



KNOWLEDGE INCUBATION FOR TEQIP, IIT KANPUR

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# Dynamics and Vibration

June 30-July 3, 2014

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Dynamics and vibration are an essential part of the curriculum of engineering department like Mechanical, Aerospace, Civil, Chemical etc. These provide critical design and performance condition in many engineering operations, machine components, vehicles, buildings, bridges, tower and various other situations of engineering importance. It is taught at the undergraduate and post graduate levels in most engineering institutes. The 4 day workshop aimed at an exposure to the subject at various levels for the teaching faculty. Talks and discussions on the subject and special topics were delivered by experts from teaching institutes and industrial organization.

Workshop was planned to focus on following essential topics:

- Pedagogy - A balanced exposure to the subject at the UG level and PG level with essential topics that to be covered. Discussion regarding standard books on the subject.
- Rigid body dynamics
- Linear vibration
- Non-linear vibration
- Basics of random vibration

Pedagogical discussions were conducted in each part. The aim was to have a common course content and text and reference books across the universities and institutions of the quality circle. It was concluded that Dynamics and Linear vibrations should be mandatory for under graduate studies in Mechanical and Aerospace engineering. These were also considered to be very important for branches like Civil, Chemical and Metallurgy. Nonlinear vibration and Random Vibration should be in the courses of studies for post graduate curriculum and should be available as elective to under graduate students in the above branches.

Twenty hours of talks were presented in the workshop. The talks aimed at an introduction to each of the four parts part along with some topics that need special attention during teaching of these courses. Current research work in these areas were also introduced by various experts.

## **Topics Discussed**

- Essentials for a course in Linear Vibration
- Nonlinear Vibration– Geometric approach
- Free and forced vibration of discrete systems
- Random Vibration
- Nonlinear Vibration – Harmonically excited Duffing oscillator

- Damping and its implications for dynamic systems
- Random Vibration – Characterization
- Rotation in rigid body dynamics
- Essentials for a course on continuous systems
- Modal analysis and issues with strings and beams
- Random Vibration – Application to linear systems
- Nonholonomic constraints in Lagrangian mechanics
- Noise suppression
- Fluidized bed segregation of particles
- Vibration study of Sitar
- Helicopter blade dynamics
- Helicopter dynamics and vibration

### **LIST OF SPEAKERS**

- Prof. Vijay Gupta, PVC Sharda University
- Prof. A.K Mallik, IEST, Shibpur
- Prof. C. Venkatesan, IIT Kanpur
- Prof. Ishan Sharma, IIT Kanpur
- Prof. Pankaj Wahi, IIT Kanpur
- Prof. S. S. Gupta, IIT Kanpur
- Prof. AnindyaChatterjee, IIT Kanpur
- Prof. Abhishek, IIT Kanpur
- Prof. D. Yadav, IIT Kanpur
- Sri Ashish Bhateja, IIT Kanpur

### **PARTICIPATING INSTITUTES**

<b>Institute</b>	<b>Number of Participants</b>
Jadavpur University	1
MNNIT, Allahabad	1
HBTI, Kanpur	2
DCRUST Murthal	1
NIT, Raipur	1
GB Pant Engg. College Pauri Garhwal	2
<b>Total</b>	<b>8</b>

## SCHEDULE OF THE WORKSHOP

June 30, 2014

<b>Time</b>	<b>Event</b>
9:00 AM – 9:30 AM	Registration
9:30 AM – 10:00 AM	Inauguration
10:00 AM – 11:00 AM	<b>Essentials for a course in Linear Vibration</b> Prof. S.S Gupta/Prof. Pankaj Wahi
11:00 AM – 11:30 AM	Tea Break
11:30 AM – 12:30 PM	<b>Nonlinear Vibration– Geometric approach</b> Prof. A.K Mallik
12:30 PM – 1:30 PM	<b>Free and forced Vibration of discrete systems</b> Prof. Pankaj Wahi/ Prof. S.S Gupta
1:30 PM – 3:00 PM	Lunch Break
3:00 PM – 4:00 PM	<b>Nonlinear Vibration – Geometric approach, continued</b> Prof. A.K Mallik
4:00 PM – 4:30 PM	Tea Break
4:30 PM – 5:30 PM	<b>Random Vibration – Introduction</b> Prof. D. Yadav

July 1, 2014

<b>Time</b>	<b>Event</b>
9:30 AM – 11:30 AM	<b>Nonlinear Vibration – Harmonically excited Duffing oscillator</b> Prof. A.K Mallik
11:30 AM – 12:00 Noon	Tea Break
12:00 – 1:00 PM	<b>Damping and its implications for dynamic systems</b> Prof. Pankaj Wahi/ Prof. S.S Gupta
1:00 PM – 2:30 PM	Lunch Break
2:30 PM – 3:30 PM	<b>Random Vibration – Characterization</b> Prof. D. Yadav
3:30 PM – 4:00 PM	Tea Break

4:00 PM – 5:30 PM	<b>Rotation in rigid body dynamics</b> Prof. Anindya Chaterjee
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**July 2, 2014**

Time	Event
9:30 AM – 10:30 AM	Essentials for a course on continuous systems Prof. Pankaj Wahi/ Prof. S.S Gupta
10:30 AM – 11:00 AM	Tea Break
11:00 AM – 12:00 Noon	Modal analysis and issues with strings and beams Prof. Pankaj Wahi/ Prof. S.S Gupta
12:00 PM – 1:00 PM	Random Vibration – Application to linear systems Prof. D. Yadav
1:00 PM – 2:30 PM	Lunch Break
2:30 PM – 3:30 PM	Modal analysis (continued) Prof. Pankaj Wahi/ Prof. S.S Gupta
3:30 PM – 4:00 PM	Nonholonomic constraints in Lagrangian mechanics Prof. Anindya Chaterjee
4:00 PM – 6:00 PM	Visit dynamics and vibration lab – demo. Prof. Pankaj Wahi/ Prof. S.S Gupta

**July 3, 2014**

Time	Event
9:00 AM – 10:00 AM	<b>Noise suppression</b> Prof. Vijay Gupta
10:00 AM – 10:30 AM	Tea Break
10:30 AM – 12:00 Noon	<b>Fluidized bed segregation of particles</b> Prof. Ishan Sharma & Mr. Ashish Bhateja
12:00 Noon- 1:00 PM	<b>Vibration study of Sitar</b> Prof. Pankaj Wahi
1:00 PM – 2:30 PM	Lunch Break
2:30 PM – 3:30 PM	<b>Helicopter blade dynamics</b> Prof. Abhishek

3:30 PM – 4:30 PM	<b>Helicopter dynamics and vibration</b> Prof. C. Venkaesan
4:30 PM – 5:30 PM	Closure

### Summary of Faculty Feedback

Questions	Excellent	Good	Ordinary
Clarity of communication about workshop	03	05	00
Organization of the sessions	06	02	00
Quality of lectures	06	02	00
Effectiveness of discussions	04	04	00
Effectiveness of learning experience	05	03	00
	<b>Appropriate</b>	<b>Short</b>	<b>long</b>
Duration of workshop	04	04	
	<b>Definitely</b>	<b>Maybe</b>	<b>No</b>
Would you like to have more such sessions?	06	02	00
Would you like e-lectures by experts on special	06	01	01
<b>Suggest specific topic that you would like additional expert lectures on</b>	<ul style="list-style-type: none"> <li>• Different types of vibration absorption system.</li> <li>• Static &amp; dynamics, strength of materials.</li> <li>• Random vibration, Non linear vibration.</li> <li>• Rotation in rigid body dynamics.</li> <li>• Non linear Vibration.</li> <li>• Experimental techniques.</li> </ul>		
<b>Additional Suggestions</b>	<ul style="list-style-type: none"> <li>• Practicals are missing in workshops.</li> <li>• Include some lab sessions.</li> <li>• Some more lectures may be devoted to get expertise in the area.</li> <li>• Schedule of talks &amp; brief idea about the topics to be discussed may be communicated beforehand.</li> <li>• Course material on discussed topics.</li> <li>• There should be only two lectures for experimental exposure.</li> <li>• TEQIP should get feedback about expenditure.</li> <li>• There should be restriction on spending money on civil work.</li> </ul>		

## Teaching

Which subjects do you teach?	<ul style="list-style-type: none"> <li>• Mechanical vibration</li> <li>• Engg. Mechanics, Strength of materials, Mechanics of composites, Dynamics of structure.</li> <li>• Design and Dynamics of Machine.</li> <li>• Material Science &amp; Mechanical vibrations.</li> <li>• Measurement and control.</li> <li>• Basics of Mechanism, Machine design &amp; drawing.</li> <li>• Vibrations, CAD</li> <li>• Manufacturing/Numerical methods</li> </ul>		
What is average student to teacher ratio in your institute?	<ul style="list-style-type: none"> <li>• 20:01</li> <li>• 15:01</li> <li>• 20:01</li> <li>• 25:01</li> </ul>		
<b>Questions</b>	<b>YES</b>	<b>NO</b>	
Do you have additional support for teaching (tutors, graders, teaching Assistants, etc)?	04	04	
Do you give class projects for UG classes?	06	02	
Do you give class projects for PG classes?	06	02	
Do you have sufficient resources for laboratory courses?	01	07	
	<b>Sufficient</b>	<b>Inadequate</b>	
Is the library/journal/e-connection support adequate?	04	04	
	<b>Definitely</b>	<b>May be</b>	<b>No</b>
Would you like to have common (TEQIP) repository of course material?	08	00	00
Would you like to visit IITK to participate in and develop course material (existing or new)	07	01	00

Would you like to participate in creation of the repository material (course files/lab. Manuals/question bank/etc)	07	01	00
	<b>e-courses</b>	<b>Workshops</b>	<b>Content</b>
How can IITK effectively help you prepare for teaching?	04	06	00
How can TEQIP help improve your teaching?	<ul style="list-style-type: none"> <li>• Time to time organize the courses and workshop related to new research topic.</li> <li>• For providing such workshops &amp; STC.</li> <li>• It is very helpful to enhance our knowledge in that particular field.</li> <li>• By sending the expert to the home institution who can give their suggestion.</li> <li>• Curriculum development.</li> <li>• Providing study material.</li> <li>• Experimentation.</li> <li>• By providing funds for purchasing instruments.</li> <li>• Conducting core subjects workshops in the field of Mech. Engg. particularly in Manufacturing Engg.</li> </ul>		

## OUTCOME

In this workshop participants were introduced to teaching methodologies at the UG and PG levels with essential topics that should to be covered while teaching Dynamics and Vibration. They also discussed what standard books should be used for teaching the subject. Participants showed keen interest in conducting lab sessions in these workshops and suggested that TEQIP should organize workshops related to new research topics frequently. Discussions were held after the workshop to get suggestions from the participants regarding teaching and research in these areas. Some of these are:

1. Most institutes do not have properly trained faculty to teach and lead research in these areas. It is suggested that TEQIP should conduct 4-6 week workshop/schools in targeted areas to train faculty in these areas.
2. Faculty from the quality circle should come for a full semester to IIT Kanpur and associate with – teaching/ attending advanced courses and research in association with some experts here.
3. Faculty from the quality circle should collaborate with IIT Kanpur faculty in projects.
4. Under TEQIP mandate, work shop should be conducted in some quality circle institutes with talks from experts from IIT Kanpur and other Institutes. This would ensure larger participation from the local faculty and students.