Annexure I: Blended MOOCs Methodology proposed by IIT Bombay

1. **Conventional Classroom:** This provides face to face group interaction, permitting discussion, spontaneous questions, and synchronized attention of all students. These are some advantages which the MOOCs cannot provide. However, in conventional teaching, the course schedule is heavily 'lecture' oriented. Teacher speaks for most of the time in a class, leaving very little time for meaningful discussions. Students are required to solve problems at home, do assignments, and study on their own. Assessment is done through tests and examinations, conducted by the teacher for the entire class, on predetermined dates. In engineering education, a subject is typically taught in a semester long duration, ending with a final examination. Scheme of marking/grading is predefined.
2. **MOOCs:** MOOCs (Massive Open Online Courses) hold promise of a paradigm shift in teaching-learning methods established over centuries. They permit self paced learning. An online discussion-forum provides interaction between learners, and permits the instructor to answer specific questions, and clarify doubts. It is now possible for thousands of students to learn a subject from renowned teachers. IIT Bombay currently offers such courses on two platforms. The first is the 'edX' platform, comprising of a consortium of several leading universities of the world. These offerings are meant for global learners. The second platform is 'IITBombayX', which stands for the extended online educational services of IIT Bombay. These courses are administered by our Centre for Distance Engineering Education Program (CDEEP). The platform is specially built, by the NMEICT projects at IIT Bombay, to cater to specific needs for Indian learners, such as multi-lingual facility, T10KT programs, and blended MOOCs. This IITBombayX platform is developed on open source codebase of open-edX, and contains several enhancements.

   One problem with pure-play MOOCs, is that the students enrolling for a MOOC, and also studying the same subject for a regular degree program, are still required to undergo their regular semester long course in their Institute, and to give all the exams, to get a passing grade in that subject. This is in addition to giving all MOOC exams as well.

3. **Flipped Classroom:** Several teachers globally, including many at IIT Bombay, have used a 'flipped classroom' model, students of a class view the recorded video lectures online, study the material beforehand, and then come to the class. The entire 'lecture hour' is spent in problem-solving and discussion. Pedagogical techniques such as 'think-pair-share', are often deployed, strongly promoting active learning. Online discussion forum provides meaningful and elaborate explanations and examples, in an asynchronous manner. It has been found that this model significantly enhances the 'engagement' of students.

4. **Blended MOOCs model from IIT Bombay:** It is possible to combine the advantages of all the modes described in points (1) to (3) above. Such a model permits students of multiple Institutions to benefit from a single common offering of a course, with appropriate local variations, to study a specific subject. In our model, for each subject, a large team of teachers is formed, which is jointly responsible for running the course. The team includes the lead faculty member(s) primarily offering MOOC, and teachers from every participating Institution, who teach the subject face-to-face to students of their own Institutes. The team efforts will be coordinated by the lead faculty (currently from IIT Bombay). The lead faculty will be responsible for handling the entire MOOC part of content and assessment. Individual faculty members at each Institute, will be responsible for all face-to-face activities by students in their Institute, including finalization of their course grades and submitting these to their own institute. The discussion forum will be handled jointly by the entire team. A T10KT workshop will run in parallel for each course, for all participating teachers of that subject. This will be the main forum for the team of teachers to interact continuously during the course. From the point of view of individual teachers from participating Institutes, the course will run in the following manner.

   (a) Content: Teachers will study the entire MOOC content, and decide the portion which is same as per the syllabus for their Institute. If they wish, they can realign the syllabus as per the MOOC syllabus completely. Alternately, they may decide to treat some topics (which are not covered by MOOCs) independently, as they teach now.

   (b)Assessment: Teachers will study the assessment pattern of the MOOCs, which will largely comprise of a number of quizzes and a final examination, and could have some additional submissions. The grading pattern for MOOC may announce to consider the best score in, say, 5 out of a total of 8 quizzes, along with marks in final examination. The total score will be normalized to 100 marks, with clear apportionment for each quiz, assignment, and examination. This score, incidentally, will be used to decide the independent MOOC grade, to be awarded to each participating student of the course. Note that there will be thousands of learners doing the course, including students from other non-autonomous institutes.

   Teacher will then formulate what assessment will be done locally. Such assessment may have conventional tests and examinations, and local assignments. It is suggested that these should also total to a normalized score of 100 marks.

They will decide the proportion in which to combine the marks of two assessments – one from MOOCs, and the other done locally, to arrive at the final grade or marks for the students of their Institute, to be submitted as the final course grade. For example, one Institute may decide to use 80% of MOOCs score, and 20% of local score to arrive at the combined grade/marks. Another may decide to do the exact opposite, and decide to use 20% of the MOOCs score, and 80% of the local score. For subjects which have a strong overlap of MOOC content with the local syllabus, the first indicated proportion can be used. For subjects where substantial portions have to be taught locally, the second proportion may be more appropriate. There could be several other considerations for deciding the final proportion. Being autonomous, teachers and Institutes are naturally expected to take decisions as they think best.

Using the marks of MOOCs assessment solely, is not advisable for two reasons. The first and foremost is that such an approach will resemble the established university system where the teacher who teaches has no role in the assessment of students being taught. Since students know that someone else is setting the papers and these are being auto-graded, they will not pay attention to what the teachers are trying to emphasize locally. This will seriously compromise the autonomy of the teacher.

The second reason is that the MOOCS are not yet able to automatically handle long answers or reports. This being an important part of the learning by students, at least some local assignments, such as a course project, must be offered, guided, and assessed by teachers locally.

Using the score of local assessment solely, is also not desirable, as the students will not take the MOOCs portion seriously at all.

In deciding the proportion, teachers have complete flexibility. For example, one Institute may decide to use best score from, say, 4 quizzes, and the marks of final examination, from the MOOCs portion.

Whatever be the final decision by each Institute/Teacher, it must be announced formally to the students, at the beginning of the course, after due endorsement and approval by the concerned academic bodies of each institute. For its part, the lead faculty will supply the complete scores of all students to the concerned teachers/Institute, including individual marks scored in each MOOC assessment.

Teachers thus have the responsibility of conducting local assignments, assessing these, maintaining all assessment records, combining the marks

with MOOC marks in the decided proportion to arrive at the final course grade/marks, and submitting these grades/marks to their own institution.

(c) Duration of course: Each MOOC course will run for a pre-specified duration. Ordinarily, the duration is about 12 weeks, but may be extended depending upon the needs of participating Institutions, say to 16 weeks. If some Institutes have the semester from July to November, whereas others have it from August to December, the MOOC course may run for 16 or more weeks, with quizzes and final exam of MOOC appropriately scheduled. This matter needs to be discussed elaborately for each subject, to arrive at a duration which is meaningful for students of ALL participating Institutes.

(d) Conduct of a course: About one month in advance, teachers from participating Institutes will be given access to the entire course material including all practice problems. Quizzes and examinations conducted in earlier offerings, will also be made available. This will enable individual teachers to plan their own local teaching schedule.

When the students enroll for the course at an Institute, they will be advised to enroll on IITBombayX, and simultaneously register for the corresponding course. Teachers will supply the list of students from their Institute to the MOOCs coordinator. Then onwards, the progress of these students on MOOCs, will be regularly reported to respective teachers, through emails, and/or portals for downloading the concerned performance files.

All the teachers in the team, will remain in touch with each other through a separate discussion forum. The lead faculty of MOOC is responsible for arranging regular interactive sessions with all teachers of the team, using A-VIEW. At least one such session every fortnight, will be arranged by the lead faculty. If the teachers or the institutions so desire, their students can also participate in some selected face-to-face interactive sessions. The institutes will have to provide for the necessary classrooms and audio-visual infrastructure for this purpose. In fact, it is for this main reason that the initial offer of the blended MOOCs model, is being made to our T10KT RCs, which have the A-VIEW infrastructure.

Teachers are encouraged to offer a flipped classroom style engagement, for topics which are same in MOOCs and local syllabus. As mentioned earlier, this method permits extensive face-to-face discussions, with much greater time to be spent on joint problem solving sessions.

Individual teachers/Institutes may wish to supervise the attempts by their students in solving online quizzes, tests, and examinations of the MOOC portion; if so desired by their institutes. They will be facilitated by providing a

common predefined time window of a few hours, to conduct each such assessment. Each institution will be responsible for providing the on-line infrastructure, and for supervising the examination. This may provide the requisite sanctity to MOOC scores, for inclusion in the final grade/Marks.

All teachers from the team, are expected to contribute substantially to the discussions in the student forum (which is the main MOOCs forum), through their own postings of explanations and examples, which may originate during the local discussions in their own institutes.

(e) Closure of a course: A course will be considered closed when all participating teachers have prepared and submitted final grades/marks for their respective students to their Institutes. This date must be agreed on at the beginning by all participating Institutes. The course content will be kept accessible for at least two weeks beyond this date. If the participating Institutes so desire, a single re-examination may be conducted within the following week or the next. This will not change the MOOC grade of the student, but the marks scored in this re-examination may be used by individual teachers/institutions as they deem fit, for awarding a pass grade as per their respective norms.

5. **Financial considerations:** To operate effectively and efficiently, every formal educational system requires funds to conduct various activities. Blended MOOCs model must also be concerned about the revenue and expenses. IIT Bombay's philosophy for MOOCs courses is as follows:

   (a) The content will be free (all our MOOC content will be released later in open source), so that any student just auditing a course, need never pay any charges. However, no certificate will be issued.
   (b) Interaction with MOOCs faculty on discussion forum, and taking on-line examinations and assignments, require significant effort on the part of MOOCs course team. There will be a cost for these efforts. Thus such interaction, leading to a honor code certificate to the students, will require some charges to be paid. We have estimated that such charges will be about Rs. 500/- per course. However, as of now, IIT Bombay will <u>not charge</u> any amount towards the honor code certificate, as the effort is currently supported by funding from MHRD.
   (c) Recognition of MOOCs grade in the form of a verified certificate, to be recognized as regular grade by a university, is often considered desirable by a learner. Indeed, it is for such recognition that a learner enrolls for a regular degree program. In such a program, there are teachers who teach in a classroom, conduct examinations, and award grades, Students normally pay a fee/fees to the college or institutions conducting such

program, and also pay a fee/fees to the university for enrolment and examinations.

Recognition of a MOOCs grade in the form of a verified certificate, should therefore requires a fees to be paid, similar in nature to what is paid by the students to the college or university. We feel that it should range between Rs. 1500/- to Rs. 3000/- per course.

Currently, there is no system which recognizes MOOCs grades towards the credits of a regular university course of a degree program. We believe that our blended model offers a gradual path in that direction. The efforts required are now done by the MOOCs team and the local teachers together. The MOOCs team now has an additional responsibility of coordinating with all local teachers from participating institutes. Local teachers' efforts will be reduced for the activity of giving lectures and setting quizzes, but will be slightly increased for interaction sessions in the flipped classroom. We believe that, for the blended model, the cost of MOOCs efforts will be around Rs. 500/- to Rs. 700/-, whereas the cost of local efforts is covered by the fees paid by the students to the college. The MOOCs part of the /cost of the MOOCs part/ cost can be paid / recovered through the equivalent of university enrollment / examination fees paid by the student.

For this first ever offering of blended MOOC model, IIT Bombay will not charge any fees. For the participating institutions, there are no additional efforts or costs. It is therefore suggested that the current offering be done by us together, free of cost to students. In the coming months we could initiate discussion on the final financial model to evolve.

Brief Description of courses proposed to be offered as blended MOOCs

These courses are offered to IIT Bombay students as part of our regular academic programs.

1) Computer Programming (CS101.1x)

https://www.iitbombayx.in/courses/IITBombayX/CS101.1x/2015-16/about

This is the first of a two-part course, and corresponds to the major part of the Computer Programming course CS101 at IIT Bombay, dealing withprocedural programming using C/C++. In this part, basic concepts of computer programming are introduced starting with the notion of an algorithm. Emphasis is on developing the ability to write programs to solve practical computational problems.

The only prerequisite for this course is the knowledge of high school mathematics.

Topics include:
- Algorithms
- Elements of C/C++ programming languages
- Basic data types
- Sequential and conditional execution
- Iterative solutions
- Arrays, matrices and their applications
- Functions
- Sorting and searching
- Elements of string processing
- Introduction to pointers
- Basics of Software Engineering
- Structures
- File Processing

Participants will get to view short lecture videos, read and understand many sample programs, solve practice problems and give online quizzes/exams. They will have to write and submit several programs on their own. This course deals with procedural programming, and attempts to inculcate good programming practices.

2) Thermodynamics (ME209x)

https://www.iitbombayx.in/courses/IITBombayX/ME209x/2015-16/about

ME209x is a basic course in thermodynamics, designed for students of mechanical engineering. The three laws of thermodynamics (zeroth, first, and second) will be explored in detail, and the properties of materials will be studied. Many useful relations will be derived.It is based on 'ME209 Thermodynamics', a course at IIT Bombay for second-year Mechanical Engineering students.

As a Prerequisite to this course, basic knowledge of high-school physics and chemistry is assumed; ability to do college calculus (differentiation, integration, partial derivatives, and exact differentials) is required.

The topics include:

Basic concepts and definitions the work interaction
The first law, energy and the heat interaction
The zeroth law, temperature and scales of temperature
Properties of gases and liquids, equations of state
The second law, thermodynamic temperature scales and entropy
Relations between properties
Open thermodynamic systems

There will be an emphasis on problem-solving. Students will need to spend significant effort on solving exercises.

3) Signals and Systems (EE210x)

https://www.iitbombayx.in/courses/IITBombayX/EE210.1x/2015-16/about

This course provides the basic toolkit for any signal processing application - the abstraction of signals and systems, from the point of view of analysis and characterization.

We encounter signals and systems extensively in our day-to-day lives, from making a phone call, listening to a song, editing photos, manipulating audio files, using speech recognition softwares like Siri and Google now, to taking EEGs, ECGs and X-Ray images. Each of these involves gathering, storing, transmitting and processing information from the physical world. This course will equip you to deal with these tasks efficiently by learning the basic mathematical framework of signals and systems.

In EE210.1x, we will explore the various properties of signals and systems, characterization of Linear Shift Invariant Systems, convolution and Fourier Transform. Ideas introduced in this course will be useful in understanding further electrical engineering courses which deal with control systems, communication systems, power systems, digital signal processing, statistical signal analysis and digital message transmission. The concepts taught in this course are also useful to students of other disciplines like mechanical, chemical, aerospace and other branches of engineering and science.