Experiments in Creating Online Course Content for Signal Processing Education

TH3.PD: Signal Processing Education: Trends and Innovations
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Institutions

KTH Royal Institute of Technology, Stockholm

Technische Universität Berlin

Indian Institute of Science, Bangalore

Key Points

- A brief introduction to the NPTEL platform of India which provides free access to quality online education content for Signal Processing.
- Experiences of creating courses related to Signal Processing, supported by the European Union funded project, MIELES.

Modernizing and Enhancing Indian e-Learning Educational Strategies - MIELES

- MIELES[1] a Joint activity between European and Indian academic institutions.
- Objective of developing a strategy to utilise the power of online learning to enhance the learning experience of learners in India and Europe.

[1] *https://mielesproject.org/*

Need for E-Learning and MOOC platform in India

- Demand for trained engineers and technologists exceeds supply.
- Continuous Learning is key for human resources as new technical areas emerge.
- Traditional classroom mode of learning is dependent on the quality of trained educators.
- A majority of teachers are young, inexperienced and not well qualified.
- In e-Learning, the video content is created by an experienced educator and uploaded to a content delivery platform.
- The power of such online platforms is that it democratizes access to good educational content and enables good educators to have a greater reach for large scale impact.

National Programme on Technology Enhanced Learning - NPTEL

- NPTEL[2] is the largest online repository in the world comprising courses in engineering, basic sciences and selected humanities and social sciences subjects
- Instructors are faculty members from top academic institutions in India.
- The NPTEL YouTube channel has more than 1.5 million channel subscribers and more than 471 million views.
- 56,000+ hours of video content, 52,000+ hours of transcribed content, 51,000+ hours of subtitled videos.
- One of the most accessed libraries of peer-reviewed educational content.
- Certificates are issued on completion of courses. Proctored handwritten and/or electronic exams conducted at several geographical locations in India.

[2] *https://nptel.ac.in*

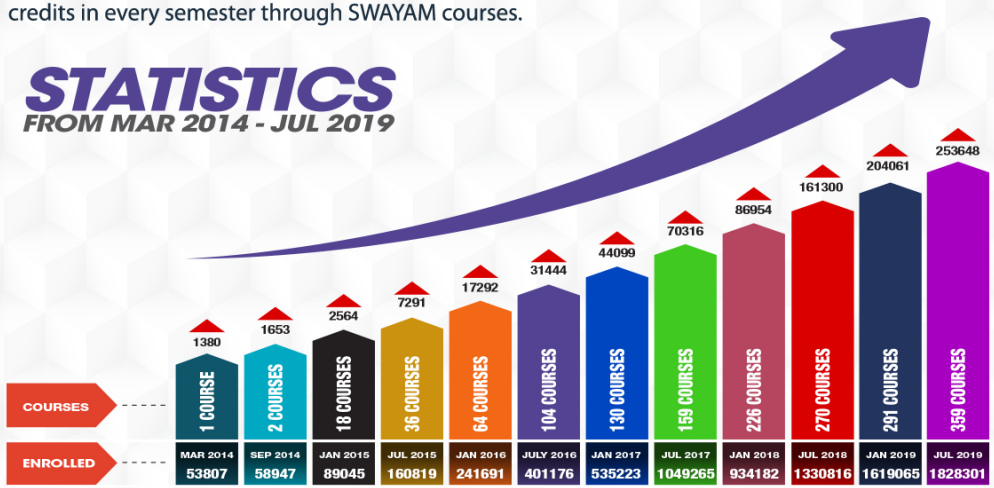
NPTEL


NPTEL
ONLINE CERTIFICATION
CERTIFICATES FROM THE
IITs & IISc
https://onlinecourses.nptel.ac.in
COMPLETED
1659 Courses
84 LAKH+ Enrollments
8.7 LAKH+ Registrations
JAN - APRIL 2020
370+ Courses
Secure https://onlinecourses.nptel.ac.in
NPTEL Online Courses
REGISTER
Elite
NPTEL Online Certification
STUDENT NAME
COURSE NAME
Step 1
Free online courses
(4/8/12 weeks duration)
Step 2
In-person Proctored Exam
(for a fee; choose from
100+ cities in India)
Step 3
Earn a Certificate
E-verifiable at nptel.ac.in/noc
AUDIENCE & BENEFITS
WEEKLY LEARNER ENGAGEMENT
76%
COLLEGE STUDENTS
LEARN FROM THE EXPERTS | INTERNSHIPS
NETWORKING OPPORTUNITIES | TANGIBLE END RESULTS
IMPROVE EMPLOYABILITY | LEARN AT ONE'S OWN PACE
19%
FACULTY
STRENGTHEN FOUNDATION | EXPLORE NEW DOMAINS
FACULTY DEVELOPMENT PROGRAM
KEEP UP CONTINUOUS LEARNING
5%
INDUSTRY
SKILLED RECRUITS | JOB READY HIRES
FRESHER TRAINING | EMPLOYEE RESKILLING
Watch the Video Lectures (3 to 4 hrs/week)
Test yourself: Weekly assignment (2 hrs/week)
Have a question? Discussion Forum (1 hr/week)
Notes / Text Transcripts/ References/ Live interaction (1 hr/week)

NPTEL

UGC / AICTE have recommended that students across India can earn up to 20% of their credits in every semester through SWAYAM courses.

STATISTICS
FROM MAR 2014 - JUL 2019



FACULTY FROM 30+ INSTITUTIONS OFFER COURSES

No! ENTRANCE EXAM ENTRY LEVEL CRITERIA

Attendance 90%

Pass Percentage 80%

Girls : Boys 40 : 60

Basically I don't see much of a difference between regular classes and online learning I look at online learning as new way of the 21st century NPTEL courses are enhancing learning thru technology The Discussion forum has been a great help as most questions that I had already been discussed there.

- **Pamir Roy** Student, NERIST, Arunachal Pradesh, First AI NPTEL Domain certified Candidate

NPTEL content is useful in filling the gap in learning. Here, one can learn from the best teachers in the country. For me NPTEL is the best platform for online learning since there is no prequalification, no age limit, and no entrance criteria to enrol. I feel myself privileged to be in the line of eminent learners from the world known organizations like ISRO, DRDO, Chennai Metro, and TCS etc.

- **Vijay More** Faculty

I am a Director at QUEST, in Bangalore and at 53+, am thrilled at my "academic" performance. Truly, the grey-cells are still active! This is turning out to be an amazing learning experience for me at 53+ ! I have 15 NPTEL Certifications,as on date. I have a passion for life-long learning!

- **Suresh Chandra** HS QUEST, Bangalore

USE OF NPTEL CERTIFICATE

"Better your career prospects"

Signal Processing Education through NPTEL and MIELES

- NPTEL has about 26 courses relevant to signal processing which include basic courses on signals and systems, analog signal processing, adaptive signal processing, video processing, wavelets, architectures, biomedical signal processing, machine learning and neural networks.
- The most popular NPTEL course on Digital Signal Processing has attracted over half a million views on YouTube and the course on Machine learning has attracted more than a quarter-million views.
- In the MIELES project it was envisaged to create courses relevant to signal processing by international faculty members from KTH Royal Institute of Technology (KTH) and Technische Universität Berlin (TUB).

Signal Processing Education through NPTEL and MIELES

- KTH offered a course in Machine Learning (ML)[3]
- KTH offered Electromagnetic Compatibility (EMC)[4]
- TUB offered the course Multimodal Interaction (MMI)[5]

		Exam		
Course	Enrolled	Registered	Present	Passed
ML	38,449	2,182	1,600	1,287
EMC	2,145	147	87	66
MMI	432	105	95	62

Table 1: Number of enrolments and students in the exams in the three courses, Machine Learning (ML), Electromagnetic Compatibility (EC), and Multimodal Interaction (MMI).

[3]ML course URL: *https://nptel.ac.in/courses/106/106/106106202/*
[4]EMC course URL: *https://nptel.ac.in/courses/108106138/*
[5]MMI course URL: *https://nptel.ac.in/courses/106106200/*

Signal Processing Education through NPTEL and MIELES - Novelty and Challenges

- Courses on EMC and MMI were not part of the NPTEL repository.
- The number of students who attended the online course far exceeded the classroom version at KTH, TUB.
- The NPTEL team produced text transcripts of all videos
- NPTEL organised a small group of teaching assistants that not only handled the student contacts but also helped with reviewing the lectures and the assignments.
- The biggest challenge observed was to design auto-gradable exam questions for problem solving tasks. The topic to be tested would require elaborate reasoning and written answers as in a classroom and adapting it to online medium of instruction was very difficult.

Signal Processing Education through NPTEL and MIELES - Conclusions

- It is recommended that educational institutions own the content, conduct assessment and provide degrees and certificates.
- To have course descriptions moving from syllabus to learning outcome oriented descriptions.
- Establish tight connections between learning outcomes, design of learning sessions and assessment tasks.
- Novel design of auto-gradable exam questions for problem solving tasks.
- Innovations in the design of virtual lab components in the online course designs.
- Global collaboration between the best institutions to deliver quality content online.

Acknowledgement

- EU Erasmus+ programme.
- MIELES Project partner institutions.
- Teams at NPTEL including Teaching Assistants.
- Dr. Benjamin Weiss, Prof. Dr.-Ing., Jens Ahrens (Chalmers University of Technology) Rahul Swaminathan, Center for Continuing Scientific Training and Cooperation[6] of TUB for the MMI course.
- Ramesh Hariharan and Pulkit Singh for the Mars orbit lectures and creation of the Mars orbit Notebook, respectively.

[6] https://www.zewk.tu-berlin.de

Questions?