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Design and Development of Framework for Computation of CO Attainment of Unstructured Excel Data

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Abstract:

The Outcome Based Education system attempts to evaluate the skill levels of the leaner and minimizes the gap between the academia and industry by inculcating the requisite skills among leaners to prepare them industry ready. It focuses on the accurate assessment of the integrated curriculum. It is extremely essential to monitor the attainment of COs as devised by the corresponding course instructor. The direct attainment is based on the results of internal and external examinations. In many occasions such data is unstructured which needs to be cleaned and converted into structured data. In the current research authors have designed and developed a framework for determining CO attainment levels of unstructured Excel data employed a scalable N-tier application architecture. The direct method is employed for determination of CO attainment levels which generates the reports of CO attainment separately for formative and summative assessments which are further employed in determination of cumulative CO attainment levels. The reports can be exported to PDF and MS-Word format.

Keywords*: Bloom's Taxonomy, Course Objectives, CO Attainment, National Board of Accreditation, Outcome Based Education, Program Specific Outcomes.*

1.0 Introduction:

Globally, there is an increasing demand for employable workers and high-quality education. The threshold for the employability and professional success of recent graduates has been raised as a result of industry advances, worldwide competitiveness, and new business requirements. Indian Education System has introduced the Outcome Based Education System through National Board of Accreditation (NBA) (NBA Manual (2005) [1-3]. OBE is well-liked and has an emphasis on boosting curriculum delivery skills and teaching-learning processes. In OBE, there isn't a single

predetermined method of instruction or evaluation; rather, all of the classes, chances, and tests should support students in achieving the predetermined outcomes. The process guidelines support the development of curricula that enhance students' technical and soft skills, increasing the employability of graduates and post-graduates. Depending on the desired results, the faculty member's position may change to include that of an instructor, trainer, facilitator, or mentor. In order for UG Engineering Programs (Tier-II) to undertake a "Self-Assessment" of their educational quality, the NBA, which insists on "Outcome Based Education," has produced guidelines and templates. In order to satisfy the international requirements for technical education, the recommendations assist the institutions in enhancing their teaching-learning procedures. The institutions can satisfy the international standards and get respect around the world by incorporating these process guidelines and concepts into various Programs [4-7].

However, the current teaching-learning method leaves a mismatch between student knowledge and university curriculum. Regular classes alone, without any practical experiments or designs, will not have a positive effect on the performance of the students. The programme outcomes detail how well students can use their knowledge in professional core classes, electives, and projects while also demonstrating competence in the principles of basic functional areas. These results give the graduates the opportunity to continue their education and to build a successful professional career. Finally, outcome-based education has a significant impact on student outcomes and higher education as a result of deep learning and analysis.

1.1 Mapping of CO- POS:

The conventional teaching-learning approach involves classroom instruction using a chalkboard, OHP sheets, and modifications. Every subject is characterized by a course outcome (CO) in an approach called outcome-based teaching and learning, and each CO will target one or more programme objectives (POs). In any programme, creating acceptable COs for each course from the first to the final year of the programme is the first step in obtaining COs, POs, and PSOs. The relevant faculty member uses action verbs of learning levels recommended by Bloom Bloom, B. S. (1956) and Anderson, L. W., and Krathwohl, D. R. (2001) when writing the course outcomes. Then, on a scale of 1 to 3, a connection between COs and POs is determined, with 1 denoting the slight (low), 2 denoting moderate (middle), and 3 denoting substantial (high). In this regard, a mapping matrix is created for each programme course, including the elective ones. A group of senior faculty members regularly examine the written course outcomes and their mapping with POs before they are completed. The COs and the CO-PO mapping matrix for a sample course are displayed in the tables below:

1.2 Attainment of Cos:

According to the Accreditation Manual, course outcomes are more specific statements that outline the knowledge and skills that students should have by the end of each course. These are related to the abilities, information, and behaviour that students develop as they progress through the course. Mark Ovinis proposed and described a Comparative Analysis of Attainment of Program Outcomes for Courses with and without the Use of Modern Tools and the usage of modern tools has led to slightly better attainment. The outcome-based teaching process for microwave and radar has been defined by M. Vasantha Lakshmi (2014). The attainment of the Course Outcomes (COs) with Program Outcomes (POs) is compared using the Outcome Based Education presented in this study to the traditional approach.

The level of CO achievement can be measured based on the internal and external examinations conductedby the institute.

1.3 Course Attainment levels:

The Course attainment is based on semester-end examinations conducted, and internal assessmentsconducted periodically during the semester. The CO attainment is defined at three levels as follows:

Level	Criterion
Level-1	30% of students achieved more than the class average
Level-2	40% of students achieved more than class average;
Level-3	50% of students achieved more than the class average.

The target level is set (e.g., Level-2). It indicates that the current target is level 2; 40% of students achievemore than the class average. The CO attainment is measured based on the results obtained. Remedialactions are taken based on the results of attainment.

CO Attainment= 80% (Attainment level in end term examination) + 20% (Attainment level in internalexamination).

2.0 Literature Review:

There are plethora of research papers on CO attainment calculations. But all of them are based on the structured data. Kavitha A. et.al. [8] stated that the transition from Output Based Education to Outcome Based Education is the real need and demand of the educational system of the twenty-first century. The Outcome-Based Education (OBE) system can evaluate students' capabilities. Outcome-based education has many guiding principles, including a commitment to

education for all students and opportunities for accurate assessment in an integrated curriculum. For the purpose of evaluating CO and PO in an undergraduate engineering program, the paper's authors provided comprehensive strategies and a variety of approaches.suggested using a methodical strategy to quickly and easily align and analyze COs and POs for evaluation [9]. The discussions were based on the Diploma of Pharmacy course Basic Pharmacology and Pharmacotherapy of the Peripheral Nervous System (PHC214). Instruction was provided through didactic lectures and small-group tutorials. The author of this paper proposed a CO-PO mapping technique in which instructors first need to define the intended lesson objectives (Los) for their courses. The authors focus into the significance of accurate CO-PO mapping and how to calculate its attainment. According to the authors, CO-PO mapping and the attainment calculations associated with it are an essential component of OBE and contribute to continuous quality improvement, which is a feedback loop for OBR [10].Outcome-based education, a performance-based approach at the cutting edge of curriculum development, was mentioned by the authors of their paper as a powerful and appealing approach to reforming and managing medical education. Instead of focusing on the educational process, the focus is on the end result—the type of doctor that will be produced. The authors formulated a three-circle model that can be used to present the learning outcomes in medical education [11].In their paper [12] authors described the background of the method used to assess the attainment of the Cos and the results are produced for the Applied physics course in diploma engineering. This assessment was conducted for one of the programs of first-year diploma with a strength of 60 students. The method uses data that has been obtained from student's marks in final theory and practical exams, test, assignments, project and other formal assessments. A computerized system using a spreadsheet has been developed based on this method to expedite the analysis process. Most of the proposed work focuses on a robust and simplified method for measuring COs and POs achieved. Measurement of the achievement of Program Specific Outcomes (PSOs) can be added to this strategy [13-15].

3.0 Research Methodology:

3.1 Application Framework:

Fig 1. depicts the scalable N-Tier application framework for determination of CO attainment levels. The unstructured Excel data is cleaned and converted into structured requisite format for further processing. The customization information is input to the application in industry standard JSON format. The data tier interacts with the MySQL database. The business logic tier is implemented in Java classes which employs 'org.apache.poi.hssf.usermodel', 'org.apache.poi.xwpf.usermodel' packages for interfacing with Excel and Word documents. The reported can be exported in Word or PDF format.

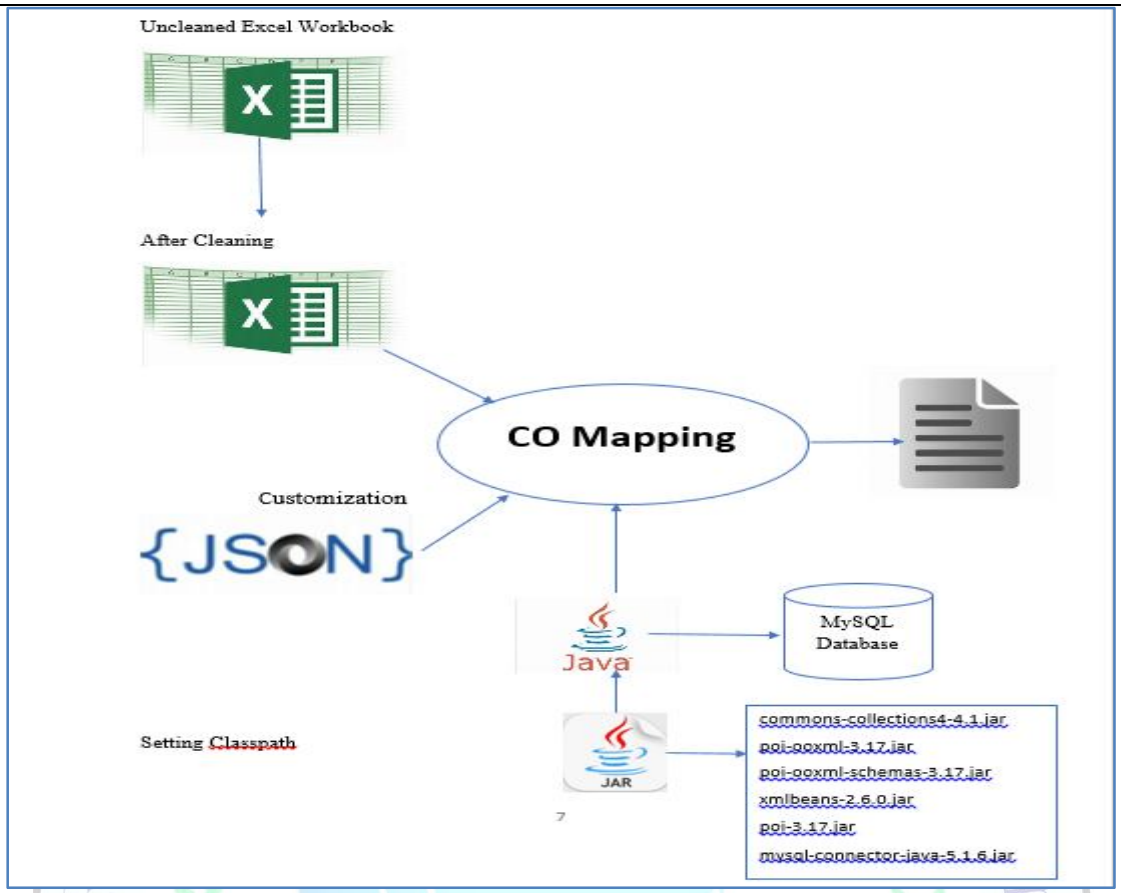
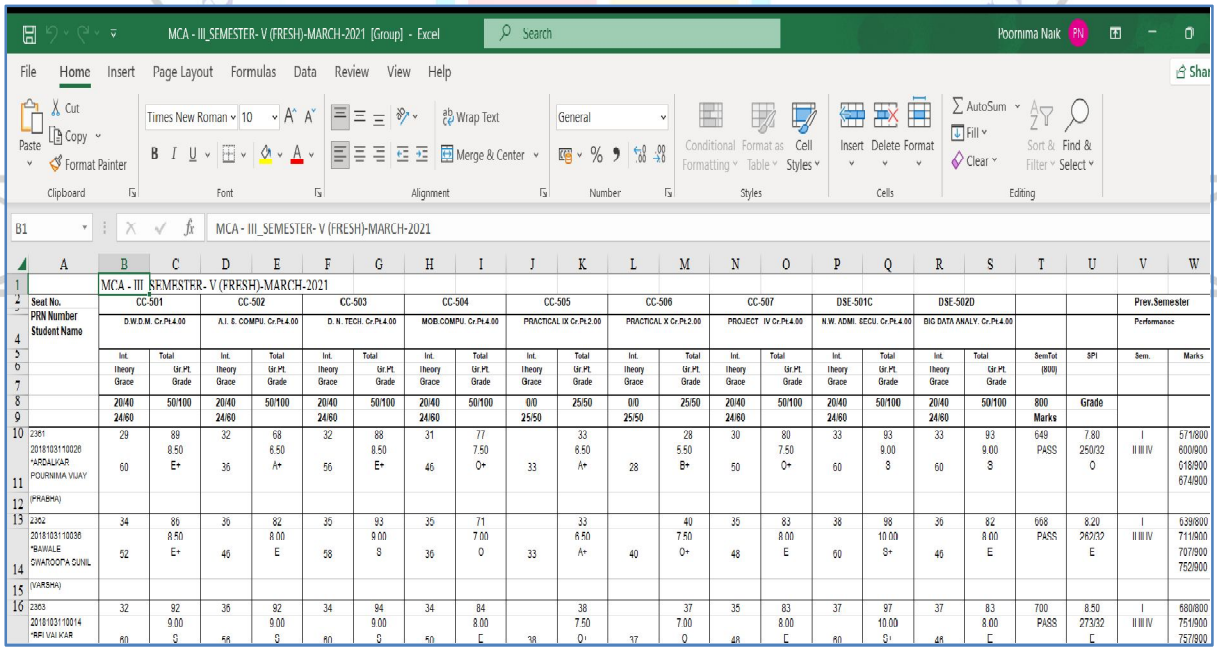


Fig 1. Multi-Tier Application Framework

3.2 Data Cleaning:

Cleaning of unstructured Excel workbook by unmerging the cells, removed unwanted rows and columns is depicted in the following steps:

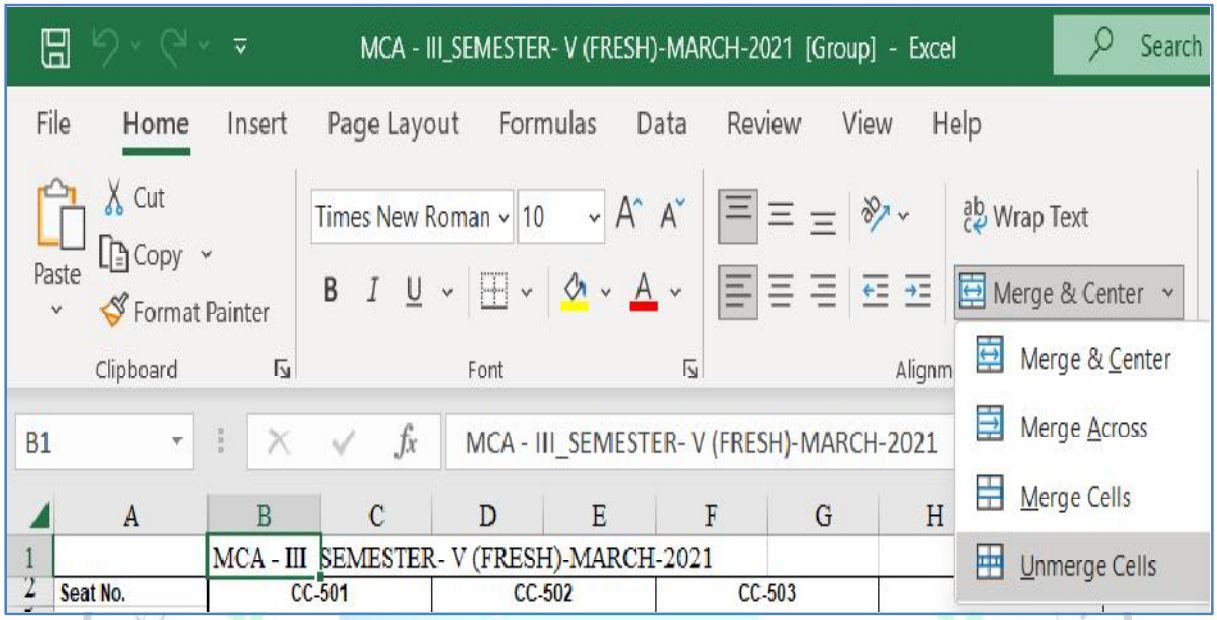
Step 1:Open the Excel file containing unstructured data and save in Excel 1997-2003 format.



This step converts the unstructured data into the structured format using the following steps:

- Unmerging Cells

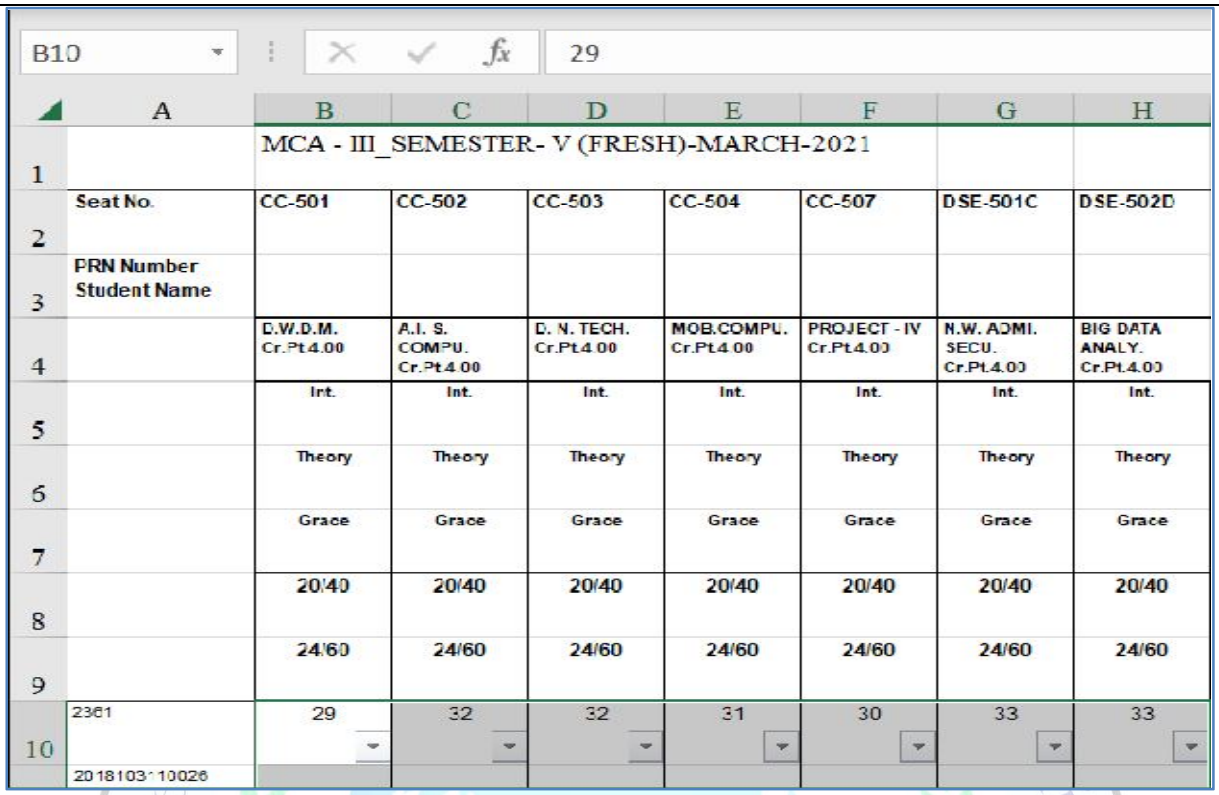
To unmerge the cells select the entire sheet and select Home → Merge and Center → Unmerge Cells from main menu.



- Select the columns and delete the unwanted columns by selecting then and using the shortcut key Ctrl + -.

	A	B	C	D	E	F	G	H
1		MCA - III_SEMESTER- V (FRESH)-MARCH-2021						
2	Seat No.	CC 501	CC 502	CC 503	CC 504	CC 507	DSE 501C	DSE 502D
3	PRN Number Student Name							
4		D.W.D.M. Cr.Pt.4.00	A.I. & COMPU. Cr.Pt.4.00	D. N. TECH. Cr.Pt.4.00	MOB.COMPU. Cr.Pt.4.00	PROJECT V Cr.Pt.4.00	N.W. ADMI. SECU. Cr.Pt.4.00	BIG DATA ANALY. Cr.Pt.4.00
5		Int.	Int.	Int.	Int.	Int	Int.	Int.
6		Theory	Theory	Theory	Theory	Theory	Theory	Theory
7		Grace	Grace	Grace	Grace	Grace	Grace	Grace
8		20/40	20/40	20/40	20/40	20/40	20/40	20/40
9		24/60	24/60	24/60	24/60	24/60	24/60	24/60
10	2081	29	32	32	31	30	33	33
11	2018103110020 *ARDALKAR POURNIMA VIJAY (PRABHA)	00	36	56	40	50	60	60
12	2082	34	36	35	35	35	38	36

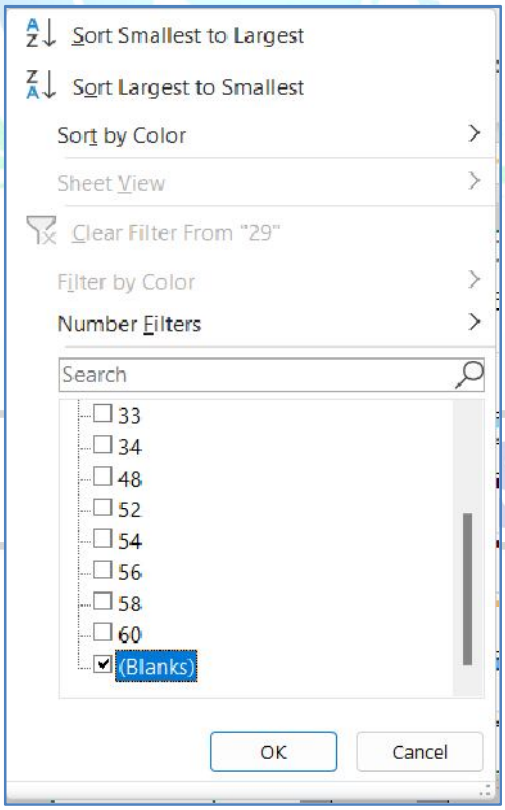
- Remove the headings that appear at the middle of the sheet as shown below:
- Select the entire marks in the sheet and select Data → Filter from



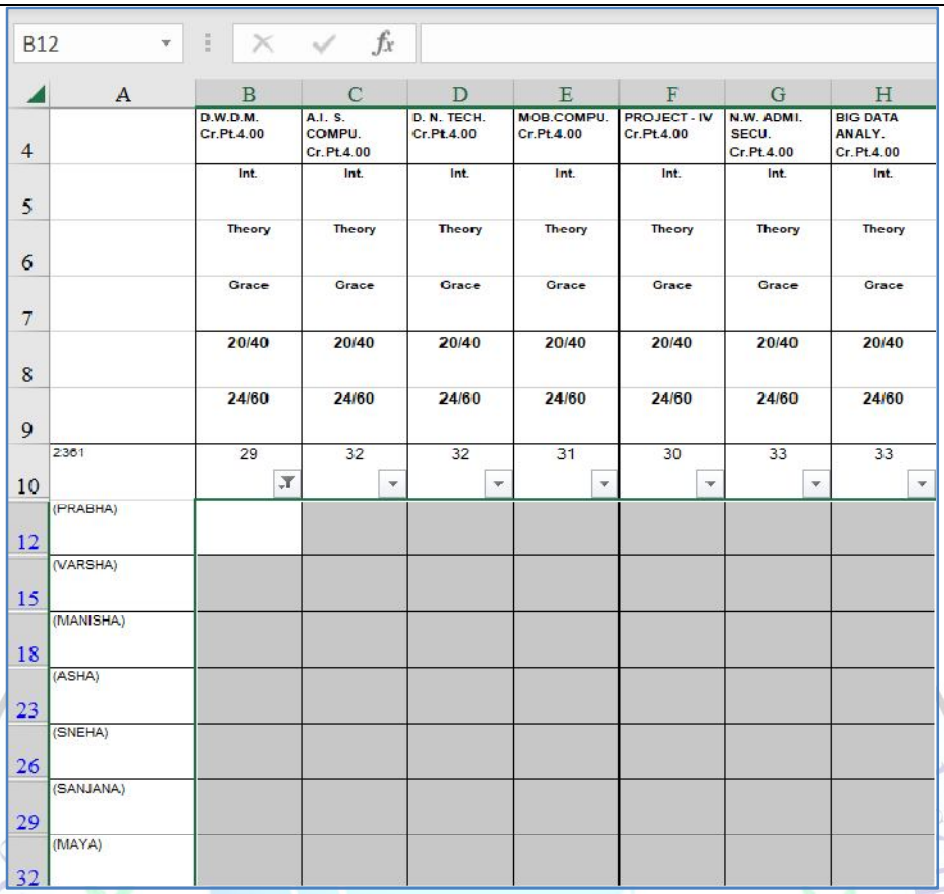
B10 | 29

	A	B	C	D	E	F	G	H
1		MCA - III_SEMESTER- V (FRESH)-MARCH-2021						
2	Seat No.	CC-501	CC-502	CC-503	CC-504	CC-507	DSE-501C	DSE-502D
3	PRN Number Student Name							
4		D.W.D.M. Cr.Pt4.00	A.I. S. COMPU. Cr.Pt4.00	D. N. TECH. Cr.Pt4.00	MOB.COMPU. Cr.Pt4.00	PROJECT - IV Cr.Pt4.00	N.W. ADMI. SECU. Cr.Pt4.00	BIG DATA ANALY. Cr.Pt4.00
5		Int.	Int.	Int.	Int.	Int.	Int.	Int.
6		Theory	Theory	Theory	Theory	Theory	Theory	Theory
7		Grace	Grace	Grace	Grace	Grace	Grace	Grace
8		20/40	20/40	20/40	20/40	20/40	20/40	20/40
9		24/60	24/60	24/60	24/60	24/60	24/60	24/60
10	2361	29	32	32	31	30	33	33
	2018103' 10026							

- Click on the drop-down list, deselect all the checkboxes and place a check mark against (Blanks) option as shown in the following figure:

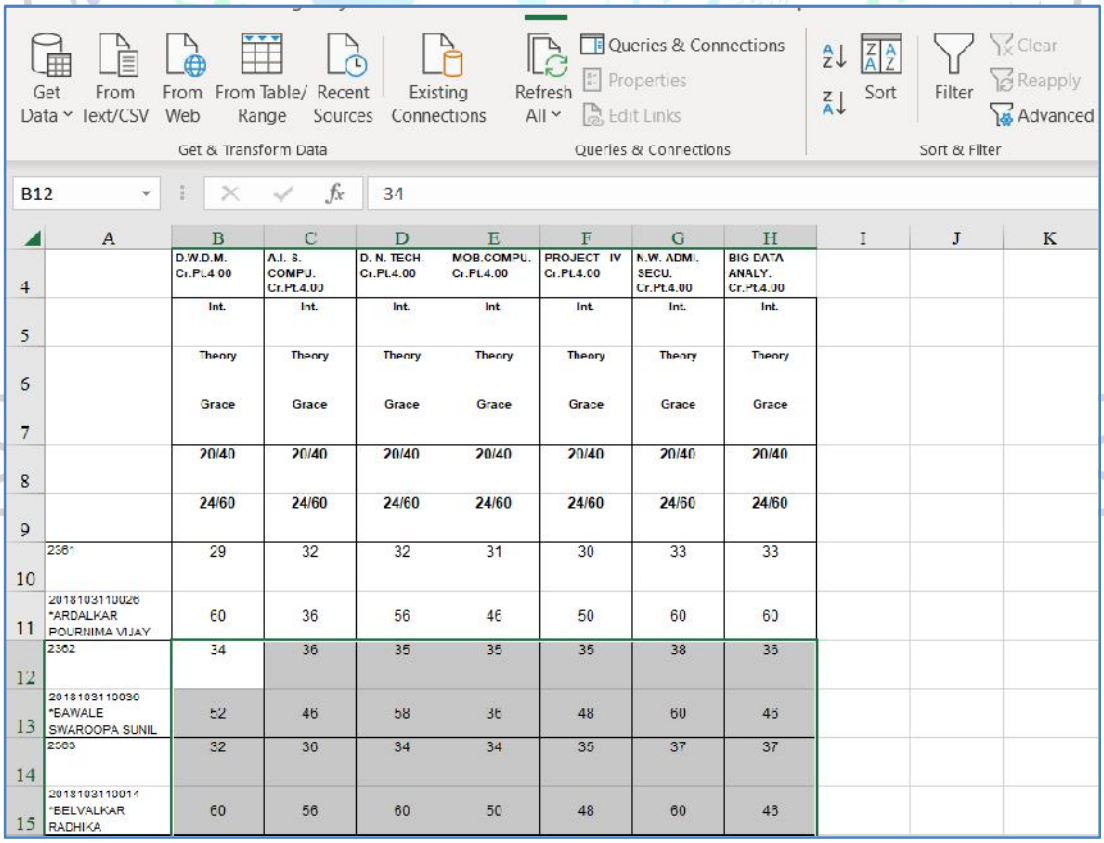


- Select all blank cells and delete by pressing Ctrl + - key combination.



	A	B	C	D	E	F	G	H
4		D.W.D.M. Cr.Pt.4.00	A.I. S. COMPU. Cr.Pt.4.00	D. N. TECH. Cr.Pt.4.00	MOB.COMPU. Cr.Pt.4.00	PROJECT - IV Cr.Pt.4.00	N.W. ADMI. SECU. Cr.Pt.4.00	BIG DATA ANALY. Cr.Pt.4.00
5		Int.	Int.	Int.	Int.	Int.	Int.	Int.
6		Theory	Theory	Theory	Theory	Theory	Theory	Theory
7		Grace	Grace	Grace	Grace	Grace	Grace	Grace
8		20/40	20/40	20/40	20/40	20/40	20/40	20/40
9		24/60	24/60	24/60	24/60	24/60	24/60	24/60
10	2361	29	32	32	31	30	33	33
12	(PRABHA)							
15	(VARSHA)							
18	(MANISHA)							
23	(ASHA)							
26	(SNEHA)							
29	(SANJANA)							
32	(MAYA)							

- Click on '***Filter'*** tool on '***Data'*** ribbon to remove filtering.



	A	B	C	D	E	F	G	H	I	J	K
4		D.W.D.M. Cr.Pt.4.00	A.I. S. COMPU. Cr.Pt.4.00	D. N. TECH Cr.Pt.4.00	MOB.COMPU. Cr.Pt.4.00	PROJECT IV Cr.Pt.4.00	N.W. ADMI. SECU. Cr.Pt.4.00	BIG DATA ANALY. Cr.Pt.4.00			
5		Int.	Int.	Int.	Int.	Int.	Int.	Int.			
6		Theory	Theory	Theory	Theory	Theory	Theory	Theory			
7		Grace	Grace	Grace	Grace	Grace	Grace	Grace			
8		20/40	20/40	20/40	20/40	20/40	20/40	20/40			
9		24/60	24/60	24/60	24/60	24/60	24/60	24/60			
10	2361	29	32	32	31	30	33	33			
11	20181031100026 *ARDALKAR POURNIMA VIJAY	60	36	56	46	50	60	60			
12	2362	34	36	35	35	35	38	35			
13	20181031100030 *EAWALE SWAROOPA SUNIL	52	46	58	36	48	60	45			
14	2363	32	30	34	34	36	37	37			
15	20181031100014 *EELVALKAR RADHIKA	60	56	60	50	48	60	45			

The final cleaned data is shown below:

	A	B	C	D	E	F	G	H
1		MCA - III_SEMESTER- V (FRESH)-MARCH-2021						
2	Seat No.	CC-501	CC-502	CC-503	CC-504	CC-507	DSE-501C	DSE-502D
3 4	PRN Number Student Name	D.W.D.M. Cr.Pt.4.00	A.I. S. COMPU. Cr.Pt.4.00	D. N. TECH. Cr.Pt.4.00	MOB.COMPU. Cr.Pt.4.00	PROJECT - IV Cr.Pt.4.00	N.W. ADMI. SECU. Cr.Pt.4.00	BIG DATA ANALY. Cr.Pt.4.00
5		Int.	Int.	Int.	Int.	Int.	Int.	Int.
6		Theory	Theory	Theory	Theory	Theory	Theory	Theory
7		Grace	Grace	Grace	Grace	Grace	Grace	Grace
8		20/40	20/40	20/40	20/40	20/40	20/40	20/40
9		24/60	24/60	24/60	24/60	24/60	24/60	24/60
10	2361	29	32	32	31	30	33	33
11	20181031100026 *ARDALKAR	60	36	56	46	50	60	60
12	2362	34	36	35	35	35	38	36
13	20181031100036 *BAWALE	52	46	58	36	48	60	46
14	2363	32	36	34	34	35	37	37
15	20181031100014 *BELVALKAR	60	56	60	50	48	60	46
16	2364	34	26	31	31	28	35	31
17	20181031100025 *BHARANE NIKITA	60	32	60	46	30	60	42
18	2365	32	29	29	29	27	32	30
19	20181031100018 *BHOSALE GOURI	56	36	58	36	40	60	20 14
20	2366	30	30	31	29	26	33	29

Fig 2(a) – 2(h) Cleaning Excel Workbook

The same procedure is repeatedfor the other sheets of the Excel Workbook. It is ensured that all the cleaned data is present in first sheet of the Excel workbook.

3.3 Application Customization:

For retrieving the marks from the Excel worksheet it is necessary to track the cell address of the first marksand the column addresses containing the courses as shown in Fig 3.

B10 fx 29

	A	B	C
1		MCA III_SEMESTER V (FRE	
2	Seat No.	CC-501	CC-502
3	PRN Number Student Name		
4		D.W.D.M. Cr.Pt.4.00	A.I. S. COMPU. Cr.Pt.4.00
5 6		Int. Theory	Int. Theory
7		Grace	Grace
8		20/40	20/40
9		24/60	24/60
10	2361	29	32
11	20181031100026 *ARDALKAR	60	36

Fig 3. Marks Information Stored in Cleaned Excel Worksheet

- Select the first marks cell and note down its address. In the above figure it is B10.

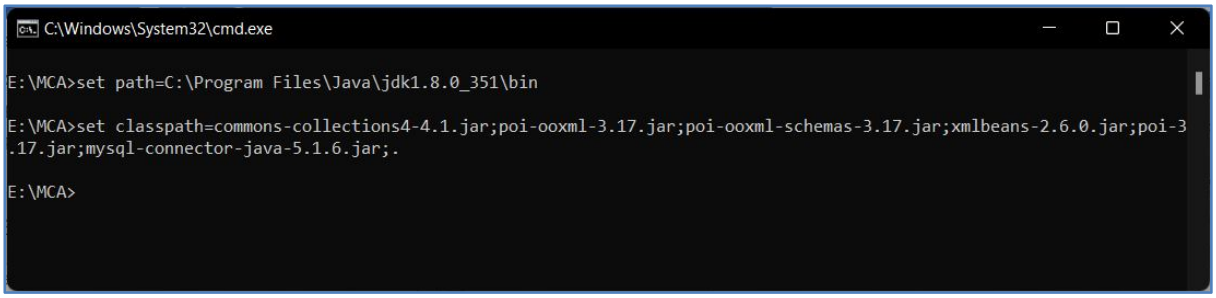
Row Address	row2 Value	Row Address	row2 Value	Row Address	row2 Value
A	0	B	1	C	2
D	3	E	4	F	5
G	6	H	7	I	8
J	9	K	10	L	11
M	12	N	13	O	14
P	15	Q	16	R	17
S	18	T	19	U	20
V	21	W	22	X	23
Y	24	Z	25		

- Start XAMPP Server
- Login to MySQL database
- Create the required tables using the following SQL commands:

```
create database co;
use co
create table marks(sub_code char(20), sub_name char(100),seatno int, internal int,
external int);
create table average(sub_name char(50), average_internal float, average_external float);
```

4.0 Results and Discussions:

The model depicted in section 3.1 is implemented with Java as front end and MySQL as backend. The customized information is stored in JSON file which is retrieved by the Java application using RESTful APIs. Fig 4 and Fig 5 show the compilation and execution of java program.



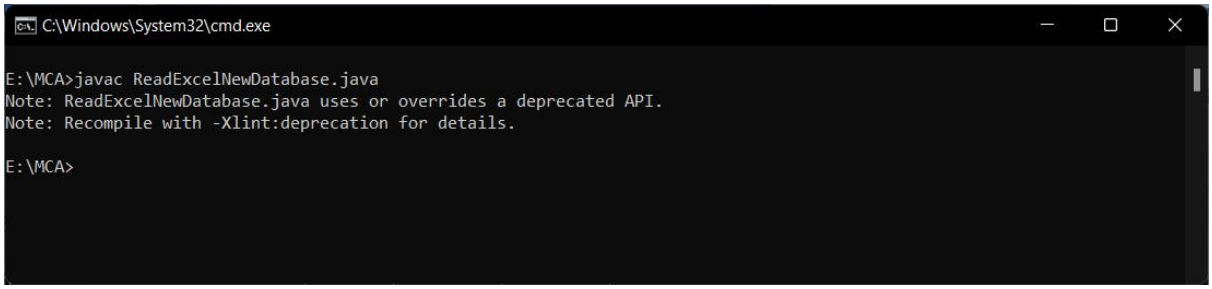


Fig 4. Compilation of Application

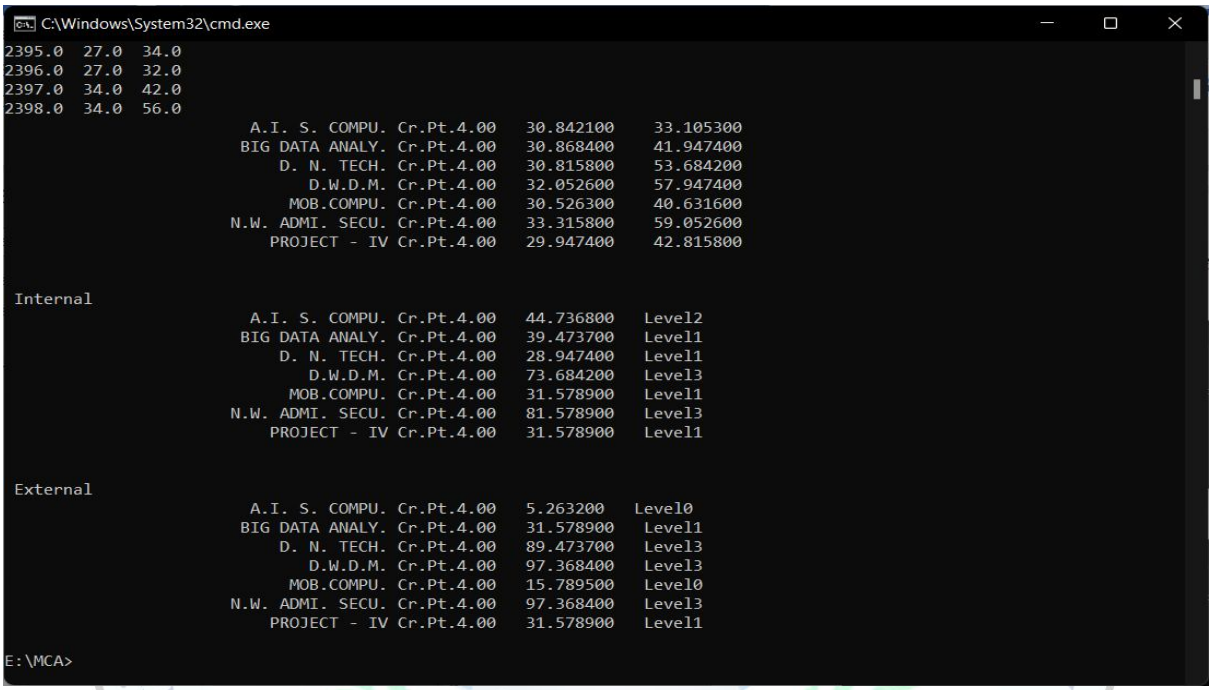


Fig 5. Execution of Application

The corresponding records are inserted in MySQL database as shown in Fig 6.

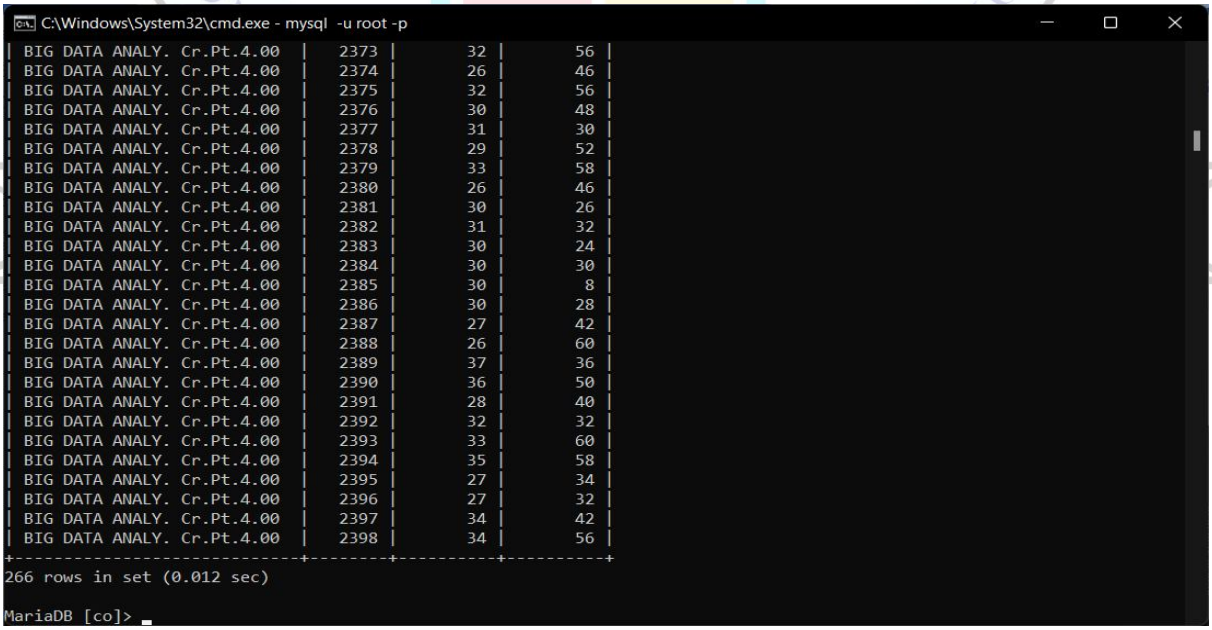


Fig 6. Persistence of Data in Back End

4.1 Reports Generated by the Software.

The report is exported to word as depicted in Fig. 7(a) – 7(c).

CO Internal Attainment Report

Exam Name : MCA - I SEMESTER - I (CBCS) DECEMBER-2019

Date : 25-01-2023

CO External Attainment Report

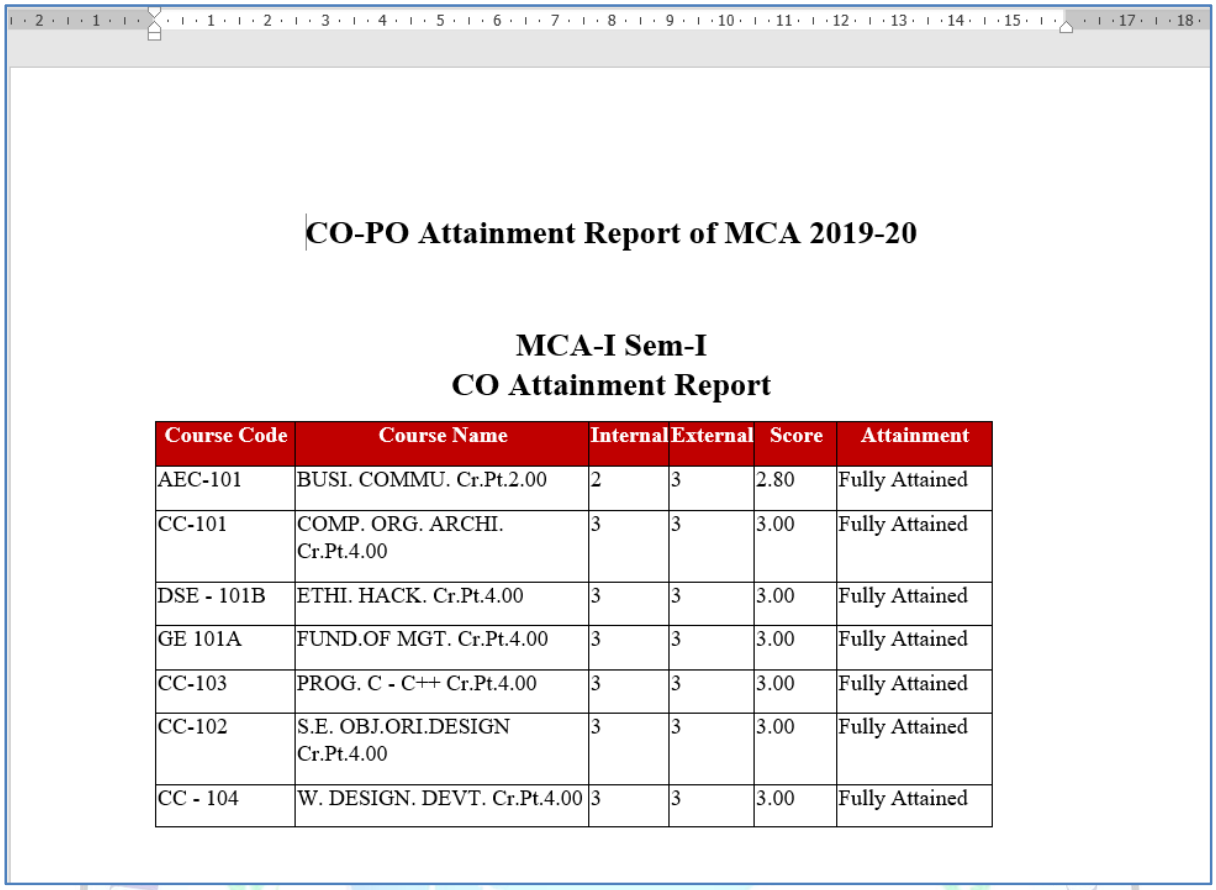
Course Code	Course Name	Above Average	Attainment
AEC-101	BUSI. COMMU. Cr.Pt.2.00	32.5581	Level2
CC-101	COMP. ORG. ARCHI. Cr.Pt.4.00	46.5116	Level3
DSE - 101B	ETHI. HACK. Cr.Pt.4.00	67.4419	Level3
GE 101A	FUND.OF MGT. Cr.Pt.4.00	65.1163	Level3
CC-103	PROG. C - C++ Cr.Pt.4.00	58.1395	Level3
CC-102	S.E. OBJ.ORI.DESIGN Cr.Pt.4.00	51.1628	Level3
CC - 104	W. DESIGN. DEVT. Cr.Pt.4.00	51.1628	Level3

CO External Attainment Report

Course Code	Course Name	Above Average	Attainment
AEC-101	BUSI. COMMU. Cr.Pt.2.00	41.8605	Level3
CC-101	COMP. ORG. ARCHI. Cr.Pt.4.00	48.8372	Level3
DSE - 101B	ETHI. HACK. Cr.Pt.4.00	58.1395	Level3
GE 101A	FUND.OF MGT. Cr.Pt.4.00	53.4884	Level3
CC-103	PROG. C - C++ Cr.Pt.4.00	51.1628	Level3
CC-102	S.E. OBJ.ORI.DESIGN Cr.Pt.4.00	41.8605	Level3
CC - 104	W. DESIGN. DEVT. Cr.Pt.4.00	53.4884	Level3

CO Attainment Report

Course Code	Course Name	Internal	External	Score	Attainment
AEC-101	BUSI. COMMU. Cr.Pt.2.00	2	3	2.80	Fully Attained
CC-101	COMP. ORG. ARCHI. Cr.Pt.4.00	3	3	3.00	Fully Attained
DSE - 101B	ETHI. HACK. Cr.Pt.4.00	3	3	3.00	Fully Attained
GE 101A	FUND.OF MGT. Cr.Pt.4.00	3	3	3.00	Fully Attained
CC-103	PROG. C - C++ Cr.Pt.4.00	3	3	3.00	Fully Attained
CC-102	S.E. OBJ.ORI.DESIGN Cr.Pt.4.00	3	3	3.00	Fully Attained
CC - 104	W. DESIGN. DEVT. Cr.Pt.4.00	3	3	3.00	Fully Attained



CO-PO Attainment Report of MCA 2019-20

MCA-I Sem-I
CO Attainment Report

Course Code	Course Name	Internal	External	Score	Attainment
AEC-101	BUSI. COMMU. Cr.Pt.2.00	2	3	2.80	Fully Attained
CC-101	COMP. ORG. ARCHI. Cr.Pt.4.00	3	3	3.00	Fully Attained
DSE - 101B	ETHI. HACK. Cr.Pt.4.00	3	3	3.00	Fully Attained
GE 101A	FUND.OF MGT. Cr.Pt.4.00	3	3	3.00	Fully Attained
CC-103	PROG. C - C++ Cr.Pt.4.00	3	3	3.00	Fully Attained
CC-102	S.E. OBJ.ORI.DESIGN Cr.Pt.4.00	3	3	3.00	Fully Attained
CC - 104	W. DESIGN. DEVT. Cr.Pt.4.00	3	3	3.00	Fully Attained

Fig 7(a)-7(c) CO Attainment Word Reports

5.0 Scope for Future Work:

The current research can be extended further for designing GUI in the presentation tier for enabling the end user for interacting with the application. The PO attainment can be monitored by interfacing the application with CO-PO mapping table. The current research focuses on subjectwise attainment of COs with subject as a dimension. If the questionwise CO mapping with the corresponding level is recorded on the question paper, the research can be extended further to determine the studentwise CO attainments which will further help in segregating slow learners from advanced learners. Each group can be treated separately for upskilling each group by using different measures.

References:

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