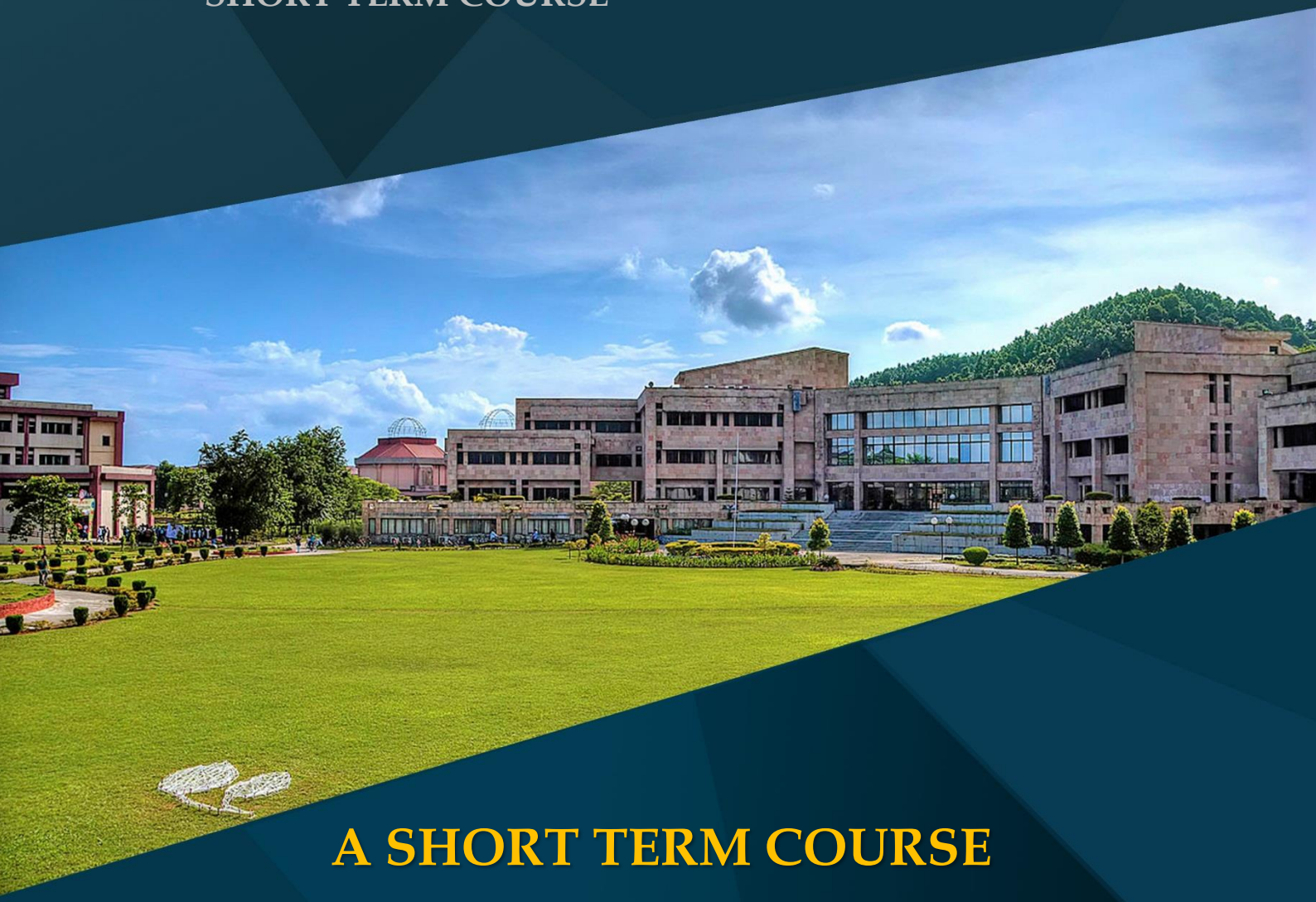
भारतीय प्रौद्योगिकी संस्थान गुवाहाटी
Indian Institute of Technology Guwahati

SHORT TERM COURSE



A SHORT TERM COURSE
on
Analytical Mechanics and its Applications

December 14th – 18th , 2020

Conducted by:
Department of Mechanical Engineering

Organized by:
Knowledge Incubation for TEQIP
Centre for Educational Technology
URL: http://www.iitg.ac.in/cet

ABOUT THE COURSE / EVENT

Analytical Mechanics deals with the study of motion of material bodies; it is called dynamics, or simply mechanics. Nowadays, invariably the term classical mechanics is also used to distinguish it from quantum mechanics. It includes Newtonian, Lagrangian and Hamiltonian approaches. In fact, these are related and it is often possible to transform the equations encountered in one approach to another approach. The knowledge of calculus of variations is required for that purpose.

This course is oriented towards providing knowledge and skill to students and researchers of Mechanical, Aerospace and Civil Engineering, besides the interested students from Physics. The details of the lectures are given in the program schedule. The lecture series starts with an exposure to a comparative evaluation of Newtonian and the Analytical approaches (Lagrangian and Hamiltonian). The advantages of the Lagrangian approach in handling complex dynamical systems is elaborated. The basic idea of constrained motion and the types of constraints are elaborated. The fundamental concepts like generalized coordinates, etc. are developed. The importance of the concept of virtual displacement and its use in analytical mechanics are demonstrated. Some basic concepts of vibrational calculus will be presented and finally the Euler – Lagrange equation of motion in terms of the generalized coordinates and generalized forces is developed through the application of d'Alembert's principle and the Principle of Virtual Work. The technique of Lagrange Multiplier for the determination of constraint forces and handling systems with non-holonomic constraints will be explained. Next the Hamilton's Principle will be derived. Hamilton's equation of motion will be derived. Suitable applications will be presented. Application of analytical mechanics related to composite materials, fracture mechanics, nonlinear structural problems, etc. will be discussed. Introduction to finite element methods for solving the equations of Analytical Mechanics will also be provided.

The key feature of the program is that the lectures will be accompanied by interesting tutorial problems. The main speaker Prof. Amitabah Ghosh is a well-known authority on this subject. Even the faculty members will find this course quite useful. At present, there are some good books on this topic, but several students feel difficulty in understanding the subject through the book because of the involved mathematics. Hence, an online course on this subject will be very useful for the participants.

Note: One dedicated session is allocated for the pedagogy.

PROGRAMME SCHEDULE		
Time	**Topic**	**Speaker**
Day 1		
09:00AM – 09:30 AM	Inauguration	
09:30AM – 11:00 AM	Introduction : Emergence of the major concepts of analytical mechanics; The Principle of Least Action; The approach for the application of the Principle of Least Action; Comparison of the Newtonian and the Variational Approach.	**Prof. Amitabh Ghosh**
11:00AM – 11:30 AM	Break	
11:30AM – 01:00 PM	Introduction to FEM as a method of solving differential equations	Prof. U.S. Dixit
01:00 PM – 02:00 PM	LunchBreak	
02:00 PM – 03:30 PM	Mechanics of composite material	Prof. S. Panda
03:30 PM – 04:00 PM	Break	
04:00PM – 05:30 PM	The concept of degrees-of-freedom and the generalized coordinates; Configuration space; Constrained motion and types of constraints – holonomic and non-holonomic constraints.	**Prof. Amitabh Ghosh**
Day 2		
09:30AM – 11:00 AM	Virtual displacement and virtual work. d'Alembert's Principle; Importance of virtual displacement; Virtual work principle combined with d'Alembert's Principle; the basic foundational principle of Lagrangian dynamics and the Lagrangian form of d'Alembert's Principle.	**Prof. Amitabh Ghosh**
11:00AM – 11:30 AM	Break	
11:30AM – 01:00 PM	FEM Analysis of simple Mechanics Problems	Prof. U.S. Dixit
01:00PM – 02:00 PM	LunchBreak	
02:00PM – 03:30 PM	Conservation properties of time finite element method	Prof. S S Gautam
03:30PM – 04:00 PM	Break	
04:00PM – 05:30 PM	Concept of generalized velocity; Kinetic energy and generalized force; generalized momentum and generalized inertia force; Derivation of Lagrange's equation for a standard system (i.e., a holonomic system with workless constraints).	**Prof. Amitabh Ghosh**

Day 3		
09:30AM – 11:00 AM	Definition of Lagrangian and the Lagrangian form of the Lagrange's equation; Physical interpretation of various terms and concepts.	**Prof. Amitabh Ghosh**
11:00AM – 11:30 AM	Tea Break	

11:30AM – 01:00 PM	Mechanics of orthotropic Laminated composite	Prof. D. Chakraborty
01:00PM – 02:00 PM	LunchBreak	
02:00PM – 03:30 PM	Analytical Methods in Fracture Mechanics	Prof. K.S. R. K. Murthy
03:30PM – 04:00 PM	Break	
04:00PM – 05:30 PM	The Lagrange multipliers and the determination of constraint forces; Lagrange multiplier technique for solving dynamics of systems with non-holonomic systems; Physical interpretation of the Lagrange multipliers.	**Prof. Amitabh Ghosh**
Day 4		
09:30AM – 11:00 AM	Review of Lagrange's equation and the Action Principle; Hamilton's Principle and derivation of Hamilton's Principle from Newton's law.	**Prof. Amitabh Ghosh**
11:00 AM –11:30 AM	Break	
11:30AM – 01:00 PM	Modelling of mechanical Metamaterials	Prof. B. Panda
01:00PM – 02:00 PM	LunchBreak	
02:00PM – 03:30 PM	Solution of Nonlinear Mechanics problems through qualitative analysis and perturbation method	Prof. S. K. Dwivedy
03:30PM – 04:00 PM	Break	
04:00PM – 05:30 PM	Basics of calculus of variation- definition of functional; Derivation of Euler-Lagrange Equation; Derivation of Lagrange's equation through Euler-Lagrange equation applied to Hamilton's Principle.	**Prof. Amitabh Ghosh**
Day 5		
09:30AM – 11:00 AM	Legendre transformation, the concept of Hamiltonian and Hamilton's equation; Canonical transformations; Properties of Hamiltonian and Hamiltonian Phase-Space; Hamilton's principal function and Hamilton – Jacobi theory.	**Prof. Amitabh Ghosh**
11:00AM – 11:30 AM	Break	
11:30AM – 01:00 PM	**Pedagogy:**	Prof. U.S. Dixit
01:00 PM – 02:00 PM	Lunch Break	
02:00 PM – 03:30 PM	Special topics of Analytical mechanics – Interpretation of Hamilton's principal function; Transition to quantum mechanics; The harmonic oscillator; Continuous systems; The electromagnetic field.	**Prof. Amitabh Ghosh**
03:30 PM – 04:30 PM	Valedictory	

ELIGIBILITY

The course/event is open to Faculty members/Students (strike off, whichever is not applicable) from TEQIP III mapped Institutions/ Engineering Colleges/ATUs. About 30% seats will be open for students and Faculty Members of other Institutions and Industry Members.

BOARDING AND LODGING

As the workshop is through online virtual mode, there will be no boarding and lodging facility.

IMPORTANT DATES

The last date for the receipt of duly sponsored application:
By email: scanned copy: 01/12/2020
Hard copy must reach by: 04 /12/2020
Intimation of selection: 6/12/2020

Registration Fee:

TEQIP members – No registration Fee
Non-TEQIP faculty members - ₹ 2500 + 18% GST /-
Non-TEQIP student members - ₹ 1000 + 18% GST /-
Industry Members - ₹5000 + 18% GST /-
Banking Details:
Branch Name - IIT Guwahati Branch
Bank Name- State Bank of India
Branch Code- 14262
Account Number - 33755947572

IFSC Code- SBIN0014262

SELECTION CRITERIA

Number of seats: 100
Selection will be based on First cum first served basis.

ADDRESS FOR CORRESPONDENCE

Prof. U.S. Dixit and Prof. S. K. Dwivedy
Course Coordinators
Department of Mechanical Engineering
Indian Institute of Technology Guwahati
Guwahati- 781 039
Email: uday@iitg.ac.in, **dwivedy@iitg.ac.in**

Ph.: 0361-258-2670 (O), 4670(R)

Application Form

1. Name (block letters):

2. Sex: ☐ Male ☐ Female

3. Category: ☐ General ☐ Reserved

4. Highest Academic Qualification:

5. Specialization:

6. Designation & pay scale:

7. Name of the organization:

8. Experience:

(a) Teaching: (b) Industrial:

9. Address for communication:

Pin code: Mobile No.:

E-mail:

Please register me for the course on **"Analytical Mechanics and its Applications"** to be held via ***online mode*** at IIT Guwahati.

I am sending an advance copy of this application by email to the coordinator of the course.

I undertake to send the Hard copy signed by the Head of my Institution.

Place:

Date: *Signature of the applicant*

SPONSORSHIP / NOMINATION CERTIFICATE

Prof/Dr./Mr./Ms./Mrs./.....

.....
is an employee/student of our institute and his/her application is hereby sponsored/nominated. The applicant is permitted to attend the online short-term course/workshop on "Analytical Mechanics and its Applications" at IIT Guwahati during 14/12/2020 to 18/12/2020 if selected.

I also certify that our institute/college is/is not (strike over which is not applicable) under the "Institution List" of 3rd phase of TEQIP Project of MHRD.

Date

Signature of Authority

Designation

Official Seal

Selected participants will be informed by e-mail. The duly sponsored/nominated application form should be mailed to:
(Name of the Course Coordinator)
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Prof. U.S. Dixit and Prof. S. K. Dwivedy
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North Guwahati, Guwahati-781 039, Assam
Ph. No. 0361-258 2670(O), 94353025 (M)
Email.: uday@iitg.ac.in and dwivedy@iitg.ac.in;
Website: https://www.iitg.ac.in/mech/TEQIP.php

ABOUT TEQIP

TEQIP conceived in pursuance of the NPE-1986 (revised in 1992) by Government of India as a long term program to be implemented in different phases. After successful execution of TEQIP II, TEQIP III starts from 2017-18 as Central Sector Scheme with a focus on the Low Income States, Northeast, Hill States and Islands. The third phase of TEQIP is also special in a way that it incorporates twinning arrangements between mentee & mentor institutions with an emphasis on Focused Training (PT) and Focused Interventions from IITs in terms of deliverables and accountability. KIT, established at IIT Guwahati under 2nd phase of TEQIP is a focal point for training Faculty, Staff and students from TEQIP-III institutions in Knowledge Engineering, Content Creation, Improving Teaching, Pedagogy & administrative skills in identified niche areas/disciplines.

ABOUT KIT

KIT (**K**nowledge **I**ncubation Cell for **T**EQIP) at IIT Guwahati functions as a multi-disciplinary as well as interdisciplinary Innovation Incubation Centre with a focus to impart Knowledge, infusing innovation and leading a path to achieve academic excellence. Its activities are in the area of improving quality of technical education, incubator of Innovative Ideas; implementer of contemporary pedagogy practices and development of Learning Content in Technical institutions while mentoring them.

ABOUT IIT GUWAHATI

SNAP OF CAMPUS

IIT Guwahati campus is spread over a sprawling 785 hectares plot of green land on the north bank of the river Brahmaputra around 25 km from the heart of the city. With hills and vast open spaces, the campus provides an ideal setting for training. Details on how to reach IITG Campus are available on the institute website

Website: www.iitg.ac.in