite and students, IIT Kanpur* |

**January 23, 2017**

| Time | Event |
|---|---|
| **8:30 – 10:00 AM** | **First-ply failure theories and damage mechanisms in unidirectional laminated composites.**<br>*Dr. PM Mohite, IIT Kanpur* |
| **10:00 – 10:15 AM** | **Tea Break** |
| **10:15 – 11:45 AM** | ***Invited Talk: Damage mechanics of unidirectional laminated polymeric composites.***<br>*Dr. C S Upadhyay, IIT Kanpur* |
| **11:45 – 1:15 PM** | **Invited Talk: Ensuring Structural Integrity of Composites.**<br>*Dr. PD Mangalgiri, IIT Kanpur* |
| **1:15 – 2:15 PM** | **Lunch Break** |
| **2:15 – 3:30 PM** | **Classical laminated plate theory and higher order shear deformable plate theories**<br>*Dr. Alfia Bano, NIT Raipur* |
| **3:30 – 3:45 PM** | **Tea Break** |
| **3:45 – 5:15 PM** | ***Buckling of laminated plate like structures.***<br>*Dr. Alfia Bano, NIT Raipur* |

**January 24, 2017**

| Time | Event |
|---|---|
| **9:00 – 10:30 AM** | **Invited Talk: Composite Aircraft Structures: A Design Perspective**<br>*Dr. GM Kamath, IIT Kanpur* |
| **10:30 – 10:45 AM** | **Tea Break** |
| **10:45 – 12:15 PM** | **Experimental mechanics, fracture mechanics of laminated composites**<br>*Dr. Rajesh Kitey, IIT Kanpur* |
| **12:15 – 1:30 PM** | **Machining of Composites**<br>*Dr. J Ramkumar, IIT Kanpur* |
| **1:30 – 2:15 PM** | **Lunch Break** |

| | |
|---|---|
| **2:15 – 4:15 PM** | **Lab visit/work:Experimentation, characterization in composites, lab facilities**<br>*Drs. Rajesh Kitey, PM Mohiteand students, IIT Kanpur* |
| **4:15 PM** | **Tea Break** |
| **7:30 Onwards** | **Workshop Dinner** |

**January 25, 2017**

| Time | Event |
|---|---|
| **9:00 – 10:30 AM** | **Invited Talk: High strain rate testing of composites, etc.**<br>*Prof. P Venkitanarayanan, IIT Kanpur* |
| **10:30 – 10:45 AM** | **Tea Break** |
| **10:45 – 12:45 PM** | **Lab work:Modeling of laminated structures using commercial finite element packages, static analysis, micromechanical analysis.**<br>*Dr. PM Mohite and student, IIT Kanpur* |
| **12:45 – 1:00 PM** | ***Valedictory function*** |
| **1:00 – 2:00 PM** | **Lunch Break** |

# Summary of Faculty Feedback

**Workshop**

| Questions | Excellent | Good | Ordinary |
|---|---|---|---|
| Clarity of communication about workshop | 17 | 6 | |
| Organization of the sessions | 16 | 6 | |
| Quality of lectures | 15 | 9 | |
| Quality of posters | 3 | 9 | |
| Effectiveness of discussions | 7 | 16 | |
| Effectiveness of learning experience | 8 | 14 | |
| | **Appropriate** | **Short** | **long** |
| Duration of workshop | 18 | 3 | 1 |
| | **Definitely** | **Maybe** | **No** |
| Would you like to have more such sessions? | 14 | 6 | 1 |
| Would you like e-lectures by experts on special topics? | 13 | 6 | |

| | |
|---|---|
| **Suggest specific topic that you would like additional expert lectures on** | • Optimization techniques.<br>• Pollution control and management<br>• Environment related analysis optimization with software exposure hydraulics, fluid flow behaviour.<br>• Some more on thermoplastic composite, nano-composite.<br>• Transport phenomena membrane, catalysis, modelling and simulation<br>• Finite element analysis<br>• Lab visit is not satisfied. There should be more slots in workshop for lab experiments.<br>• Devices & tools form safety measures handling composite materials.<br>• Finite element modelling of laminated structures by hands on training is required.<br>• Finite element<br>• Analysis of composite materials.<br>• Experimental characterization of FRP composites.<br>• Dynamics(Linear /Non-Linear vibration) of FRP Composites structures (beam/plate/etc)<br>• Soft skills for numerical analysis of composites.<br>• Beam Theory<br>• Finite element analysis<br>• Plasticity , crystal plasticity |
| | • Mechanics of functionally graded structures and stability of FG structures.<br>• Evaluation of fracture roughness of laminated composites.<br>• Experimental mechanics.<br>• How to use composite material as a structural load bearing material and a construction material.<br>• Some civil engineering related topic may be considered. |

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| **Additional Suggestions** | • Lab exposure should be more, it can be of five days.<br>• Mathematics part should be less.<br>• Kindly have workshop in July end.<br>• More concentration on lab. Visit and hands on training may be given.<br>• In single day so many topics have been covered which we can't understand effectively.<br>• Overall the organization of the event is ok.<br>• Duration of lectures must be closed at 3pm and for rest the 2 hrs laboratory based lectures may be arranged.<br>• In the morning of every day we can have some yoga classes (6am – 7am).<br>• At least one lecture on social responsibility for the nation must be there.<br>• At the end of the programme short kind of cultural programme may be organized.<br>• Include more of hands-on and laboratory sessions.<br>• Lectures delivered by the speaker were excellent technically. So experts should be always from seniors researchers of research centres and from IITs only.<br>• Laboratory class/demonstration should always be in support of the lectures wherever possible.<br>• Kindly conduct a workshop regarding preparation of specimen and testing of specimens.<br>• The workshop was really well organized and it was very beneficial for me to listen to such speakers.<br>• All sessions were really good<br>• I suggest to have a similar workshop of 2 weeks wherein theory as well as lab sessions go parallel. It will help all participants not only understand but also apply the knowledge they gain.<br>• Duration of workshops and conferences should be for long time. Maintain schedule of time. |

**Teaching**

| | |
|---|---|
| **Which subjects do you teach?** | • Modelling and simulation, Optimization, Pollution control<br>• Fluid Mechanics, Modelling for water flow, Engg Graphics.<br>• Structure &property of polymers<br>• Advanced polymer materials.<br>• Mass transfer, fluid mechanics, heat transfer, thermodynamics<br>• Finite element analysis, stability of structures.<br>• CAD/CAM, Advanced Manufacturing Technologies FEM etc.<br>• Manufacturing Technology.<br>• Material science & engineering<br>• Strength of Materials.<br>• Casting techniques, Engineering metallurgy, mechanics of composite materials, FEM for manufacturing<br>• Chemical processing<br>• Vibrating, Engg Mechanics.<br>• Adv mechanics of solids, mechanical. Vibrations, FEM, Robotics.<br>• FEM, Stress analysis.<br>• Strength of Materials, Engg Mechanics, Advance strength of materials, production development.<br>• FEM, solid mechanics<br>• Quality control techniques, fluid mechanics and basics of mechanics Engg.<br>• Finite element method, machine design, CAD, engg, Graphics, Machine parts.<br>• Metallurgy<br>• Numerical Methods, Processing of Composites, FEA<br>• Soil mechanics and foundation engineering.<br>• Geo-Technical Engineering & transportation Engineering.<br>• Manufacturing Science, fluid Mechanics |

| | | | | |
|---|---|---|---|---|
| **What is average student to teacher ratio in your institute?** | • 20:01<br>• 15:01<br>• 16:01<br>• 10:01<br>• 80:01<br>• 28:01<br>• 15:01<br>• 40:01<br>• 10:01<br>• 15:01<br>• 11:01<br>• 15:02 | | | |
| **Questions** | **YES** | | **NO** | |
| Do you have additional support forteaching (tutors, graders, teachingAssisttants, etc)? | 9 | | 14 | |
| Do you give class projects for UGclasses? | 19 | | 3 | |
| Do you give class projects for PG classes? | 16 | | 5 | |
| Do you have sufficient resources forlaboratory courses? | 12 | | 9 | |
| | **Sufficient** | | **Inadequate** | |
| Is the library/journal/e-connectionsupport adequate? | 11 | | 8 | |
| | **Definitely** | **May be** | **No** | |
| Would you like to have common(TEQIP) repository of coursematerial? | 19 | 3 | | |
| Would you like to visit IITK toparticipate in and develop coursematerial (existing or new) | 15 | 7 | 1 | |
| Would you like to participate increation of the repository material(course files/lab. Manuals/questionbank/etc) | 12 | 10 | 1 | |
| | **e-courses** | **Workshops** | **Content** | **none** |
| How can IITK effectively help youprepare for teaching? | 11 | 17 | 2 | |

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|---|---|
| How can TEQIP help improve your teaching? | • To provide basic teaching aids and library facilities.<br>• More funds should be allotted for training & to attend FDP in other institutions which may improve our teaching.<br>• It provides us opportunity to attend such programmes to increase our technical knowledge<br>• Sharing ideas on various topics, meeting to aero faculty of various institute at a common place through such kind of programmes.<br>• By providing course material for analysis subject.<br>• Funding for demonstration models<br>• Economical laboratory equipments developments especially for material testing.<br>• Allow us to work with premier institutions.<br>• By supporting financially for research infrastructure development in department and support for direct/indirect expenses for research scholars.<br>• By providing laboratory access at IIT Kanpur<br>• By attending different workshops organized in different organizations, I came to know what was unknown to me and also was not available in books.<br>• Having interaction with experts of different subjects is great.<br>• Help our institute to organize such workshop with the support of such faculties.<br>• TEQIP arrange expert talk time to time in our institute and facilitate for attending courses and workshops.<br>• TEQIP should improve our teaching quality. It provide the facility to improve our research work. |

**Research**

| Questions | Definitely | Maybe | No |
|---|---|---|---|
| Would you like to visit an IIT for a visiting-faculty/post-doctoral fellow ,if offered (via TEQIP)? | 16 | 5 | 2 |
| Would you like to share/use research infra- | 17 | 3 | |
| Would you like to conduct collaborative research with IITK? | 22 | 1 | |

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|---|---|---|---|
| Would you like lectures by experts (Indian and international) on niche research areas/topics? | 19 | 3 | |
| Do you want special-topic conferences? | 10 | 9 | 1 |

| | |
|---|---|
| How can TEQIP help improve your research? | • TEQIP can act as a mediator for providing interaction between various labs for uses of their facilities for the research.<br>• By lab development.<br>• By providing funds for developing research lab for advanced research.<br>• Journals availability.<br>• Funds for purchasing latest equipments centre facilities.<br>• Man power.<br>• Through summer internship<br>• If IIT faculty can mentor and provide lab facility to some projects<br>• If TEQIP can give funds to setup basic research facility<br>• Scholarship to M.Tech and PhD students.<br>• In our institution because of TEQIP we have purchased equipments that are necessary for doing research. More over for Phd and research scholars stipends are given using TEQIP funds.<br>• TEQIP provides us platform to interact with people of different technical research .<br>• Providing more fund for equipments and consumables.<br>• Sharing knowledge based ideas with various faculties at common place through programmes.<br>• We can use the laboratory of other institution as some of the institute do not have sufficient equipments for research.<br>• Through TEQIP so many students & faculty enhanced their academic degrees with their own expense it is quiet difficult to manage.<br>• If TEQIP provides sophisticated equipments for testing in the nearby IIT/NITs with common access to the nearby TEQIP institution will surely improve the research facility and rate.<br>• Through workshops update knowledge<br>• Travel and conference grants to attend the conferences<br>• Develop economical method of repositionary of various material properties.<br>• Provide us permission to use laboratory facilities at IIT Kanpur.<br>• State of the art laboratory development for practical classes and research work.<br>• Permit to attend international conference under TEQIP fund |

# Summary of Student Feedback

**Workshop**

| Questions | Excellent | Good | Ordinary |
|---|---|---|---|
| Clarity of communication about | 12 | 20 | 3 |
| Organization of the sessions | 14 | 19 | 1 |
| Quality of lectures | 15 | 18 | 2 |
| Quality of posters | 5 | 19 | 3 |
| Effectiveness of discussions | 8 | 14 | 4 |
| Effectiveness of learning experience | 4 | 19 | 3 |
| | **Appropriate** | **Short** | **long** |
| Duration of workshop | 18 | 11 | 2 |
| | **Definitely** | **Maybe** | **No** |
| Would you like to have more such | | 9 | 3 |
| Would you like e-lectures by experts on special topics? | 27 | 7 | |
| **Suggest specific topic that you would like additional expert lectures on** | • Modelling of composites by software.<br>• Elaborate discussion on damage mechanics and damage evaluation on composite material.<br>• Thermoplastic polymer matrix composite (PMC) manufacturing & fabrication<br>• I want to attend in future special expert lectures on these topics along with programming software like MATLAB.<br>• Some exclusive lectures on lingo cellulosic polymer composites if possible.<br>• Issues & challenges on the manufacturing process of composites.<br>• FEM formulation using MATLAB coding.<br>• More topics from fracture mechanics.<br>• Damage mechanism of laminates.<br>• Analysis of hybrid composites (Inter and Intra Hybrid composites.)<br>• Experimental testing.<br>• Lab work<br>• Matlab Simulation.<br>• Non-linear analysis of elements such as beams, plates and specially shells<br>• Finite element formulation using MATLAB<br>• The topic should also cover all the aspects related to nano-composite and their applications. | | |

| | |
|---|---|
| | • Biomedical application of polymer composite.<br>• Non-linear modelling of smart composite structures.<br>• Fabrication of composite materials and characterization of the same after validation or analysis of different type of composite materials.<br>• Non-linear finite element analysis and evolution of new materials for biomedical applications.<br>• Related to fluid dynamics.<br>• Model making issues in some commercial softwares.<br>• Multiscale Modelling<br>• Mathematical Modelling<br>• Numerical modelling.<br>• Some software talks should be arranged. |

| | |
|---|---|
| **Additional Suggestions** | • In teqip workshops, some lectures are very short & some lectures are very long.<br>• Should organize such schools on regular basis.<br>• Practical labs has to be added more so that we can learn by seeing more.<br>• Giving chance to young speakers is appreciable but not at the cost of their level of delivery & ease. Rest all is more than sufficient.<br>• Handouts & some worksheet should be provided with in the lecture. There should be checking or analysis of the level of understanding.<br>• Conduct such schools on regular basis as they are very helpful for students and gives them exposure to the recent researches in their field.<br>• Organize workshops more true to specific topics rather than covering broader view and do try to organize lectures in proper orders.<br>• Hands out or work sheets should be given during the workshop and also test should be taken to analyse the level of understanding.<br>• If any session is not relevant then we should not be forced to attend this.<br>• Please try to address all aspects of polymer composite (physical, chemical and biological)<br>• Arrange at least 5 days workshop because the APF index is zero for less than this. So please take this in your consideration.<br>• Please make sure to arrange equipments in future to perform some experiments related to the topic covered in workshop.<br>• If you arrange complete lab work in which making composite, testing and analysis in any software then it would be more beneficial for research work.<br>• It would be better if there is more focussed approach on lab visit and real time work apart from theory lecture.<br>• Sessions are very big, the timings of session have to be reduced.<br>• Need few more testing labs.<br>• Hands on software environment<br>• Programming Assignments.<br>• Sessions are very big please make it shorter & easier.<br>• Invited talks by prominent speakers will help alot.<br>• Course content, lecture delivery and acticulate of idea conveyed is very good. |

**Learning**

| Questions | Yes | No |
|---|---|---|
| Do you get enough class projects? | 19 | 10 |
| Is the learning adequate? | 24 | 8 |
| Do you have sufficient resources for laboratory courses? | 12 | 18 |
| What is your area of specialization | • FEA of composite<br>• Design<br>• Mechanical<br>• Machine design<br>• Manufacturing & automation.<br>• Polymer Matrix Composite<br>• Composite Materials (Production)<br>• Composite Materials.<br>• Natural fibre Reinforced polymer composites.<br>• CAD/CAM<br>• Non-Linear dynamics of plate structure.<br>• Machine Design.<br>• Design composite<br>• Civil Engg<br>• ME CADM<br>• Mechanical [CAD-CAM]<br>• Composites Structures FEM<br>• Composite Structure, Static Analysis<br>• Machine Design<br>• Polymer Composites<br>• Short composite beam<br>• Nano biotechnology<br>• Biomedical<br>• Metal Matrix Composites<br>• Nanotechnology<br>• Geometric & Material Non Linearity of smart composite structural.<br>• Natural fibre based hybrid composite material.<br>• Nano composite<br>• Heat transfer<br>• Structural Engg<br>• Structures. | |

| | Sufficient | inadequate |
|---|---|---|
| Is the library/journal support/e-connection adequate? | 15 | 11 |

| | Definitely | Maybe | No |
|---|---|---|---|
| Would you like to have common (TEQIP) repository of course material? | 26 | 3 | 3 |

| | | | |
|---|---|---|---|
| Would you like to visit IITK to attend specialized courses? | 26 | 4 | 2 |
| Would you like MOOCS/e-resources based courses? | 18 | 9 | 2 |
| How can TEQIP help improve your learning? | • By covering new topic in research<br>• By conducting workshops and by giving opportunity to us for attending it.<br>• Providing Financial support.<br>• By giving specific assignments related to my field.<br>• These types of school should be very frequent and number of participants should be less for effective learning.<br>• Helping researchers who are interested but lack resources, helping by making resources available by allowing to work with IITK or any other possible help.<br>• By making different opportunities available to students.<br>• By organizing support talks on our fields.<br>• By providing more expert talks & lab work.<br>• Duration of scholars and workshops can be extended to get adequate understanding of any topic.<br>• Expert talk should stick to the topic given, as topic was on polymer composite there should be synthesis.<br>• Expert should be called from different field to cover the entire topic.<br>• Expert called for lecture should be of adequate knowledge.<br>• By conducting more and more workshops at proper intervals related to our research work.<br>• More workshops<br>• Funding for resources. | | |

**Research**

| Questions | Definitely | Maybe | No |
|---|---|---|---|
| Would you like to visit an IIT for a short visit/internship/post-doctoral stint, if offered (via TEQIP)? | 32 | | 1 |
| Would you like to share/use research infra-structure at IITK, if made available? | 29 | 4 | |

| | | | |
|---|---|---|---|
| Would you like to conduct collaborative research with IITK faculty? | 29 | 4 | 1 |
| Would you like lectures by experts (Indian and international) on niche research areas/topics? | 28 | 5 | |
| Do you want special-topic conferences? | 28 | 4 | 1 |
| How can TEQIP help improve your research? | • Co-ordination and collaborative research in academic projects<br>• It helps me in better understandings about composites.<br>• Providing the facilities available at IIT to the non-IIT institute who do not have the facilities to carry out research study.<br>• By providing facilities, funds to the research scholars so that we can perform our research projects/experiments without any difficulty.<br>• By providing lab facilities and financial support. | | |
| | • 1 month research internship with reputed faculty along with some stipend.<br>• To arrange good & effective topics so that no IITian gets from IITs. | | |

# Outcome

- Participants got the chance to interact with experts of different field at common place.
- Participant got an exposure to the mechanics of reinforced polymer composites at macro as well micro levels and the insight to the experimental mechanics.
- The lectures delivered by speakers were very useful for participant to explore their research and career.
- The theoretical part of the school represented the different aspects of mechanics of fibre and particular composites.
- Advanced techniques presented by invited speakers.
- This school introduced the fundamental of characterization of composites under various conditions.

# Organizer's Report

*A Report on*

## School on Mechanics of Reinforced Polymer Composites

This school was organized by Department of Aerospace Engineering, IIT Kanpur under the aegis of TEQIP. The school was held from 22-25 January 2017. Two speakers, from the National Aerospace Laboratory, Bangalore, were special invitee and among others 8 speakers were from within and outside the IIT Kanpur. In this school total 57 participants from 20 institutions across India when the initial targeted participant size was about 25! The number of participants, probably, is the highest number among the schools, workshops, etc. organized by Knowledge Incubation for TEQIP, IIT Kanpur. The participants were mainly with Mechanical Engineering background. However, there were participants from Civil, Textile, Production and Chemical Engineering as well as from Chemistry, Applied Mechanics and Plastic Technology areas.

The speakers delivered over 23 hours lectures altogether. Further, a demonstrative laboratory session of 3 hours was held. Initially, it was supposed to be a hands-on session. However, due to overwhelming participation it was not feasible to accommodate the hands-on session. The participants were familiarized with the various composite handling processes like materials preparation, fabrication, sample and component making, testing, extracting and post-processing the experimental data. It was an excellent exposure to the participants. The participants are encouraged to utilize the facilities available at Aerospace Engineering. A session on modeling of laminated structures and micromechanical modeling of unidirectional fibre composites using commercial codes and MATLAB based codes for post-processing was also held. This code along with relevant software information is shared with the participants for their research work.

The school covered the broad areas of materials, fabrication, usage, fundamentals of modeling including a brief introduction on micromechanics, damage and failure, design, characterization, experimentation and machining.

In conclusion, the school was a success. There was a demand from the participants to hold another such a school or workshop on this subject. Many participants have expressed their desire and contacted various faculties of IIT Kanpur to collaborate with them in this area.

The course coordinator felt that the hands-on session was a shortfall in this school. This could have been another feather in the dissemination of knowledge to the participants. The course coordinator was highly encouraged by TEQIP Coordinator and extended all possible help.

Dr. PM Mohite
Course Coordinator
Associate Professor
Department of Aerospace Engineering
Indian Institute of Technology Kanpur