Organization and Administration of ICT Enabled Teaching-Learning

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E-learning

• Strategies for Effective Learner-Centric E-learning

• Strategies to develop and implement effective e-learning processes
Acknowledgments:

IIT Madras Web Studio and the Centre for Continuing Education
And
National Mission on Education through Information and Communication Technology (NMEICT)
Ministry of Human Resource Development
Government of India
Outline of lectures of course

Syllabus

Preliminary requirements for students to enroll

The outcome of learning

Class schedules

Exam schedule

Assignments and quizzes online.
Implementing an e-learning program from an academic Institution in India

Challenges
Technologies
Pedagogies
Mindset of peers and students
The directions of IITM alone and IITM with other IITs and IISc.
All are offset by the necessity to serve the community better than we have done since independence.
Challenges:

1. Development of e-learning content is an intense and time-consuming process.

One must know where to begin:

- Whole course?
- Lecture notes/Supplementary notes?
- Interactive tutorials to follow lectures?
- Assignments and quizzes only?
- Streaming video lecture contents?
2. Development of e-learning content must be targeted to a specific audience / group(s)

Is this an elementary course for a large number of students? Or, advanced?

What are the requirements/qualifications for taking the course?

What do you expect them to learn at the end of the course? (Objectives / goals as well as deliverables)
3. How does the teacher propose to interact with the students outside of the class?

Through E-mail?

Through forum-Initiated discussions/Discussion threads?

Through Chat?

All are time consuming processes

Employ well-trained Teaching Assistants/Content facilitators/tutors?
4. What assessment mechanisms that the teacher has at his/her disposal?—often policies of the institution.

Continuous evaluation? Periodically announced quizzes, mid-terms, presentations, submissions (assignments, term papers etc?)

Semester examinations only with both objective and analytic skills tested?

Machine corrected online examinations only?
Technologies

Online Course delivery is usually not sustainable in India till now:

Barring a few Institutions none of them have the hardware and software infrastructure.

The situation is changing but slowly.

Please give me 24 hour unfailing electricity and internet access.
Fibre-optic LAN is absent in more than 50 percent of Institutions in India.

Internet bandwidth in the most prestigious Institutions is under a meagre 100 MBps

Awareness of e-learning methodologies and implementation of online learning yet to take up in a big way.
Mindset of faculties and students:

Mindset of Faculty members
What motivates faculty members to e-learning and distance education?

Desire to use new technologies

Desire to implement new pedagogies

Desire to innovate teaching processes

To lead others in an organizational activity over and above research

To reach students outside of their own institution
What de-motivates faculty members to be away from e-learning and distance education?

Do not think they have sufficient time to do research and consultancy. Time taken for an electronic course is too much.

Do not think they have enough time to teach already in the traditional manner

Teaching using Internet is neither valued nor a scholarly activity.

Does not help in promotions or career advances

No financial incentives / reward schemes either
Not many students will attend the class if things are made available in the web

E-learning /distance education can and will threaten the livelihood of teachers and will obviate them in the society in the near future. Therefore “We” should not allow our demise for an administrator

Students best understand from professors through one-to-one interaction and all other forms of teaching-learning are inferior, secondary, of low quality.
Verbal cues and spontaneity of classroom discussion is lost. Also student’s input through their reactions allows the teachers to change the level of instruction instantly.

Only certain courses are amenable to learning through the internet and not all courses.
The teachers don’t trust the administration. Therefore if the administration insists on e-learning then there is a hidden agenda. The University wants to make money while not compensating the teachers adequately.

Faculty don’t like any one preaching e-learning while not actively involved himself / herself.
Strategies for Improving Faculty participation in an e-learning program:

Institutions must accept the responsibility for running e-learning programs

Information dissemination to faculty through periodic meetings, seminars, newsletters

Provide training and instructional support for faculty
Encourage faculty to adopt the technology in their own class rooms first by providing electronic classrooms—classrooms with internet facility, document reproduction on a large screen, LCD and computer in each class room
Strategies for Improving Faculty participation in an e-learning program:

- Provide incentives for faculties—financial, academic credit / enhancement of promotion for creating publishable e-content

- Encourage student community to work with faculty on creation of e-content

- Adequate central infrastructure for faculty to draw upon.

Mindset of students
Will I get a better grade if I read supplementary notes?

Can I download and print the notes?

The animations are not working in my Computer screen?

There is too much to read already.

My doubts are not cleared immediately when I am reading my notes. I have to wait for days to get a reply.
Summary

• Basic elements for course distribution through the Internet
  – Visualization
  – Text elements
  – Video

• Content aggregation

• Online distribution strategies

• Digital libraries

• Examples from my courses and the National Programme on Technology Enhanced Learning (NPTEL)
Basic Elements of Online Academic Contents

• Text, Visuals, voice, dynamical exchanges / motion / animation
• Interactivity, assessment and feedback
• Instructional design process is tedious as the students are generally anywhere, anytime and any pace learners
Basic Elements of Online Academic Contents

• Class room dynamics: (Teacher + students ---- synchronous (teaching and learning taking place at the same time)

• Improvisation in a class room and change in the intensity of learning subject to student attention– are all instant

• Designing contents online is a challenge, pedagogically and technologically
Basic Elements -- Organization
Basic elements-text and navigation

CY101 - Microscopic and Macroscopic Structures of Chemical systems

Course Contents

Lecture 1 - Historical preliminaries to quantum mechanics

Lecture 2 - The Schroedinger equation

Lecture 3 - Surface Plots of wave functions and their squares for the particle in a two dimensional (square) box

Lecture 4 - Postulates of Quantum Mechanics using particle-in-a-box examples

Lecture 4 - Part II - Particle-in-a-ring

Lecture 5 - Harmonic Oscillator - A simple model for the vibrational motion of a diatomic molecule

Lecture 6 - Hydrogen atom I

Lecture 7 - Hydrogen atom II

Lecture 8 - Bonding Preliminaries
\[
\text{Re} \left[ Y_1^1 \right] = -\sqrt{\frac{3}{8\pi}} \cos \phi \sin \theta
\]

\[
\text{Im} \left[ Y_1^1 \right] = -\sqrt{\frac{3}{8\pi}} \sin \phi \sin \theta
\]

\[
Y_1^0 = \sqrt{\frac{3}{4\pi}} \cos \theta
\]

**Flash file** Note that the Flash file axes are X and Z.

**3d file** The signs are due to the phi term which changes sign in the second and the third quadrant.

**Flash file** Note that the Flash file axes are Y and Z.

**3d file** The signs of the lobes are due to the phi term which changes sign in the third and the fourth quadrant.

**3d file** The signs of the lobes are due to the theta angle sonly since the function is independent of phi and is therefore the...
A layout for Flash Animation

PROCEDURE
1. Vary angle theta made by the vector with z axis for values (0 ≤ θ ≤ π)
2. Draw circle of radius r = cos(θ). Mark the point of intersection of circle with the vector
3. This plot is made for φ = 0

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<th>cos(θ)</th>
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<tr>
<td>180</td>
<td>-1</td>
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</table>
3D Animation-in avi file

Avi File:
about 7.2 Mb
Another example for animation

**PROCEDURE**

1. Vary angle theta made by the vector with z axis for values \(0 \leq \theta \leq \pi\)
2. Draw circle of radius \( r = (3\cos^2(\theta) - 1) \). Mark the point of intersection of circle with the vector
3. This plot is made for \( \phi = 0 \)

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<tr>
<td>180</td>
<td>2</td>
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Typical Components in a computer-aided instruction

- Text files
- Figures/graphs
- Animations/movies
- Voice/audio

An organizer
Online Delivery techniques illustrated using a course delivery platform

Brihaspati—HRD and MIT funded freeware

Freeware and commercial software are both available. On the Web you search under LMS or Learning Management Systems

---

Freeware:
- Claroline
- Moodle
- Atutor

Commercial software:
- WebCT
- Blackboard
- Acado
Welcome to IITM Web courses

Welcome to IIT M course on web. This site contains all the courses developed by faculty of IIT Madras.

Click the link above to access IITM courses on web.
Welcome to Professors and Students

Course categories

- Computer Science and Engineering 8
- Management Studies 23
- Civil Engineering 45
- Mathematics 6
- Humanities 15
- Chemical Engineering 23
- Engineering Design 4
- Introduction To Design 7
- Bio Technology 5
- Ocean Engineering 8
- Applied Mechanics 22
- Aerospace Engineering 7
- Chemistry 35

You are not logged in. (Login)
Welcome to Professors and Students

My courses

CY101: Chemistry I
Teacher: Mangala Sunder Krishnan

CY101_2008: Chemistry
Teacher: Mangala Sunder Krishnan

CY102: Chemistry II : Organic Chemistry
Teacher: Mangala Sunder Krishnan

CY306: Structure and Energetics of Biomolecules
Teacher: SUPRIYA ATTA
Teacher: kannna krishna
Teacher: Mangala Sunder Krishnan
Teacher: students students
Teacher: student study

CY5040: Principles of Quantum Mechanics
Assign roles in Course: QCG

<table>
<thead>
<tr>
<th>Roles</th>
<th>Description</th>
<th>Users</th>
<th>Users Description</th>
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</thead>
<tbody>
<tr>
<td>Teacher</td>
<td>Teachers can do anything within a course, including changing the activities and grading students.</td>
<td>1</td>
<td>Mangala Sunder Krishnan</td>
</tr>
<tr>
<td>Non-editing teacher</td>
<td>Non-editing teachers can teach in courses and grade students, but may not alter activities.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>Students generally have fewer privileges within a course.</td>
<td>35</td>
<td>More than 10</td>
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<tr>
<td>Guest</td>
<td>Guests have minimal privileges and usually cannot enter text anywhere.</td>
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Click here to enter your course.

Moodle Docs for this page

You are logged in as Mangala Sunder Krishnan (Logout)
A Review of valence shell electron pair Repulsion (VSEPR) theory.

(CS555 Lecture 4)

Dr. K. Mangala Sunder, Department of Chemistry, Indian Institute of Technology Madras.
Several examples for accurate prediction of shapes based on the above one criterion are available.

The following gives shapes, and examples of molecular species for each one of them.

1). Linear:

When there are two bond pairs the repulsion between them is a minimum for a linear configuration.

2). Bent:

Examine the structure of water molecule using VSEPR:

Molecular structure of H$_2$O

Bonding pair

Bonding pair

I lone pair
Question bank

Category: Default for CY555: Quantum Chemistry and Group Theory - Molecular Structure and Symmetry

Display questions from sub-categories too
Also show old questions
Show question text in the question list.

The default category for questions shared in context ‘CY555: Quantum Chemistry and Group Theory - Molecular Structure and Symmetry’.

Create new question: Choose...

No questions have been added yet
CY555: Quantum Chemistry and Group Theory - Molecular Structure and Symmetry

Question bank

Category: Default for CY555: Quantum Chemistry and Group Theory - Molecular Structure and Symmetry

Display questions from sub-categories too
Also show old questions
Show question text in the question list

The default category for questions shared in context 'CY555: Quantum Chemistry and Group Theory - Molecular Structure and Symmetry'.

Create new question
Choose...
- Calculated
- Description
- Essay
- Matching
- Embedded answers (Cloze)
- Multiple Choice
- Short Answer
- Numerical
- Random Short-Answer Matching
- True/False

No questions have been added yet
Import questions from file

File format
- Aiken format
- Blackboard
- Blackboard V6+
- Course Test Manager format
- Embedded Answers (Cloze)
- Examview
- GIFT format
- Hot Potatoes format
- Learnwise format
- Missing word format
- Moodle XML format
- WebCT format

General
- Category: Default for CY555:Quantum Chemistry and Group Theory - Molecular Structure and Symmetry
- Match grades: Get category from file, Get context from file
- Stop on error: Yes
Assignment (cy555)

Question 1
Question 2
Question 3
Question 4
Question 5
Question 6
Question 7
Question 8
Question 9
Question 10
Question 11
Question 12
Question 13
Question 14
Question 15
Question 16
Question 17
## Grader report

<table>
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<tr>
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<tr>
<td>Mohamed Akbar Ali</td>
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<tr>
<td>SUPRIYA ATTA</td>
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<tr>
<td>ASHOK BADEE</td>
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<td>AGHIVA BANERJEE</td>
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<td>Saswata Banerjee</td>
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<td>SOUTNRITA BARMAN</td>
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<td>tanei dalnath</td>
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<td>DEBAPRATA DHARA</td>
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<td>Manjusha Elizabeth Mathew</td>
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<td>KALIYANASMIT JANA</td>
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<tr>
<td>RANEESH KUMAR K</td>
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Content Pedagogy

The following slides were prepared by Prof. Anup K. Ray, IIT Kharagpur, for a National Programme on Pedagogical research. Permission to use is gratefully acknowledged.
Essence of Proposed Change

- **Combine best elements of Distance Education Systems with best of Institution Based Systems.**
  - Set learning objectives. Promote guided independent learning in institute ambience.
  - Ensure close *individual monitoring*, regular tutorial and feedback by teachers.

- **Use ICT to overcome problems of both.**
Outline of a learner-centric system

**Important Steps**

- Choose *Appropriate, Challenging but Achievable* Specific Learning Objectives

- Write them down in *clear and measurable terms using standard action verbs*

- Prepare study guides / learning strategies with detailed list of learning resources

- Make it available early to all concerned
● **Develop adequate self assessment material well matched with learning objectives to allow students monitor their progress and seek timely help.**

● **Provide suitable technology tools to allow:**
  ♦ *students to access learning resources, interact effectively with peers and mentors.*
  ♦ *faculty to monitor progress, evaluate and provide timely remedial lessons.*
  ♦ *external experts / industry to participate.*
Reduce lecture hours and increase tutorial hours to:

- discuss unsolved problems.
- conduct formative evaluations.
- provide individual feedback.
- allow more time for students to learn.

Promote use of active learning through simulation tools, virtual labs and also game based learning.

Design courses to promote collaboration, communication and problem solving.
Examples of Specific Learning Objectives
(from Prof Richard Felder)

• **Unacceptable**-- *Principles of pollution control.*

• **Poor**-- *Understand principles of pollution control*

• **Weak**-- *Be able to design a pollution control system for a phosphoric acid production plant*
Good--If given the flow chart of a chemical process production plant, be able to:

1. **identify** potentially hazardous pollutants (K)

2. **estimate** the likelihood that their emission rates will exceed EPA regulations (An)

3. **select** monitoring devices for all emission sources and **justify** their selection (Ev)

4. **design** a system for reducing an unacceptable emission level (Cr) and identify the possible flaws (An)
Technology Application Areas

- Collaboration tool for geographically separated experts.
- Rich multimedia content repository, search, sharing and organization tool.
- Collaboration tool for students.
- Assessment /feedback /evaluation tool
- Modeling, simulation, gaming tool.
- LMS, virtual laboratory /reality tool.
Implementing a learner-centric system

An example of a suitable curriculum structure from the project on

‘Developing suitable pedagogical methods for various classes, intellectual calibers and research in e-learning’

National Mission Project on Education through ICT
Ministry of Human Resource Development
Government of India
**Course Name**: Control Systems  
**Course ID**: EE 302/10-11  
**Institute**: XYZ Institute of Technology  
**Department**: Electrical Engineering

<table>
<thead>
<tr>
<th>Overview</th>
<th>Objectives</th>
<th>Summary</th>
<th>References Resources</th>
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**Abbreviations**:  
C: Course  
M: Module  
U: Units  
A: Audio  
V: Video  
Txt: Text
Spectroscopy teaching in India using NPTEL and MOOCs

Component topics

Quantum mechanics
- up to Hydrogen atom (Course I)
- Perturbation and variation, time independent (course II)
- Time dependent perturbation and scattering; angular momentum coupling (Course III)

Spectroscopy theory and experimental, along with simulations
- Introductory spectroscopy and lasers
- Microwave, infrared and electronic spectra, matrix elements and intensities
- Theoretical molecular spectra: Eckart frame, Watson Hamiltonian, effective Hamiltonians

Group theory
- Symmetry operations and elementary groups, character tables (Course I)
- Normal modes, point group classification, selection rules (course II)
- Molecular symmetry groups and Wigner-Eckart theorem (course III)
Quantum part and introductory molecular spectra in a MOOC format being offered from July 1 this year (Open to all and animation-rich)

http://onlinecourses.nptel.ac.in

Videos (between 15 and 30 minutes each; a topic may have more than one video)

Unit I:
- Particle in a one-dimensional box; two and three dimensional boxes with infinite barriers
- Particle on a ring and on a spherical surface: angular momentum and spherical harmonics
- Harmonic oscillator
- Electron in a hydrogen atom: the Schrodinger equation and solutions
- Pictorial / animated representations of wave functions, spherical harmonics (real and imaginary part)
- Calculation of average values and eigenvalues
Unit 2:

Introduction to electromagnetic radiation; interaction with dipole moments
Semiclassical description; Lab practices
molecular vibrations through harmonic oscillator models; triatomic molecules
Elementary electronic spectra, Born-Oppenheimer potential energy surfaces and
Franck-Condon principle

Advanced topics

The more advanced courses follow clear pedagogy, however lecture videos are NOT limited by 20-30 min duration.

Duration is a Semester-long, 40 plus hours of recording with additional learning materials as pdf.

Advanced courses are problem-rich and require discussions/elaboration of concepts; flipped class model is being used.

Elementary courses are animation-rich with numerous multiple-choice questions
p shapes

d shapes
f shapes
Group theory and spectroscopy: Simple animations for complex operations: Tetrahedron $S_4$
Group Theory - Simple animations for complex operations

Octahedron -- $S_6$
Group Theory - Simple animations for complex operations

Dodecahedron -- 15 C₂ Icosahedral Symmetry
Spectroscopy-rigid rotors, normal modes and beyond

Several video and text based lecture contents under NPTEL

Suggested mode:
Flipped Class by teachers for intermediate to advanced courses.

MOOC format with proctored exams for introductory courses with large registrations: use short videos and plenty of online assessments. In class, engage them with brief lecturing and intermittent clicker-based or similar instant responses to quiz.
Current topics under recording: video based online content (for supplementary online teaching-learning by a large number of post-graduate /honours students)

★ Elementary introduction to interaction of radiation with matter.
★ Time dependent perturbation theory and intensity via dipole moment matrix elements.
★ Angular momentum and matrix elements of various operators associated with rotation.
★ Symmetric and Asymmetric top Hamiltonians. Solutions for symmetric top
★ Normal Modes and anharmonicity- Introduction to perturbation matrix elements using harmonic oscillator raising and lowering operators.
Current ADVANCED topics under recording:
video based online content

Euler rotations and molecule-fixed angular momenta
Energy levels of asymmetric rotor and labeling transition frequencies
Anharmonic corrections: Morse oscillator
Rotation-vibration coupling and centrifugal distortion constants
General ro-vibrational Hamiltonian: The Watson Hamiltonian
Contact transformation and effective rotational Hamiltonians for each vibrational degree of freedom

Course currently underway till March 2016
NPTEL Phases II/III (contents being developed as 4 quadrants, integrated in the final form)

| Content--web based lecture notes / video lectures in an organized form | Animations/ visuals / illustrations, video demonstrations/documen
taries and interactive simulations wherever required |
<table>
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<tbody>
<tr>
<td>Supplementary reading/Wiki Development on the course, other resources /open content in the internet, <strong>Case studies, anecdotal information, historical development</strong> of the subject</td>
<td>Problems, quizzes, assignments and solutions, online feedback through discussion forums and setting up the FAQ</td>
</tr>
</tbody>
</table>
NPTEL, Virtual Labs, Online Curricula by NMEICT, OpenCourseware of MIT, Stanford, Yale, Open University, Curricula tailored from OERs worldwide: AN ENORMOUS OPPORTUNITY

✴ Offers opportunities for cross-disciplinary learning independent of time, geography and social needs for anyone.

✴ Professionals can update their knowledge while being on the job, without interrupting their service.

✴ Industry-academia partnership in training and re-training.

Teaching is short-duration delivery; Learning is a lifelong experience; Access the classroom, therefore, on demand.
I think, however, that there isn’t any solution to this problem of education other than to realize that the best teaching can be done only when there is a direct individual relationship between a student and a good teacher—a situation in which the student discusses the ideas, thinks about the things and talks about the things. It’s impossible to learn very much by simply sitting in a lecture, or even by simply doing problems that are assigned. But in our modern times we have so many students to teach that we have to try to find some substitute for the ideal. Perhaps my lectures can make some contribution. Perhaps in small place where there are individual teachers and students, they may get some inspiration or some ideas from the lectures. Perhaps they will have fun thinking them through—or going on to develop some of the ideas further.

Richard Feynman, Foreword to Lectures on Physics.
Thank you