SANT BABA BHAG SINGH UNIVERSITY

Methodology of Measuring Attainment of POs/PSOs and COs

Proposed by:

Internal Quality Assurance Cell (IQAC)

Approved by:

Vice- Chancellor, SBBS University

Terminology (Abbreviations)

- OBE: Outcome-Based Education (OBE) is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve stated objectives and outcomes. It focuses on measuring student performance at different levels.
- Course Outcomes (CO): Course Outcomes (COs) are what the student should be able to do at the end of a course. The most important aspect of a CO is that it should be observable and measurable
- Program Outcomes (PO): Program outcomes are statements that describe what the knowledge, skills and attitudes students should have at the time of graduation from a program.
- Program Specific Outcomes (PSO): PSOs are outcomes that are specific to a program. PSOs characterize the specificity of the core courses of a program. PSOs can be 2 to 4 in number.

CO-PO-PSO ATTAINMENT PROCESS

- After CO statements are developed by the course in-charge, CO will be mapped with any possible PO's based on the relationship exist between them. All PO's are not necessarily mapped with any one CO of the particular course and it may be left blank.
- The faculty incharge has to consolidate the CO's of the respective year/semester and maintain the documentation of the CO attainment level of the respective year/semester courses.
- These details will be handed over to the Head of the department in order to evaluate PO attainment of the individual course at the end of the program.
- All these works have to be done under the guidance of Internal Quality Assurance Cell (IQAC).

Remark: The PO-PSO statements shall published and disseminated using the following methods:

- to be explained to students during orientation sessions
- to be displayed in Institute/department notice boards
- Uploaded in university website

Method of Measuring Attainment Levels

The attainment levels of POs, PSOs and COs by the students are measured for every programme offered in the University. For all faculties calculation of attainment

of COs is done by direct method whereas attainment of PO & PSOs are measured 80 % via direct assessment methodology and 20 % via indirect assessment methodology.

All the courses together must cover all the POs (and PSOs). For a course we map the COs to POs through the CO-PO matrix and to PSOs through the CO-PSO matrix as shown below. The various correlation levels are:

"1" – Slight (Low) Correlation

"2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation

"-" – Indicates there is no correlation

Sample:

SANT BABA BHAG SINGH UNIVERSITY

Institute: University Institute of Sciences | Department: Physical Science

Faculty Name: .....

Programme: M. Sc. (Hons.) Mathematics | Course: Linear Algebra

Semester: 2 | Couse Code: MAT 510

Academic Year: 2021-2022

CO-PO Mapping

COs	Programme Outcomes (POs)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	0	0	0	0	0	0	2	2
CO2	3	2	3	0	0	0	0	0	0	2	2
CO3	3	2	3	0	0	0	0	0	0	1	2
CO4	2	2	2	0	0	0	0	0	0	1	2
CO5	2	2	2	0	0	0	0	0	0	1	2
Average	**2.6**	**2**	**2.6**	**0**	**0**	**0**	**0**	**0**	**0**	**1.4**	**2**

Table 1

SANT BABA BHAG SINGH UNIVERSITY

Institute: University Institute of Sciences | Department: Physical Sciences

Faculty Name: .....

Programme: M. Sc.(Hons.) Mathematics | Course: Linear Algebra

Semester: 2 | Couse Code: MAT 510

Academic Year: 2021-2022					
CO-PSOs Mapping					
Cos	Programme Specific Outcomes (PSOs)				
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2		2	2	0
CO2	2		2	2	0
CO3	2		2	2	0
CO4	1		2	2	0
CO5	1		0	1	0
Average:	1.6		1.6	1.8	0

Table 2

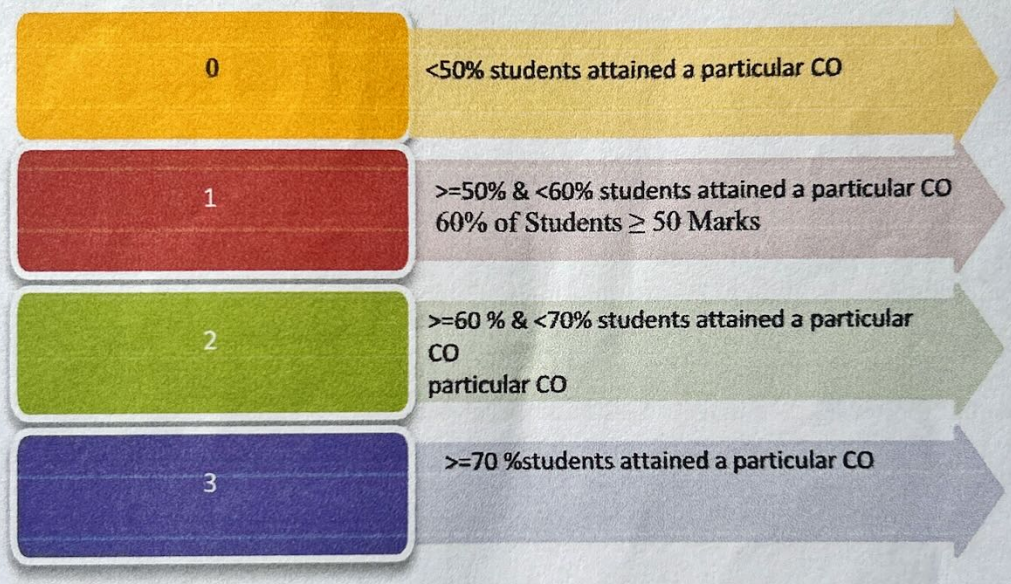
Assessment Methodology Adopted by IQAC

Direct Assessment

Section	Evaluation Components	Marks allocation
A	Mid Term test	One Mid Semester Examination. Marks allocated: 30
B	Assignments	Assignments are given to the students based on the nature of the subject. Assignment sheets are prepared by the faculty member with COs. Marks allocated: 10
C	Test/Tutorials/quiz/ class performance	The Test/ Quiz are prepared by the faculty member with COs. Marks allocated: 5
D	University Examination	At the end of each semester, final examination isconducted for Theory and Laboratory courses by SBBS University, in which question paper covers the entire syllabus and all the Cos are covered in the question papers. Marks allocated: 50

E	Continuous Assessment & Lab Performance (Laboratory Course)	The attainment of COs is calculated through continuous assessment, Viva Voce, practical files and experiment performance in lab. Marks allocation is as: Internal marks: 60 (40 continuous evaluation+10 viva +10 practical file) External marks: 40
F	Project Reviews	• Reviews are conducted periodically to monitor and evaluate the progress of the project. • Viva-Voce is conducted at the end of the semester as per university norms. The Co wise evaluation is done by the Project supervisor. Marks allocated: 100

CO Attainment Levels are set as:



Part -I

CO Attainment (Section A, Section B & Section C)

Mid Term & Internal Assessment

(i) One Mid Semester Examination: 30 Marks

(ii) 4-5 Assignments: 10 Marks each

(iii) Class Performance/Tests/Quiz: 5 Marks

Note: Attendance (5 marks) is not considered towards calculation of CO/PO/PSO attainment

Following two divisions for calculation of CO attainment are considered:

i. MSE

ii. Assignments+ Test/Quiz/Class Performance(A+Q)

In these two divisions, weightage of marks allocated to each CO shall be in the ratio 2:1 respectively. In other words, this can be understood as: out of total weightage (45), each CO (say there are 5 COs in total)) has been equal weightage (9) and that weightage marks of each CO is allocated to MSE & (A+Q) in the ratio 2:1 (6 & 3). Then Student's CO wise attainment percentage is calculated by using the following formula

$$\text{Student CO Attainment\%} = \frac{MSE\ marks * 6}{Max\ marks\ in\ MSE^{**}} + \frac{(Assignments + Test/Quiz\ Marks) * 3}{Max\ marks\ in(\ Assignment + Quiz)^{***}90} * 100$$

** $Max\ Marks in\ MSE = Max\ Marks\ allocated\ to\ that\ particular\ CO\ in\ MSE$

*** $Max\ marks\ in\ (Assignment + Quiz) = Max\ Marks\ allocated\ to\ that\ particular\ CO\ in\ (Assignment\ \&\ Quiz\ together)$

Further, the threshold value of attainment of CO is fixed as >= 50 % means a CO is taken into consideration if it is attained at least 50 %

Tables 3-6 represents overall CO Attainments:

Institute Name: University Institute of Sciences

Programme: M. Sc. (Hons.) Mathematics

Name / Code: Linear Algebra (MATS10)

Semester/Section: 3

Academic Year: 2021-2022

CO Attainment Calculation for MSE & Internal Awards(excluding Attendance)

PART 1: Students' CO attainment

	Weightage Marks[CO]->	6			3	6			3	6			3	6			3	6			3														
	Minimum Marks->	25	5	5	10	25	5	5	10	20	3	5	8	20	5	5	8	20	3	5	8														
		CO1				CO2				CO3				CO4				CO5																		
Sr. No.	Regd. No.	Student Name	MSE	Assign[A]+Quiz/Test[A+Q			MSE	Assign[A]+Quiz/Test[A+Q			MSE	Assign[A]+Quiz/Test[A+Q			MSE	Assign[A]+Quiz/Test[A+Q			MSE	Assign[A]+Quiz/Test[A+3																
1	20036001	MANINDERJIT KAUR	22	5	8	10	7	2	2	4	18	3	5	8	18	3	5	8	18	2	5	7														
2	20036003	IFRAH RATHORE	2	5	5	10	0	2	5	7	2	3	5	8	0	3	5	8	0	2	5	7														
3	20036004	POOJA DEVI	14	5		5	14	2	5	7	20	3	5	8	11	3	5	8	15	4	5	9														
4	20036005	LOVEJIT KAUR	15	5	5	10	8	2	2	3	15	3	5	8	11	3	5	8	15	4	5	9														
5	20036006	SUMAN	11	5	5	10	11	5	5	10	30	3	5	8	15	3	5	8	6	2	2	4														
6	20036007	AMTPAL SINGH	4	5	5	10	22		5	5	45	3	5	8	10	3	5	8	35	4	5	9														

Table 3

Then, every student's CO attainment percentage (CO wise) is calculated by using the following formula:

$$\textbf{Student CO attainment percentage} = \frac{\frac{MSE\ marks * 6}{Max\ marks\ in\ MSE^{**}} + \frac{(Assignments + Test/Quiz\ Marks) * 3}{Max\ marks\ in\ Assignment + Quiz)marks^{**}}}{9} * 100$$

Students' CO Attainment percentage				
CO1	CO2	CO3	CO4	CO5
82	44	93	83	79
42	23	40	33	29
79	86	100	70	88
100	46	83	70	88
82	82	100	83	37
69	70	83	67	88

Table 4

Note 1:	Either only one assignment (best one) may be considered for calculation or the average of 3/4 assignments (CO wise) may be considered by assigning equal weightage
Note 2:	Either only one test/Quiz (best one) may be considered for calculation or the average of 3/4 test/Quiz (CO wise) may be considered by assigning equal weightage
Note 3:	Here total 45 marks are allocated to 5 Cos

Overall CO attainment is shown in table 5

	CO1	CO2	CO3	CO4	CO5
No. of students attained 50 % or more	5	3	5	5	4
Total no. of students	6	6	6	6	6
% of students attained threshold value	83	50	83	83	67

Table 5

Part -II

CO Attainment (Section D)

CO attainment calculation in End Semester Examinations (50 Marks):

The step-by-step procedure to calculate CO attainment is as follows:

- Referring to ESE question paper, maximum marks allocated to each CO are identified
- Write CO wise score of the students.

- Find %age score in each CO by using the formula:

$$\%\text{age score in each CO} = \frac{\text{Marks scored by te student in that particular CO}}{\text{Max Marks allocated to each CO}} * 100$$

(See table 6)

- Calculate CO attainment %age by using the formula:

$$CO\ attainment\ \%age = \frac{No.\ of\ students\ who\ got\ \geq 50\%}{No.\ of\ students\ who\ attempet\ that\ particular\ CO} * 100$$

(See table 7 & table 8)

		Maximum Marks allocated to each CO in ESE →	15	15	12	12	16	% CO attainment(Student wise)				
Sr. No.	Regd. No.	Student Name	CO1	CO2	CO3	CO4	CO5	CO1	CO2	CO3	CO4	CO5
1	20036001	MANINDERJIT KAUR	10	11	5	10	13	67	73	42	83	81
2	20036003	IFRAH RATHORE	9	10		8	12	60	67	0	67	75
3	20036004	POOJA DEVI	13	12	8		15	87	80	67	0	94
4	20036005	LOVEJIT KAUR	12	13		9	16	80	87	0	75	100
5	20036006	SUMAN	14	12	5	4	14	93	80	42	33	88
6	20036007	AJITPAL SINGH		10	5	9	13	0	67	42	75	81

Table 6

Note 1: In table 6, total marks allocated to COs are more than the maximum marks of ESE i.e. 50 (because of Choice) but the student shall be evaluated for 50 marks only and hence some cells corresponding to some COs for certain students may be blank

	CO1	CO2	CO3	CO4	CO5
Number of students who got >=50 %	5	6	1	4	6
Number of students who did not attempt the question related with that particular CO	1	0	2	1	0
Total no of students	6	6	6	6	6
Number of students who attempted the question	5	6	4	5	6

Table 7

CO attainment percentage(overall)				
CO1	CO2	CO3	CO4	CO5
100	100	25	80	100

Table 8

Final CO attainment levels (theory papers i.e. based on section A, B, C &D)

Then the final CO attainment is calculated by taking average of percentage CO attainment in ESE & percentage CO attainment in MSE+(A+Q). From sample calculation tables 5 & table 8, the final CO attainment via direct method is calculated in table 9

	CO1	CO2	CO3	CO4	CO5
Percentage CO attainment in ESE	100	100	25	80	100
percentage CO attainment in MSE+Assign+ Quiz/tests	83	50	83	83	67
% of CO attainment (Avg of above two attainments)	92	75	54	82	83
CO attainment levels	3	3	1	3	3

Table 9

Part -III

CO Attainment (Section E & F)

As discussed above, CO attainment for Laboratory Courses (Projects) is calculated by taking average of percentage CO attainment in each of the component of Laboratory (Project) by assigning equal weightage to each CO.

PO & PSO ATTAINMENT:

Sr. No.	Name of Evaluation Criteria	Weightage in %
Direct Assessment (80%)		
1.	Direct Evaluation of POs /PSOs	80
Indirect Assessment (20%)		
2.	Graduate Exit Survey	10
3.	Alumni Survey	10
	Total	**100**

(DIRECT METHOD):

This method of attainment is based on the CO attainments and CO-PO & CO-PSO matrices For each course PO PSO attainment is calculated by using the formula:

$\frac{\sum(PO)_i(CA)_j}{\sum(CA)_j}$ & $\frac{\sum(PSO)_i(CA)_j}{\sum(CA)_j}$ **where** $(CA)_j$ **is the attainment level of (CO**j**)**

	CO1	CO2	CO3	CO4	CO5
CO attainment (COA)	3	3	1	3	3

Cos	Programme Outcomes (PO's)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	0	0	0	0	0	0	2	2
CO2	3	2	3	0	0	0	0	0	0	2	2
CO3	3	2	3	0	0	0	0	0	0	1	2
CO4	2	2	2	0	0	0	0	0	0	1	2
CO5	2	2	2	0	0	0	0	0	0	1	2
PO & PSO Attainment	2.5385	2	2.538	0	0	0	0	0	0	1.462	2

Programme Specific Outcomes (PSO's)				
PSO1	PSO2	PSO3	PSO4	PSO5
2		2	2	0
2		2	2	0
2		2	2	0
1		2	2	0
1		0	1	0
1.5385	0	1.538	1.769	0

Table 10

Similarly, PO & PSO attainment levels of all the courses are calculated and then overall attainment of POs & PSOs are calculated by taking their averages

e. g. If there are 7 courses in a programme and PO & PSO attainment levels are calculated by using the above method and the same are listed in below table, then, the overall POs & PSOs attainment (by direct method) is calculated as shown in following table:

Course/Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Linear Algebra/510	2.538	2	2.538	0	0	0	0	0	0	1.462	2
Real Analysis-I/MAT501	2.2	1.8	2.4	1.2	0	0	0.4	0.4	0	1.2	1
Complex Analysis/MAT5	2.4	2.2	2.6	0	0	2	1.2	0.8	1	2	2
Abstract Algebra-I/MAT5	3	3	3	2	0	0	0	0	0	2	2
ODE/MAT507	2	1.33	2	1.33	1.33	1	0.67	0	1	0	0.67
Classical Mechanics & Cal of Var/ MAT509	1.333	2.333	3	0	0	0	0	0	0	0	0
Real Analysis-II/MAT502	2.33	2.66	2	2	0	0	0	0	0	0	0
Average PO attainment level →	2.257	2.189	2.505	0.933	0.19	0.429	0.32	0.17	0.286	0.952	1.096
Overall PO attainment	1.03										

PSO1	PSO2	PSO3	PSO4	PSO5
1.5385	0	1.538	1.769	0
2	1	2	1	1
0	2.2	2	0	0
1	3	1.33	1.33	2
0	1.33	0	0	1.33
0	1	2	2	0
1	2	3	1	1
Average PSO attainment level →	0.7912	1.504	1.695	1.014	0.7614
Overall PSO attainment	1.153				

Indirect Assessment

Indirect assessment (for PO & PSO only) is done through program exit survey and alumni survey where each survey is given 50 % weightage.

Note: These surveys are conducted at the end of the programme

Graduate Exit Survey:

A exit survey is conducted for students who have graduated out of the department for that year. Relevant questionnaire in exit survey form to evaluate attainment of POs and PSOs is given in below sections

Alumni Survey:

Feedback is taken from alumni. Relevant questionnaire in alumni survey form to evaluate attainment of POs and PSOs

Evaluation Process:

The questionnaire consists of 12 questions which is relevant for assessing each PO and 3 questions for assessing each PSO. Each question is having 3 options namely Excellent, Very Good and satisfactory which is given marks 3,2,1 respectively. These survey results are tabulated and the average values corresponding to each PO and PSO are determined

Indirect Attainment:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Graduate Exit Survey	Attainment values of Graduate Exit Survey											
Alumni Survey	Attainment values of Alumni Survey											
Overall Attainment	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	I_{11}	I12

Indirect Attainment Ii= 50% attainment of Graduate Exit survey + 50% attainment ofAlumni survey

Overall PO and PSO attainment

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Direct Attainment	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}	D_{12}
Indirect Attainment	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	I_{11}	I_{12}
Overall Attainment	O_1	O_2	O_3	O_4	O_5	O_6	O_7	O_8	O_9	O_{10}	O_{11}	O_{12}

Overall Attainment of PO_i; $O_i = 80\%$ of $D_i + 20\%$ of I_i

where:
D_i – Direct Attainment of each PO
I_i – Indirect Attainment of each PO

Similarly PSO attainment is also evaluated

PSOs	PSO1	PSO2	PSO3
Direct Attainment	D_1	D_2	D_3
Indirect Attainment	I_1	I_2	I_3
Overall Attainment	O_1	O_2	O_3

Overall Attainment of PSOi; **Oi = 80% of Di + 20% of Ii**

where Di – Direct Attainment of each PSO Ii – Indirect Attainment of each PSO

Following are sample Graduate EXIT survey Questionnaire & **Alumni Feedback** Survey– Questionnaires for B Tech. Programme and can be modified as per the particular Programme requirements

Graduate Exit Survey – Questionnaires

(e. g. B Tech Graduate)

S. No	Program Outcomes (POs)	POs	Excellent (3)	Very Good (2)	Satisfactory(1)
1.	I have gained knowledge of mathematics, science, and engineering for solving Engineering problems and modeling	PO1			
2.	I have an ability to design, simulate and conduct experiments, as well as to analyze and interpret data including hardware and software components	PO2			
3.	I am able to apply engineering knowledge to design a complex electronic system or process to meet desired specifications and needs	PO3			

4.	I am able to identify, formulate, comprehend, analyze, design synthesis of the information to solve complex engineering problems and provide valid conclusions.	PO4			
5.	I have the opportunity to use the techniques, skills and modern engineering tools necessary for engineering practice	PO5			
6.	Able to show the understanding of professional, health, safety, legal, cultural and social responsibilities	PO6			
7.	I am able to understand the impact of engineering solutions in a global, economic, environmental and demonstrate the knowledge need for sustainable development	PO7			
8.	I am able to apply ethical principles, responsibility and norms of the engineering practice	PO8			
9.	I can able to function on multi-disciplinary teams.	PO9			
10.	I can able to communicate and present effectively	PO10			
11.	I am able to use the modern engineering tools, techniques, skills and management principlesto do work as a member and leader in a team,to manage projects in multi-disciplinary environments	PO11			
12.	I have an ability to engage in, to resolve contemporary issues and lifelong learning	PO12			

S.No	Program Specific Outcomes(POs)	POs	Excellent (3)	Very Good (2)	Satisfactory(1)
1.	I am able to analyze, design and implement application specific electronic system for complex engineering problems for analog, digital domain, communications and signal processing applications by applying the knowledge of basic sciences, engineering mathematics and engineering fundamentals.	PSO1			
2.	I am able to adapt for rapid changes in tools and technology with an understanding of societal and ecological issues relevant to professional engineering practice through life-long learning	PSO2			
3.	I am able to function in multi-disciplinary work environment, good interpersonal skills as a leader in a team in appreciation of professional ethics and societal responsibilities	PSO3			

Alumni Feedback Survey– Questionnaires (for B.Tech. Pass out)

S. No	Program Outcomes(POs)	POs	Excellent(3)	Very Good(2)	Satisfactory(1)
1.	How do you rate the engineering knowledge obtained during course period?	PO1			
2.	How do you find the programme related to problem analysis?	PO2			
3.	Were able to design solutions for complex engineering problems?	PO3			
4.	Did you use research based knowledge for interpreting your data during project work?	PO4			
5.	How this programme helped in applying modern tool usage for your problems?	PO5			
6.	How do you rate your understanding of impact of engineering solutions in a global on the society, economic, environmental aspects?	PO6			
7.	Did you understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7			
8.	Were you able to apply ethical principlesand commit to professional ethics and responsibilities and norms of engineering practice?	PO8			
9.	Did you have opportunity to function as an individual or in a team?	PO9			
10.	How do you rate your skill of communicating effectively in speech and in writing, including documentation of hardware and software systems?	PO10			
11.	Were you able to manage project and finance aspects effectively in your work environment?	PO11			
12.	How far this programme helped you to acquire new knowledge in the engineering discipline and to engage in life- long learning?	PO12			

S. No	Program Specific Outcomes(POs)	POs	Excellent(3)	Very Good(2)	Satisfactory(1)
1.	Are our graduates able to analyze, design and implement application specific electronic system for complex engineering problems for analog, digital domain, communications and signal processing applications by applying the knowledge of basic sciences, engineering mathematics and engineering fundamentals?	PSO1			

2.	Are our graduate able to adapt for rapid changes in tools and technology with an understanding of societal and ecological issues relevant to professional engineering practice through life-long learning?	PSO2			
3.	Are our graduates able to function in multi-disciplinary work environment, good interpersonal skills as a leader in a team in appreciation of professional ethics and societal responsibilities?	PSO3			

Dr. Anju Sood

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Submitted to

Vice Chancellor, SBBS University for approval please (through Director IQAC).