Shikshan Prasarak Sanstha's

PADMABHUSHAN VASANTRAODADA PATIL MAHAVIDYALAYA,

Kavathe Mahankal, Dist.- Sangli

Department of Chemistry

(Academic Year 2022-23)

Vision

The Chemistry Department is committed to prepare competitive and professional graduates within an innovative and intellectually stimulating environment, support other academic programs by offering quality chemistry learning experiences, conduct basic and applied research of national and international impact, build proactive partnerships with industry and offer effective training and educational and technical services to the society. To achieve excellence in teaching and research.

Mission

- Enhance the basic and applied research framework in the Chemistry Department.
- To empower through knowledge and information.
- To develop, enhance, and improve the quality of human resources.
- To cultivate resolute moral and ethical values through good chemical practices.
- To meet contemporary regional and national needs and anticipate future social and economic development.
- Build partnerships with the industry to increase employability skills.

Program Outcomes (Pos)

After completion of this program student will be able to,

PO1:	Facilitate the coordination between classical academics and societal needs
PO2:	Apply practical knowledge to industrial application and for developing methods
PO3:	Cope up with the challenges and the advances in the science
PO4:	Acquire the ability of critical analysis of different issues.

Program Specific Outcomes (PSO's)

After completion of this program student will be able to,

PSO1:	Cater the needs and the challenges of chemical and metallurgical industries.
PSO2:	Handle sophisticated instruments used for different analysis.
PSO3:	Work in pharmaceutical industries
PSO4:	Cope up for higher education such as post-graduation and research

Course outcomes (CO's)

B.Sc. I (Sem I)

DSC-3A-Course I (Inorganic chemistry)

After completing the course students will able to,

CO-1.1	Foster the ability and to aquire the knowledge of terms, facts, concept principles of atomic structure and ionic bonding
CO-1.2	Develop the proper aptitude and interest towards the concepts of inorganic chemistry like VBT and MOT

DSC-4A Course II (Organic Chemistry)

CO:2.1	Learn fundamentals of chemistry stereochemical aspects and nomenclature of stereoisomers.
CO:2.2	Understood concept of aromaticity Preparation reactions of cycloalkanes cycloalkenes and alkadienes.

B.Sc. I (Sem II)

DSC- 3B: Course III (Physical Chemistry)

CO:3.1	Understand the basic concepts of thermodynamics thermochemistry and free energy change in chemical reaction.
CO:3.2	Understand different theory of gases factors affecting rate of reactions and theories of reaction rates

DSC-4B-Course IV (Analytical Chemistry)

CO:4.1	Understand the basic methods of analysis techniques of sampling basic principle of chromatography and important aspect of titrimetric analysis.
CO:4.2	Acquire the knowledge about physical methods of water analysis chemical methods of water analysis along with basic aspects of fertilizers.

Course V Laboratory course (practical)

CO:5.1	Understood the kinetics of various reaction
CO:5.2	Acquire the knowledge of analysis of organic compounds
CO:5.3	Acquire the knowledge of simple techniques such as paper chromatography, quantitative analysis
CO:5.4	Determine the strength of mineral acid

B.Sc. II (Sem III)

DSC-C3-Course VI (Physical Chemistry)

CO:6.1	Understand conductivity, transport number of the aqueous solutions with different applications surface tension viscosity refractive index and surface phenomena at heterogeneous surfaces.
CO:6.2	Learn the various nuclear phenomena techniques of measurement of nuclear radiations and third order reaction

DSC-C4-Course VII (Industrial Chemistry)

CO:7.1	Understood the basic concepts in Industrial Chemistry and electroplating
CO:7.2	Acquire the knowledge of Indian paper industry, Soaps and Detergents

B.Sc. II (Sem IV)

DSC-D3- Course VIII (Inorganic chemistry)

CO:8.1	Understood the meaning of terminologies, concepts of co ordination chemistry and chelation
CO:8.2	Understood the periodicity of P block, 3d series elements and inorganic qualitative analysis

DSC-D4-Course IX (Organic Chemistry)

CO:9.1	To impart knowledge about Preparation synthesis reactivity and applications of carboxylic acids carbohydrates Amines and Diazonium Salts
CO:9.2	Understood the basic knowledge conformational analysis of organic compounds nomenclature and reactivity of aldehydes and ketones

Course X Laboratory course (practical)

CO:10.1	Understood the kinetics of various reaction and use of instruments for different analytical application
CO:10.2	Acquire the knowledge of Preparation, analysis of organic compounds and mixture.
CO:10.3	Foster the knowledge of extraction, purification of various metals and the analysis of inorganic compounds and mixture.
CO:10.4	Perform the quantitative analysis of various analytes

B.Sc. III (Sem V)

DSE-ES-Course XI (Inorganic Chemistry)

CO:11.1	Acquire the knowledge of Acids bases and bonding in transition metal complexes
CO:11.2	Understood the metals, semiconductor, superconductors, organometallic compounds and catalysis

DSE-E6-Course XII (Organic Chemistry)

CO:12.1	Understand the energy associated parameters chromophore, auxo chrome, calculation of Amax, vibrational transitions, regions of IR spectrum and functional group recognition.
CO:12.2	Get the knowledge of magnetic non-magnetic nuclei, shielding-deshelling, chemical shift, splitting pattern molecular ion, fragmentation pattern and different types of ions produced. Also, able to solve problems based on UV-Vis, IR, NMR, Mass Spectral data and predict the structure of organic compound with the help of provided spectral data

DSE-E7-Course XIII (Physical Chemistry)

CO:13.1	Understand elementary quantum mechanics quantum Chemistry and spectroscopy Knowledge
CO:13.2	Learn different aspects of Photochemistry solutions and electrochemistry

DSC-E8-Course XIV (Analytical Chemistry)

CO:14.1	Learn the techniques of gravimetric analysis potentiometric titrations and acquire the knowledge of instrumental analysis of alkali and alkaline earth elements by using flame photometry
CO:14.2	Understand working applications of optical methods as an analytical tool and Quality control practices in analytical industries/laboratories

B.Sc. III (Sem VI)

DSC-F-5-Course XV (Inorganic Chemistry)

CO.15.1	Impart the advances in coordination Chemistry, Nuclear chemistry and its societal applications
CO:15.2	Understood the Chemistry of f block Elements, extraction of iron and steel and Role of various metals in Bio inorganic chemistry

DSE-F6-Course-XVI (Organic Chemistry)

CO:16.1	Knowledge of different organic reactions reagents used in organic transformations and retrosynthesis of some organic compounds.
CO:16.2	Learn electrophilic addition to >C-C<CC bond and get knowledge of alkaloids and terpenoids understand chemistry of some pharmaceutical drugs

DSE-F7-Course XVII (Physical Chemistry)

CO:17.1	Know Phase equilibria, phase rule, Thermodynamics and solid-state chemistry
CO:17.2	Learn Chemical kinetics and understanding the knowledge of distribution law

DSC-F-8-Course XVIII (Industrial chemistry)

CO:18.1	Understand the process of manufacture of sugar industrial heavy chemicals and synthesis of various polymers
CO:18.2	Understand the petroleum Industry need of use of eco-friendly fuels and Understanding

Course XIX Laboratory course (practical)

CO:19.1	Apply practical knowledge to industrial application and for developing methods
CO 19.2	Understood the kinetics of various reaction
CO 19.3	Handle instruments for different analytical application.
CO:19.4	Foster the knowledge of extraction, purification of various metals the analysis of inorganic compounds and mixture
CO 19.5	Analyze the commercial samples such as talcum powder, milk sample etc
CO:19.6	Acquire the knowledge of preparation of organic compounds though green chemistry approach
CO 19.7	Carry out qualitative analysis of organic mixture
CO:19.8	Work in chemistry related industries.

Step 4: Defining relation between Course Outcomes (COs) and POs/PSOs for each course to obtain overall CO mapping with each POs/PSOs. (Course Articulation Matrix)

In this step, CO's of each course are mapped with PO's & PSO's. A correlation is established between CO's and PO's / PSO's in the scale of 0 to 3. 0 if there is no correlation between CO's and PO's / PSO's, 1 being low, 2 being median and 3 being high.

For example, suppose program XYZ (say) has 4 PO's & 4 PSO's. Then, course articulation matrixfor a course – 1 (say) with two CO's is as follows.

CO's – PO's & PSO's mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

CO's	PO's / PSO's							
	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO 1.1	2	0	2	1	2	1	1	2
CO 1.2	3	2	1	2	2	1	2	3

In the same way we have course articulation matrices for all courses in that Program.

CO's – PO's & PSO's mapping matrix (1-low, 2-medium, 3-high, 0-No correlation)

CO's	PO's / PSO's							
	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO 1.1	2	0	2	1	2	1	1	2
CO 1.2	3	2	1	2	2	1	2	3
CO 2.1	2	1	3	2	2	1	3	3
CO 2.2	2	2	2	2	2	1	2	2
CO 3.1	2	2	2	2	1	0	2	3
CO 3.2	1	3	1	2	2	1	1	2
CO 4.1	2	3	2	3	2	3	3	2
CO 4.2	1	3	1	2	2	1	1	2
CO 5.1	2	2	3	2	2	1	3	2
CO 5.2	2	3	2	2	2	1	3	2
CO 5.3	3	2	2	2	1	2	3	2
CO 5.4	2	2	1	2	2	0	1	1
CO 6.1	2	2	1	2	2	2	2	2
CO 6.2	1	2	2	2	0	1	0	2
CO 7.1	2	2	1	1	2	1	1	1
CO 7.2	2	2	1	2	2	1	2	1
CO 8.1	2	2	1	2	2	1	1	2
CO 8.2	3	2	2	2	2	2	1	2
CO 9.1	2	2	2	1	2	1	3	2
CO 9.2	2	2	2	2	1	1	2	2
CO 10.1	2	2	3	2	2	2	1	2
CO 10.2	2	2	2	2	1	0	3	2
CO 10.3	2	2	1	2	2	1	3	2
CO 10.4	3	2	1	2	1	1	2	2

CO 11.1	2	2	2	2	1	1	1	2
CO 11.2	2	2	2	2	2	2	0	2
CO 12.1	1	2	2	1	2	1	3	2
CO 12.2	1	2	2	2	2	2	3	3
CO 13.1	1	1	3	2	1	1	0	2
CO 13.2	2	1	1	2	1	2	1	2
CO 14.1	3	2	2	2	3	2	1	3
CO 14.2	3	2	2	1	2	3	2	2
CO 15.1	3	2	2	2	2	1	2	2
CO 15.2	2	2	2	2	2	1	1	2
CO 16.1	2	2	2	2	2	1	2	2
CO 16.2	2	2	2	2	2	1	1	2
CO 17.1	1	1	2	1	1	1	1	2
CO 17.2	2	2	3	2	2	1	1	2
CO 18.1	2	2	2	2	2	2	1	1
CO 18.2	2	2	2	2	2	2	0	2
CO 19.1	2	3	2	2	2	2	2	2
CO 19.2	2	2	3	2	2	2	1	2
CO 19.3	2	2	2	2	2	3	2	2
CO 19.4	2	2	1	2	2	1	2	2
CO 19.5	2	2	1	2	1	1	1	1
CO 19.6	2	2	3	2	2	2	2	2
CO 19.7	2	2	1	2	1	1	2	2
CO 19.8	2	2	2	2	2	2	2	2

Step 5: Development of overall CO's-PO's mapping matrix for all courses (Program Articulation Matrix).

The CO levels corresponding to each PO/PSO in course articulation matrix are averaged to obtain overall level of relation of course with each PO & PSO. For example, the overall relation of course – 1 (say) are reported the following matrix.

CO's	PO's / PSO's							
	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO 1.1	2	0	2	1	2	1	1	2
CO 1.2	3	2	1	2	2	1	2	3
Average ($X_{1,.,l}$)	2.5	1	1.5	1.5	2	1	1.5	2.5

Similarly, the overall level of relation of all the courses in the programme is established. These levels are reported in the matrix form and this matrix is called as the programme articulation matrix. For example, if the programme XYZ has 19 courses then the programme articulation matrix will be as follows.

Programme Articulation Matrix

ID	Course name	$X_{i,.,1}$	$X_{i,.,2}$	$X_{i,.,3}$	$X_{i,.,4}$	$X_{i,.,5}$	$X_{i,.,6}$	$X_{i,.,7}$	$X_{i,.,8}$
C_1	Course_1	2.5	1	1.5	1.5	2	1	1.5	2.5
C_2	Course_2	2	1.5	2.5	2	2	1	2.5	2.5
C_3	Course_3	1.5	2.5	1.5	2	1.5	0.5	1.5	2.5
C_4	Course_4	1.5	3	1.5	2.5	2	2	2	2
C_5	Course_5	2.25	2.25	2	2	1.75	1	2.5	1.75
C_6	Course_6	1.5	2	1.5	2	1	1.5	1	2
C_7	Course_7	2	2	1	1.5	2	1	1.5	1
C_8	Course_8	2.5	2	1.5	2	2	1.5	1	2
C_9	Course_9	2	2	2	1.5	1.5	1	2.5	2
C_{10}	Course_10	2.25	2	1.75	2	1.5	1	2.25	2
C_{11}	Course_11	2	2	2	2	1.5	1.5	0.5	2
C_{12}	Course_12	1	2	2	1.5	2	1.5	3	2.5
C_{13}	Course_13	1.5	1	2	2	1	1.5	0.5	2
C_{14}	Course_14	3	2	2	1.5	2.5	2.5	1.5	2.5
C_{15}	Course_15	2.5	2	2	2	2	1	1.5	2
C_{16}	Course_16	2	2	2	2	2	1	1.5	2
C_{17}	Course_17	1.5	1.5	2.5	1.5	1.5	1	1	2
C_{18}	Course_18	2	2	2	2	2	2	0.5	1.5
C_{19}	Course_19	2	2.125	1.875	2	1.75	1.75	1.75	1.875

Step 6: Methodology for measuring of Course Outcomes (CO's), Programme Specific Outcomes (PSO's) and Programme Outcomes (PO's) and setting up the target level.

In this step, methodology for measuring the attainment level of learning outcomes is defined and the target levels for the batch are defined.

- **Methodology for the attainment of learning outcomes for this year:**

  Details of a programme:

  - Name of the Program: XYZ
  - Program has n_1 PO's, say, $PO_1, PO_2, \dots, PO_{n1}$
  - Program has n_2 PSO's, say, $PSO_1, PSO_2, \dots, PSO_{n2}$

    Let $n = n_1 + n_2$, total number of PO's and PSO's.
  - For convenience, let us denote the PO's & PSO's $PO_1, PO_2, \dots, PO_{n1}, PSO_1, PSO_2, \dots, PSO_{n2}$ by $P_1, P_2, \dots, P_n$
  - Program has m courses, say, $C_1, C_2, \dots, C_m$
  - Each course C_i has k course outcomes (CO's) denoted as $CO_{i,1}, CO_{i,2}, \dots, CO_{i,k}$, $i = 1,2, \dots, m$. and k represents the number of outcomes particularly that of course.

Course articulation matrices and programme articulation matrix are obtained as discussed in previous steps. Let $X_{i,j,l}$ be the level of correlation of $CO_{i,j}$ with P_l where, $i = 1,2, \dots, m$, $j = 1,2, \dots, k$, $l = 1,2, \dots, n$. Then, the overall CO levels with PO's & PSO's of course C_i is computed as $X_{i,\,.\,,} = {}^{1}\sum^{*}$ $X_{i,j,l}$, Here k be the number of outcomes in the average course taken.

k j=1

- **Attainment of COs:**

The CO attainment levels are measured based on the results of the internal assessment and external examination conducted by the university. The CO attainment level based on internal assessment and external assessment are computed separately.

Attainment levels based on internal/external assessment method are defined as follows:

Level 1: Average of student marks belongs to the class 0% - 20% for that assessment method

Level 2: Average of student marks belongs to the class 20% - 40% for that assessment method

Level 3: Average of student marks belongs to the class 40% - 60% for that assessment method

Level 4: Average of student marks belongs to the class 60% - 80% for that assessment method

Level 5: Average of student marks belongs to the class 80%-100% for that assessment method

Let ALC_E and ALC_I be the CO attainment level of the course based on external assessment and internal assessment respectively. The overall CO attainment of the course is calculated by taking 80% weightage to external assessment and 20% weightage to internal assessment.

$$ALC = 0.2 * ALC_I + 0.8 * ALC_E.$$

Let $ALC_1, ALC_2, \dots, ALC_m$ be the attainment levels of the courses $C_1, C_2, \dots, C_m$ respectively.

The overall course attainment levels are categorized as below,

Level 1: Poor – if $0 < ALC_i \leq 1$,

Level 2: Average – if $1 < ALC_i \leq 2$,

Level 3: Good – if $2 < ALC_i \leq 3$,

Level 4: Very Good – if $3 < ALC_i \leq 4$,

Level 5: Excellent – if $4 < ALC_i \leq 5$.

For every course, we have set Very Good – Attained as target level that is we are aiming minimum level 4 (very good) and how the course status is attained in the performance of abilities of students.

At the end we will have attainment levels of all the courses,

ID	Course name	ALC_i	Level	Status
C_1	Course_1	5	Excellent	Attained
C_2	Course_2	5	Excellent	Attained
C_3	Course_3	5	Excellent	Attained
C_4	Course_4	5	Excellent	Attained
C_5	Course_5	5	Excellent	Attained
C_6	Course_6	4	Very Good	Attained
C_7	Course_7	4	Very Good	Attained
C_8	Course_8	4	Very Good	Attained
C_9	Course_9	4	Very Good	Attained
C_{10}	Course_10	5	Excellent	Attained
C_{11}	Course_11	3	Good	Not Attained
C_{12}	Course_12	4	Very Good	Attained
C_{13}	Course_13	4	Very Good	Attained
C_{14}	Course_14	4	Very Good	Attained
C_{15}	Course_15	3	Good	Not Attained
C_{16}	Course_16	3	Good	Not Attained
C_{17}	Course_17	4	Very Good	Attained
C_{18}	Course_18	4	Very Good	Attained
C_{19}	Course_19	5	Excellent	Attained

Step 7: Calculation of attainment levels of PO's and PSO's.

- **Attainment of PO's & PSO's:**

The attainment of PO's & PSO's are calculated using direct method. In direct method the attainment of PO's & PSO's are calculated through the attainment levels of courses. The course attainment values (ALC_i , i = 1, 2, 3, ….., m.) and the overall level of relation of course with each PO and PSO ($X_{i,.,l}$, i = 1, 2, 3, ….., m, l = 1, 2, 3, ….., n.) are used to compute direct attainment level of each PO and PSO.

Direct Assessment: Direct attainment level of the l^{th}, PO's & PSO's is calculated as follows.

$$DALP_l = \frac{}{\sum_{i=1}^{m} ALC_i} \sum_{i=1}^{m} x_{i,.l,} * ALC_i \text{ ,l=1,2,…….n.}$$

ID	Course name	ALCi	$X_{i,.,1}$	$ALC_i * X_{i,.,1}$
C_1	Course_1	5	2.5	10
C_2	Course_2	5	2	8
C_3	Course_3	5	1.5	6
C_4	Course_4	5	1.5	6
C_5	Course_5	5	2.25	12.5
C_6	Course_6	4	1.5	8
C_7	Course_7	4	2	8
C_8	Course_8	4	2.5	8
C_9	Course_9	4	2	8

C_{10}	Course_10	5	2.25	15
C_{11}	Course_11	3	2	10.2
C_{12}	Course_12	4	1	8.4
C_{13}	Course_13	4	1.5	6.8
C_{14}	Course_14	4	3	8.4
C_{15}	Course_15	3	2.5	6.8
C_{16}	Course_16	3	2	8.5
C_{17}	Course_17	4	1.5	6.8
C_{18}	Course_18	4	2	8.4
C_{19}	Course_19	5	2	10
Sum		80		157.5
			$DALP_1$ = 157.5/80	1.9688

Similarly, we have to find attainment levels of all PO's and PSO's.

Sr. No.	ALC_i	$X_{i,.,1}$	$X_{i,.,2}$	$X_{i,.,3}$	$X_{i,.,4}$	$X_{i,.,5}$	$X_{i,.,6}$	$X_{i,.,7}$	$X_{i,.,8}$
1	5	2.5	1	1.5	1.5	2	1	1.5	2.5
2	5	2	1.5	2.5	2	2	1	2.5	2.5
3	5	1.5	2.5	1.5	2	1.5	0.5	1.5	2.5
4	5	1.5	3	1.5	2.5	2	2	2	2
5	5	2.25	2.25	2	2	1.75	1	2.5	1.75
6	4	1.5	2	1.5	2	1	1.5	1	2
7	4	2	2	1	1.5	2	1	1.5	1
8	4	2.5	2	1.5	2	2	1.5	1	2
9	4	2	2	2	1.5	1.5	1	2.5	2
10	5	2.25	2	1.75	2	1.5	1	2.25	2
11	3	2	2	2	2	1.5	1.5	0.5	2
12	4	1	2	2	1.5	2	1.5	3	2.5
13	4	1.5	1	2	2	1	1.5	0.5	2
14	4	3	2	2	1.5	2.5	2.5	1.5	2.5
15	3	2.5	2	2	2	2	1	1.5	2
16	3	2	2	2	2	2	1	1.5	2
17	4	1.5	1.5	2.5	1.5	1.5	1	1	2
18	4	2	2	2	2	2	2	0.5	1.5
19	5	2	2.125	1.875	2	1.75	1.75	1.75	1.875
Sum	80	37.5	36.875	35.125	35.5	33.5	25.25	30	38.625

Sr. No.	$ALC_i * X_{i,.,1}$	$ALCi * X_{i,.,2}$	$ALCi * X_{i,.,3}$	$ALCi * X_{i,.,4}$	$ALCi * X_{i,.,5}$	$ALCi * X_{i,.,6}$	$ALCi * X_{i,.,7}$	$ALCi * X_{i,.,8}$
1	12.5	5	7.5	7.5	10	5	7.5	12.5
2	10	7.5	12.5	10	10	5	12.5	12.5
3	7.5	12.5	7.5	10	7.5	2.5	7.5	12.5
4	7.5	15	7.5	12.5	10	10	10	10
5	11.25	11.25	10	10	8.75	5	12.5	8.75
6	6	8	6	8	4	6	4	8
7	8	8	4	6	8	4	6	4
8	10	8	6	8	8	6	4	8
9	8	8	8	6	6	4	10	8
10	11.25	10	8.75	10	7.5	5	11.25	10
11	6	6	6	6	4.5	4.5	1.5	6
12	4	8	8	6	8	6	12	10
13	6	4	8	8	4	6	2	8
14	12	8	8	6	10	10	6	10
15	7.5	6	6	6	6	3	4.5	6
16	6	6	6	6	6	3	4.5	6
17	6	6	10	6	6	4	4	8
18	8	8	8	8	8	8	2	6
19	10	10.625	9.375	10	8.75	8.75	8.75	9.375
Sum	157.5	155.88	147.13	150	141	105.75	130.5	163.63
$DALP_l$	1.9688	1.9484	1.8391	1.875	1.7625	1.3219	1.6313	2.0453

Step 8: Comparison of target level with obtained PO attainment.

In this step the target level of PO's and PSO's attainment are compared with obtained $DALP_l$

Attainment levels are defined as stated below.

Level 1: Poor – if $0 < ALC_i \leq 1$,

Level 2: Average – if $1 < ALC_i \leq 1.5$,

Level 3: Good – if $1.5 < ALC_i \leq 2$,

Level 4: Very Good – if $2 < ALC_i \leq 2.5$,

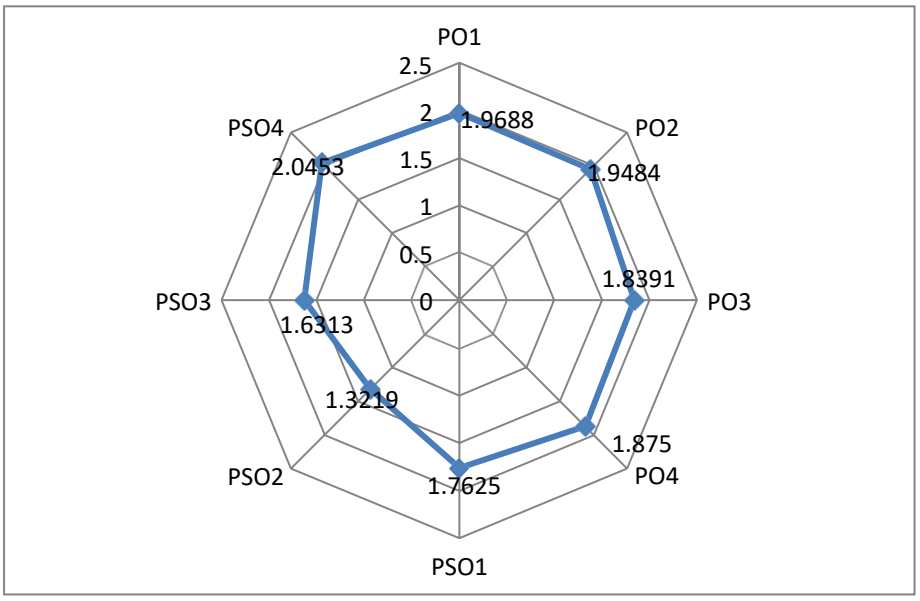
Level 5: Excellent – if $2.5 < ALC_i \leq 3$.

For every PO's and PSO's, we have set level 3 as target level that is we are aiming minimum level 3 (good) in the performance of abilities of students.

Attainment level of all the POs and PSOs

PO's	*DALP* $_l$	Level	Status
PO1	1.9688	Good	Attained
PO2	1.9484	Good	Attained
PO3	1.8391	Good	Attained
PO4	1.875	Good	Attained
PSO1	1.7625	Good	Attained
PSO2	1.3219	Average	Not Attained
PSO3	1.6313	Good	Attained
PSO4	2.0453	Very Good	Attained

P_l attainment target level say, 3, indicates that, the department is aiming minimum level-3(good) in the performance of abilities of students.



Step 9:

Planned actions for course attainment: Courses having course level less than level-4 are addressed bydesigning the different remedial measures like assignment/tutorials/remedial teaching.

Planned actions for program outcome attainment: PO's and PSO's with level attainment less than level-3 are addressed by planning remedial measures for the corresponding courses with respect tothan P_l.