

Study And Analysis Of Online And Hybrid Mode Learning Of An Engineering Course Conducted During COVID-19 Pandemic

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Abstract—A completely new situation emerged during COVID-19 pandemic for the engineering institutes in India. Various ad hoc strategies were used as per the understanding, suitability, and availability of resources for conduct courses in online mode. There was no prior experience of the same. Along with online mode of learning, hybrid mode was also adopted when institutes started reopening. It will be useful if these experiences are shared with both student and teacher's perspective. This paper gives study and analysis of online and hybrid mode learning based on instructor's observations and students' feedback and perception about these experiences. A framework for teaching and learning in hybrid mode is suggested for conduct of the courses based on the analysis.

Keywords—COVID-19, online learning, face-to-face learning, hybrid mode.

I Introduction

The higher education sector especially the technical education in India has become very competitive due to mushrooming of institutes. COVID-19 pandemic added more challenges for these institutes and forced them to go online in March 2020. It was a totally a new situation for all the stakeholders of this sector involving students, faculty, support staff, management, society, service providers, government, policy makers, employers etc. Especially for teachers & students it seemed to be difficult to adapt to in initial period. In the past two years it was either complete or partial lockdowns in India. During this period the higher education institutes in India adapted to online mode of teaching. When the situation started easing out after vaccination in July 2021, the institutes started face-to-face teaching learning along with online mode which will be termed as hybrid mode in this paper.

The experiences of both teachers & students will be useful to plan for future activities and improve the learning experiences of students. The hybrid mode of teaching-learning need to be studied

from the various perspectives. It is necessary because the current situation may continue for some time where all the students may not be able to report for face-to-face learning for some time. In addition, the advantages both online and face-to-face mode can be exploited to create more opportunities for students. This experience will also be useful to offer quality education at affordable cost.

There are different learning modes or models which need to be discussed here and the terminologies related to that need to be cleared. It is because, these terminologies are defined in literature in different ways and context

Face-to-face learning: It is traditional way of learning where both student and instructor will be physically present all the time during the conduct of the course.

Distance Learning: In this mode the students and teachers are at remote locations. The students are provided learning material (text, audio, video etc.) which they use for self-study. Some doubt clearing sessions are organized for the students.

Online mode: In this mode the student and teacher are at remote locations. If the student learns by attending live lectures, it is called synchronously online learning and if the student

learns through the recorded lectures, it is called asynchronously online learning. Asynchronous online learning is similar to Distance mode.

Blended Learning: In this mode of learning face-to-face course delivery is combined with online teaching material (text, audio, video etc.). This is also termed as hybrid mode in literature.

Hybrid mode: It is combination of online delivery and face-to-face delivery. In this mode there can be three different scenarios.

i) Blended learning as described above.

ii) All students need to attend both online & face-to-face sessions. Hence these sessions need to be scheduled or conducted separately.

iii) The students may be given flexibility to attend either in online or face-to-face mode. This model is also called hyflex model. In this model classes are conducted in the classroom where some students attend physically. These sessions are also made available online so that remaining students will attend in online mode.

From July 2021 to Dec 2021 the author had an opportunity to run a course in both online and hybrid (hyflex) mode. The experiences instructor and perceptions of students about this course are shared and analyzed in this paper. An effort to recommend best possible ways to conduct the course in hybrid mode is made through a suggested framework.

Hybrid learning concept is not new but the context in which it is now used is slightly different. In literatures prior to COVID-19 pandemic, it was used in context with mix of e-learning & Face-to-Face (FTF) learning [6]. It was also used in the context of mix of distance learning and face-to-face learning [7]. It was also termed as blended learning [8] [9].

When the COVID-19 situation started to ease out, the schools & colleges started opening. Due to insufficient infrastructure to accommodate students in the hostel & classrooms and not all students being fully vaccinated; the teaching-learning started in hybrid mode. That is students were given freedom to attend classes in both online and offline modes. The students who could report to the institute started attending the classes in FTF mode whereas remaining students continued attending in online mode.

2 Related Work

In [1] feedback analysis of outcome-based education is done using machine learning algorithm. The rating score given by students as their feedback does not reflect true sentiments. Hence textual analysis of their comments is carried out.

How students could or could not thrive in a sudden changeover to online learning due to COVID-19 is studied in [2]. The authors have interviewed first year engineering students undergoing Engineering Design course and applied workplace thriving framework for analysis of the feedback received from the students. One of the key recommendations of this work include creating sufficient opportunities for interpersonal relationships among the students and between teacher and students during online learning. These opportunities can be created by instructor as well as students themselves through self-motivation. The elements such as relationships with others, building and sharing knowledge through interactions, perceptions of experiential learning, and individual behaviors must be optimized.

Analysis of feedback given by students is also influenced by various factors such as attendance of students, their academic background, course outcome achieved, their own efforts etc. Paper [3] uses a machine learning technique called Naïve Bayes to refine the feedback analysis using quality features. It also recommends subjective feedback and outcome-based feedback to extract the quality features.

An in-depth study of hybrid learning can be found in paper [4]. It gives detailed SWOT analysis of hybrid/blended learning and tells how we can combine best of both face-to-face and online learning. Analysis of problems faced by instructors during the transition to online learning is also given in the paper.

An observational study of online education in engineering streams can be found in [5]. The results and recommendations of this study on the problems faced by students, faculty and administration during online learning will help in improving effectiveness of online engineering education during and after pandemic.

References of hybrid model of teaching-learning are found in pre-pandemic literature like [6] to [9]. In these literatures, the term blended learning

is also used for hybrid mode. It is used in the context of integration of face-to-face and online instructions.

A pedagogical study of experiences of online learning of students during first lockdown can be found in [10]. A survey of difficulties faced by students, access to resources, health issues etc. is carried out and analyzed with reference to their socio-economic background. This paper highlights the fact that hybrid model will be useful for the students as it offers flexibility to students. But the online component of hybrid learning should be judiciously used, and the students should be given some compulsory face-to-face sessions for interactions and practical work.

A detailed study of student's perception about various modes of study explained in section 1 can be found in reference [11]. The study indicates that online repeatable mode, where online real time lectures with their recorded versions was the most preferred mode of learning. Majority of student's seemed to be in favor of continuing with partial online learning post-COVID.

The college student's willingness to use mobile platform for online learning is studied and analyzed in [12] based on the various factors such as exploratory learning, self-efficacy, course quality & word of mouth.

A study of Instructor's views on distance education can be found in [13]. The study indicates extensive training of teachers in using online teaching tools.

A framework for development of e-contents is proposed in [14]. Cognitive theory to build multimedia learning can be used to improve student's learning. Learning environment, course contents and user interface are the three main aspects of e-content development. Effective use of this can result into quality e-contents.

Ethics code for online learning is proposed in [15] to address the challenges of online education such as academic integrity, digital privacy. Commitment of both teachers and students for teaching and learning, awareness about sensitivity to privacy of others are addressed in this work.

3 Methodology

It was decided to conduct observational & feedback analysis study of online & hybrid learning.

Study of the course in Data Structures (Theory & Lab) for second year engineering students of Bachelor of Engineering in Electronics & Telecommunication Engineering programme at Army Institute of Technology Pune is conducted. The course was conducted by the author himself. The Course started on 20 August 2021 and ended on 15 December 2021. Initially during 20 August to 20 Oct 2021, the classes were conducted in online mode due to pandemic and after 20 October when the restrictions were eased, students were given choice to attend the classes in hybrid mode. The course was attended by 61 students. More than 50% students started attending the classes in hybrid mode from 1 November 2021. Note that these students did not get opportunity to attend the engineering classes in offline mode since their first year. They were attending the classes in FTF & hybrid mode for the first time after their admission to engineering programme. At the end of the course a feedback was conducted. The feedback form is given in Appendix 'A'. The questions were formulated to assess various aspects of learning in online & hybrid mode. The level of understanding was assessed through course outcome feedback (Q No 1 to 8) and related questions (Q No 9 to 11). Feedback of online learning was collected through Q No 12 to 15. Feedback of students who attended classes in offline mode during hybrid learning was collected through Q No 16 to 19. A qualitative analysis of the feedback is done.

4 Feedback analysis of online & hybrid learning

The course outcomes or learning outcomes were evaluated through the course outcome feedback & evaluation of the students through various assessments conducted during the semester. In the course outcome feedback, more than 50 to 55 students (90 to 100%) have given highest rating for each outcome. The attainment calculation of course outcomes calculated through performance of students in tests and examinations do not yield similar results.

It was also decided to analyze the online and hybrid learning through some more descriptive questions in the feedback. The prerequisite for this course was knowledge of programming. Prelimi-

nary knowledge of C programming was added advantage. State of knowledge of C programming before start of the course was asked. 26 students had no prior knowledge of C programming. 30 students had basic knowledge of programming as well as C. At the end of the course, 43 students (78.18%) stated that they had clear understanding of C programming. This is approximately 15% less than highest course outcome feedback rating given by students pertaining to Course Outcome1 (CO1). Similarly, the feedback on state of knowledge about Data structures which can be also related to

CO2 to CO6 and both lab COs was taken through a descriptive question and options. 37 students (67%) stated that they have clear understanding of the concepts of data structures. This is also approximately 15% less than course outcome feedback rating given by students pertaining to CO2 to CO6 and Lab CO1 & Lab CO2. Performance of students was also evaluated through class tests conducted during this course and mapped to COs. Table 1 gives course outcome calculations based on the 3 different factors.

Table 1. Course Outcome Feedback Data

Course Outcome (CO)	% Students giving highest rating for Course Outcome (Course Outcome Feedback rating)	% Students stating maximum satisfaction (Descriptive Feedback)	% Students scoring more than 80% marks
CO1	100	78.18	56.67
CO2	96.36	67.27	83.33
CO3	96.36	67.27	86.67
CO4	96.36	67.27	66.67
CO5	96.36	67.27	78.33
CO6	90.90	67.27	48.33
Lab CO1	94.54	67.27	74.33
Lab CO2	90.90	67.27	76.55

The comparison is done based on highest rating for COs, Maximum satisfied students in descriptive feedback and best performing students in the course (Benchmark of 80%). Various issues related to student feedback are highlighted in [3] where, a probabilistic approach is used to mine the true feedback. The course outcome rating feedback given by students is more than 15% compared to their descriptive feedback & performance.

Hence, we can decide to use it or not for course outcome attainment calculations. A deviation of 5 to 10% can be acceptable.

Feedback regarding online mode of learning was obtained from students. The first question was regarding what went well during the online learning. The result of each response is given in Table2.

Table 2. Feedback of Online Mode Learning (What went Well)

Response	% Students Responded
The faculty was engaging & interactive	63.63
Ease of attending classes	42.27
Teaching material, Chat Box replies & posts by teacher and students were helpful	67.27
Could ask & clarify my doubts very easily	58.18
Could do some hands on along with teachers	50.90

In the online mode of learning, where students and faculty were at remote locations the main challenge was generating interest and increasing their interactions with faculty and peers. From above results, it can be seen that more than 50% students were able to participate in the activities carried out during the course to increase interactions and interest of the students. To improve this perfor-

mance, it is necessary to have some more innovative measures. Only 42% students feel that it is easy to attend classes in online mode. This low number may be due to connectivity issues and fatigue due to screen time which is reflected in the answer to another question.

The second question regarding online mode was regarding what did not go well during online learning. The result of each response is given in Table 3.

Table 3. Feedback of Online Mode Learning (Problems faced)

Response	% Students Responded
Frequent Connectivity issues	57.72
Fatigue due to more screen time.	60.00
No time for self-study	14.50
No interaction with faculty for clarification of doubts	3.63
No Peer learning	29.09

Above results indicate that, frequent connectivity issues and fatigue due to more screen time are the two major challenges or hurdles in the online mode of learning. Peer learning was another issue which is pointed out by 29% students. It is because during the course sufficient opportunities for interactions with peers were generated using chat box, group assignments, breaking room discussions, asking students to present or share their screens etc.

Out of 55 students who responded, 34 students attended the classes in hybrid mode; that is after 20 Oct 2021, they attended classes in person in the classrooms and whenever it was not possible for them to attend face-to-face, they attended in online mode. Since all the sessions were also available online from lecture hall, the remaining 21 students attended in pure online mode. The response of students who attended in hybrid mode was collected on various issues as given in Table 4.

Table 4. Feedback of Hybrid Mode Learning

Response	% Students Responded
The faculty was engaging & interactive	100
Ease of attending classes	58.82
Teaching material, Chat Box replies & posts by teacher and students were helpful due to hybrid mode	61.76
Peer learning	64.70
Could ask & clarify my doubts very easily	79.41
Could do some hands on along with teachers	61.76
No Connectivity issues	61.76
No Fatigue due to less screen time.	47.07
More time for self-study	35.29

Interaction with faculty for clarification of doubts	73.52
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Interaction with students was increased due to presence of students in the class. It is reflected in the responses# 1, 5 & 10 of the students in above results. There seems to be marginal improvement in ease of attending classes. The experience of these students for chat box replies, teaching material & posts was not similar to students attending in online mode. It was more helpful to online students than these students. It is because the students attending face-to-face cannot access it immediately. Because of the physical presence hands on sessions were more effective and useful for these

students. 65% students felt that they were benefited from peer learning in hybrid mode. It is because it becomes slightly difficult generate activities in hybrid mode which can aid peer learning. The screen tie could not be reduced in hybrid mode much. The students who attended in face-to-face were forced to use their laptops for hands on or look at larger screen in the classroom. Only 35% students felt that they could get more time for self-study in the schedule.

Various ICT tools & pedagogical techniques were used during this course. The response of students about this is given in Table 5.

Table 5. Feedback of Tools & Pedagogical Techniques Used

Response	% Students Responded
Use of Microsoft One note	63.63
Use of Microsoft Teams	61.18
Use of Moodle	54.54
Use of pen tablet	49.09
Use of Code-Blocks for programming	70.90
Hands on programming sessions & assignments	65.45
Breaking rooms for discussions	38.18
Group assignments.	50.90

Use of interactive tools such as Microsoft One-note, Teams, Programming IDE, Hands on Programming sessions etc. are rated higher by students compared to pedagogical techniques like breaking rooms, group assignments etc. These responses indicate that the teacher involvement matters more to the students. Use of Moodle, Breakout rooms for discussion, group assignments fetched low response due to this.

5 Framework for Hybrid mode of course delivery

Based on the experiences of instructor during the conduct of the course and analysis of feedback from the students, a framework for conduct of course in hybrid mode can be suggested. It is assumed here that the courses will be conducted by the instructor in the classroom. All the lectures will be available online as well. The students will be given flexibility to attend the course either in online mode or face-to-face. The framework is depicted in Table 6.

Table 6. Framework for Hybrid Mode Learning

Sr. No.	Name of Activity	Details
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1	Semester Planning	<p>Creating or adding facilities for conduct of hybrid classes. Training of teachers to use these facilities</p> <p>Preparing or updating SOP & guidelines for teachers and students for conduct of hybrid classes.</p> <p>Ethics code mentioned in [15] can also be part of the guidelines. The guidelines should clearly indicate about what percentage of course will be allowed to attend in online mode.</p>
2	Course Planning	<p>Preparing detailed teaching plan along with instructions to students regarding how it will be conducted and what pedagogical technique will be used for delivery.</p> <p>The techniques should be designed such that the students attending online will be involved with students attending face-to-face classes.</p> <p>The course study material can be made available in advance.</p> <p>The assessment and feedback planning will also be useful for mid-course correction.</p> <p>A separate session can be planned to interact and socialize the students.</p> <p>A session on mental health to cope with online mode can also be planned.</p>
3	Student Orientation & Demo Sessions	<p>The students should be oriented at the beginning of the course about conduct of the course in hybrid mode.</p> <p>They should be made aware about how they should attend the course. The detailed teaching plan can be explained to the students in this session.</p> <p>Few sessions in the beginning can be utilized to check if the students have understood the instructions correctly. This can be done through observations and informal feedback mechanism</p>
4	Course Delivery & Assessment	<p>It is necessary to include various innovative techniques which should create more opportunities for human interactions during the course delivery.</p> <p>Collaborative activities among students should be encouraged such as hands-on sessions, breakout rooms, chat box replies, role-playing exercises, pair-share, team-based case study discussions, and problem-based learning exercises etc.</p> <p>Communicating each and everything related to course on continuous basis will be the key. Student responses analyzed & queries need to be answered immediately in order to maintain the tempo.</p> <p>During course delivery, the record of students attending in online mode and face-to-face can be maintained. The students will be assessed regularly, and feedback will be collected from students.</p> <p>Since the students are given freedom to attend online sessions, there is possibility that some students may try to attend maximum number of sessions in online mode. Such students if found not participating in the course activities or not performing well should not be permitted to attend in online mode.</p>
5	Course & Semester End Activities	<p>The course outcome feedback and course end feedback will be collected from students at the end of the course or semester.</p> <p>This can be utilized for future corrections & planning.</p> <p>A peer review or audit to improve quality of the course delivery can help in understanding best practices, effective methods of course delivery etc.</p>

6. Conclusion & Future Work

A study and analysis of online & hybrid mode of teaching-learning of a course conducted during COVID-19 pandemic is carried out in this paper. Online mode cannot be an alternative for face-to-face learning, but the hybrid mode can be effectively used based on these experiences. A framework for implementation of hybrid mode is suggested. The various activities in the framework if planned properly, can result into effective course delivery for teachers and better learning experience for students.

This work is based on analysis of only one course and feedback from limited number of students. A study of different courses with involvement of more student participants can be carried out. Micro-planning of the activities suggested in framework can also be done based on this study.

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7 References

- [1] H. H. Lwin, S. Oo, K. Z. Ye, K. Kyaw Lin, W. P. Aung and P. Paing Ko, "Feedback Analysis in Outcome Based Education Using Machine Learning," 17th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), 2020, pp. 767-770, 2020. <https://doi.org/10.1109/ECTI-CON47248.2019.8955365>
- [2] Krishnakumar, S., Maier, T., Berdanier, C., Ritter, S., McComb, C., & Menold, J., "Using workplace thriving theory to investigate first-year engineering students' abilities to thrive during the transition to online learning due to COVID-19." *Journal of Engineering Education*, pp. 1-20, Jan 2022. <https://doi.org/10.1002/jee.2044>
- [3] Sandhya Maitra, Sushila Madan, Rekha Kandwal, Prerna Mahajan, Mining authentic student feedback for faculty using Naïve Bayes classifier, *Procedia Computer Science*, vol. 132, pp. 1171-1183, 2018. <https://doi.org/10.1016/j.procs.2018.05.032>
- [4] Singh J, Steele K, Singh L "Combining the Best of Online and Face-to-Face Learning: Hybrid and Blended Learning Approach for COVID-19, Post Vaccine, & Post-Pandemic World.", *Journal of Educational Technology Systems*, vol. 50, no. 2, pp.140-171, Oct 2021. <https://doi.org/10.1177/00472395211047865>
- [5] Asgari S, Trajkovic J, Rahmani M, Zhang W, Lo RC, et al. "An observational study of engineering online education during the COVID-19 pandemic", *PLOS ONE* 16(4), 2021. <https://doi.org/10.1371/journal.pone.0250041>
- [6] Lin, Oiuyun. "Student Views of Hybrid Learning." *Journal of Computing in Teacher Education*, vol 25, no. 2, pp. 57 – 66, 2008. <https://doi.org/10.1080/10402454.2008.10784610>
- [7] Fong, Joseph & Kwan, Reggie & Wang, Fu Lee & Qi, Yanli, "Analysis on Application of Hybrid Teaching Mode in Higher Education", *International Conference on Hybrid Learning (ICHL)*, 2008, pp. 161-168, 2008.
- [8] Graham, C. R. "Emerging practice and research in blended learning. Chapter 21." *Handbook of distance education*, third edition. Routledge: pp. 333-350, 2013. <https://doi.org/10.4324/9780203803738>
- [9] Dziuban, C., Graham, C.R., Moskal, P.D. et al. "Blended learning: the new normal and emerging technologies", *Int J Educ Technol High Educ* **15**, 3 (2018). <https://doi.org/10.1186/s41239-017-0087-5>
- [10] Bashir Amreen, Bashir Shahreen, Rana Karan, Lambert Peter, Vernallis Ann, "Post-COVID-19 Adaptations; the Shifts Towards Online Learning, Hybrid Course Delivery and the Implications for Biosciences Courses in the Higher Education Setting", *Frontiers in Education*, vol. 6, 2021. <https://doi.org/10.3389/feduc.2021.711619>
- [11] K. Yatigamma and G. Wijayarathna, "Students' Perceptions of Online Lecture Delivery Modes: Higher Education During Covid-19

Pandemic and Beyond”, Int. J. Emerg. Technol. Learn., vol. 16, no. 21, pp. pp. 58–73, Nov. 2021.
<https://doi.org/10.3991/ijet.v16i21.25305>

[12] Q. Feng and B. Feng, “Influencing Factors of College Students’ Willingness to Use Mobile Online Education Platforms”, Int. J. Emerg. Technol. Learn., vol. 16, no. 22, pp. pp. 29–41, Nov. 2021.
<https://doi.org/10.3991/ijet.v16i22.26067>

[13] B. Prevalla Etemi, T. E. Zulfugarzade, N. L. Sokolova, V. V. Batkolina, N. I. Besedkina, and R. G. Sakhieva, “The Qualifications and Views of Instructors in the Distance Education

System”, Int. J. Emerg. Technol. Learn., vol. 16, no. 22, pp. pp. 17–28, Nov. 2021.
<https://doi.org/10.3991/ijet.v16i22.26067>

[14] M. Hamdi and T. M. Hamtini, “Designing an Effective e-Content Development Framework for the Enhancement of Learning Programming”, Int. J. Emerg. Technol. Learn., vol. 11, no. 04, pp. pp. 131–141, Apr. 2016.
<https://doi.org/10.3991/ijet.v11i04.5574>

[15] R. Salhab, S. Hashaykeh, E. Najjar, D. Wahbeh, S. Affounch, and Z. Khlaif, “A Proposed Ethics Code for Online Learning During Crisis”, Int. J. Emerg. Technol. Learn., vol. 16, no. 20, pp. pp. 238–254, Oct. 2021.
<https://doi.org/10.3991/ijet.v16i20.24735>

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Appendix ‘A’

Course Outcome & Course end Feedback form

Please rate the extent to which your experiences in this course have helped you to acquire your ability to achieve: (5- To great Extent 1-Not at all)

This form will record your name, please fill your name:

1. CO1: Write C programs to solve, analyse and investigate a problem.

5 4 3 2 1

2. CO2: Use, Select & Implement searching & sorting algorithms to solve, analyse and investigate a problem

5 4 3 2 1

3. CO3: Use, Create, Select & Implement stacks & queues to solve, analyse and investigate a problem

5 4 3 2 1

4. CO4: Use, Create, Select & Implement linked lists to solve, analyse and investigate a problem

- 5 4 3 2 1
5. CO5: Use, Create, Select & Implement trees to solve, analyse and investigate a problem
- 5 4 3 2 1
6. CO6: Use, Create, Select & Implement graphs to solve, analyse and investigate a problem
- 5 4 3 2 1
7. Lab CO 1: Work in teams & as individual to implement various data structures & algorithms using C programming language
- 5 4 3 2 1
8. Lab CO 2: Analyse & interpret the results obtained by performing experimentation on given data, write reports & and present it.
- 5 4 3 2 1
9. What was your state of knowledge of C programming before start of this course (Select one)
- I had no knowledge of C programming
 - I knew only fundamental concepts of C programming.
 - I knew Basic C programming, arrays & functions and could write small programs
 - I had clear understanding of advanced C programming concepts including use of pointers and could understand & write C programs.
10. What is your state of knowledge of C programming after completion of this course (Select one option)
- I still have no knowledge of C programming
 - I know only fundamental concepts of C.
 - I know Basic C, arrays & functions and can write small programs
 - I have clear understanding of advanced C programming concepts including use of pointers and can understand & write C programs.
11. What is your state of knowledge of Data Structures (DS) after completion of this course? (Select one option)
- I still have no knowledge of DS
 - I know only fundamental concepts of DS.
 - I know basic concepts Data Structures & can implement some of them
 - I have clear understanding of DS concepts & can understand & implement data structures
 - I can use DS as a tool effectively to solve real life problems.
12. What do you think went well while attending this course in online mode? (Can Select more than one option)
- The faculty was engaging & interactive
 - Ease of attending classes
 - Teaching material, Chat Box replies & posts by teacher and students were helpful
 - Could ask & clarify my doubts very easily
 - Could do some hands on along with teachers
 - Any Other
13. If Q 12 Ans is Any other Please mention
14. What do you think did not go well while attending this course in online mode? (Can select more than one option)
- Frequent Connectivity issues

- b) Fatigue due to more screen time.
 - c) No time for self study
 - e) No interaction with faculty for clarification of doubts
 - f) No Peer learning
 - g) Any other Please mention
15. If Q 14 Answer is any other please mention
16. What do you think went well while attending this course in offline mode (if attended)? (Can select more than one option)
- a) The faculty was engaging & interactive
 - b) Ease of attending classes
 - c) Teaching material, Chat Box replies & posts by teacher and students were helpful due to hybrid mode
 - d) Peer learning
 - e) Could ask & clarify my doubts very easily
 - f) Could do some hands on along with teachers
 - g) No Connectivity issues
 - h) No Fatigue due to less screen time.
 - i) More time for self-study
 - j) Interaction with faculty for clarification of doubts
 - k) Any other Please mention
17. If Answer to Q 16 is Any other Please mention
18. While teaching this course following techniques were adapted. Which one do you think were more effective & useful? (Can select more than one option)
- a) Use of Microsoft One note
 - b) Use of Microsoft Teams
 - c) Use of Moodle
 - d) Use of pen tablet
 - e) Use of Code-Blocks for programming
 - f) Hands on programming sessions & assignments
 - g) Breaking rooms for discussions
 - h) Group assignments
 - i) Any other Please mention
19. If Answer to Q 18 is Any other option please mention
20. Any constructive suggestion/comments for improving the learning experience of students.
-