

# ATTAINMENT OF COURSE OUTCOMES AND PROGRAM OUTCOMES

Session: 2021-22

Submitted by

**Department of Mathematics**

**Mankar College**



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## List of programme outcomes

### Name of the program: Mathematics Hons

PO1	Gain a strong knowledge in different areas of mathematics and solve real life problems by constructing and solving mathematical models.
PO2	Acquire numerical skill and logical thinking and apply these in facing competitive examinations, internships with confidence.
PO3	Gain scientific knowledge and skills which enables them to undertake further studies in Mathematics, Statistics or its allied areas.
PO4	Pursue research in the field of Mathematics, Engineering, Information Technology, Computer Science and Social Science
PO5	Apply knowledge of principles, concepts, and results in specific subject area to analyse their impact both locally and globally.
PO6	Enhance problem-solving skills to resolve day to day problems.

# List of course outcomes

## 1<sup>st</sup> Year (Semester I semester II)

### Semester -I

Course code: **BMH1CC01**

Course Name: **Calculus, Geometry, and differential equations**

SL. No	Outcomes	PO addressed
CO1	Recall the idea of derivative, integration, rules of differentiation and understand the concept of formulating differential equations.	PO1
	Will be able to solve different kinds of differential equations.	PO1
	Demonstrate the ability to visualize various forms of straight lines, planes, conic sections and enables them to apply these concepts in explaining mathematical theories geometrically.	PO4
	Apply the concepts of differentiation to estimate velocity, acceleration, and integration like measuring area of a surface, volume etc.	PO6
	Know hyperbolic functions and compare these functions with circular functions, trigonometric functions, inverse trigonometric functions and learn their properties.	PO3

Course code: **BMH1CC02**

Course Name: **Algebra**

SL. No	Outcomes	PO addressed
CO2	Learn the basic ideas of the theory of equations and will be able to solve different types of equations.	PO5
	Learn the operations on polynomials and associated theorems.	PO3
	Calculate arithmetic mean, geometric mean and hyperbolic mean and will be able to apply them to solve real life problems.	PO6
	Know the divisibility of integers, congruence operations, Principle of mathematical induction etc.	PO3
	Develop numerical skill to solve practical problems.	PO2, PO6

### Semester -II

Course code: **BMH2CC03**

Course Name: **Real Analysis**

SL. No.	Course outcome	PO Addressed
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CO3	Learn the basic concepts of countable sets, metric space, connectedness, compactness of metric spaces, which are the backbone of real analysis.	PO5, PO3
	Understand the techniques and examples in analysis, which helps them to be well prepared for courses like Topology, Measure theory and Functional analysis.	PO3
	Using the concept of sequence and series find the sum of infinite terms with different methods.	PO2, PO6
	Differentiate continuous functions and uniform continuous functions	PO2
	Understand iterative numerical methods to find the roots of an equation, which are based on the concept of sequence.	PO4
	Explain the applicability of mathematical models using the concepts of real analysis	PO1

**Course code: BMH2CC04**

**Course Name: Differential Equations and Vector Calculus**

SL. No	Outcomes	PO addressed
CO4	Identify different types of equations, such as linear, non-linear, homogeneous differential equations.	PO2, PO3
	Formulate and solve various types of differential equations.	PO1, PO5
	Demonstrate the ability to formulate mathematics model for a real-life problem like outbreak of a disease, logistics problems etc and solve these.	PO1, PO4
	Able to find equilibrium points and know the interpretation of phase plane.	PO3
	Learn the basics of vector calculus including gradient, divergence and curl which is mostly used in the study of physics.	PO2, PO3

## **2<sup>nd</sup> Year (Semester III semester IV)**

**Course code: BMH3CC05**

**Course Name: Theory of Real Functions and Introduction to Metric Spaces**

SL. No	Outcomes	PO addressed
CO5	Recall the limit and continuity of functions. Equipped with basic mathematical tools such as open & close sets, continuity, connectedness, compactness which can be used to study mathematics in higher level.	PO2, PO3
	Understand mean value theorem and its application, Taylor's series and Maclaurin's series expansion of exponential and trigonometric functions.	PO3, PO4
	Know the basic concepts and terminologies of metric space.	PO3
	Acquire knowledge helps to study further in advance mathematics courses.	PO3, PO4

	Acquire problem solving ability through solving different problems on various concepts involved.	PO6
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**Course code: BMH3CC06**

**Course Name: Group Theory I**

SL. No	Outcomes	PO addressed
CO6	Acquire knowledge about different types of groups and their properties.	PO2, PO3
	Learn the algebraic structure 'Groups' in detail, which is useful in study of Rings, Modules, Algebraic topology etc.	PO3, PO4
	Learn Lagrange theorem and apply this to check if a given subset is a subgroup of a group or not.	PO2
	Determine the condition for the group $Z_n$ to be an integral Domain and Field and find the Characteristic of the Ring, Integral Domain, and Field.	PO2, PO3
	Learn the properties of homomorphism and isomorphism.	PO2, PO3

**Course code: BMH3CC07**

**Course Name: Numerical Methods and numerical methods lab**

SL. No.	Course outcome	PO Addressed
CO7	Understand the necessity of using numerical methods apply these to solve various types of problems	PO1, PO2
	Find roots of transcendental and polynomial equations using numerical techniques	PO2, PO6
	Solve mathematical models using appropriate numerical methods and pursue research in the field of mathematics, engineering, computer science.	PO4, PO1
	Constructs polynomials employing different methods and understand numerical differentiation and integration which enables them to undertake further studies in Mathematics, or its allied areas.	PO3
	Compare the rate of convergence of different numerical formula.	PO2
	Understand C programming language and can solve problems using C-programming software.	PO4, PO5

**Course code: BMH3SEC11**

**Course Name: Logic and Sets**

SL. No	Outcomes	PO addressed
CO8	Introduced with basic terminologies of Logics such as truth table, negation conjunction and disjunction.	PO2, PO3
	Know sets operations and the laws of sets theory and Venn Diagrams.	PO2, PO4
	Learn relations, composition of relations and their examples.	PO2, PO3

	Using the knowledge of sets theory, demonstrate the ability to solve reasonings. It may help them to get prepared for the competitive exams.	PO2
	Enhance logical skills.	PO2, PO1

## Semester -IV

**Course code: BMH4CC08**

**Course Name: Reimann Integration and Series of Functions**

SL. No	Outcomes	PO addressed
CO9	Get introduced with Reimann integration and associated theorems. Demonstrate the ability to solve related problems.	PO2, PO3
	Know fundamental theorem of integral calculus and its application.	PO2, PO3
	Learn improper integral and the convergence of Beta and Gamma functions. Enhance the ability to solve related problems.	PO3, PO4, PO5
	Understand the definition of Fourier coefficient and series.	PO3
	Learn power series and associated theorems. Can solve problems related to series of functions.	PO1, PO2, PO3, PO6

**Course code: BMH4CC09**

**Course Name: Multivariate Calculus**

SL. No	Outcomes	PO addressed
CO10	Introduced with function of several variables and the limit, continuity, and differentiability of these functions.	PO3
	Learn double and triple integral and able to solve the related problems. Enhance the ability to calculate area and volume using double and triple integral.	PO3, PO4
	Know vector operators, gradient of scalar function, vector field, divergence and curl. The acquired knowledge help them to study further in the field of applied mathematics, engineering, and physics.	PO3, PO4
	Enhance the problem-solving skills.	PO5, PO6
	Demonstrate the ability to solve real-life problems using the knowledge of integration and vector operators.	PO1, PO6

**Course code: BMH4CC10**

**Course Name: Ring Theory and Linear Algebra I**

SL. No	Outcomes	PO addressed
	Learn the algebraic structure of Ring and gain detailed knowledge through various examples.	PO2, PO3
	Understand ring homomorphism and its properties and the fields of quotient.	PO3

CO11	Learn vector spaces and its associated theorem. Able to solve related problems.	PO2, PO3, PO4
	Know linear transformation, its rank and nullity. Learn the algebra of linear transformation and its matrix representation.	PO3
	Enhance problem solving skills by solving problems of linear algebra.	PO5, PO6

**Course code: BMH4SEC21**

**Course Name: Graph theory**

SL.No.	Course outcome	PO Addressed
CO12	Understand the concept of Graphs, which is an important tool for Mathematical Modelling	PO1, PO3
	Understand different types of graphs and operations on graphs	PO2, PO3
	Relate real life problems or events with mathematical graphs	PO5, PO6
	Understand the concept of trees and algorithms to find special spanning trees	PO3, PO4
	Understand directed graphs and its applications	PO2, PO4



### 3<sup>rd</sup> Year (Semester V semester VI)

**Course code: BMH5CC11**

**Course Name: Partial Differential Equations and Applications**

SL. No	Outcomes	PO addressed
CO13	Know basic concepts and definition of partial differential equations and its application.	PO1, PO2, PO3
	Familiar with different types of partial differential equations and can solve them.	PO2
	Learn the construction and geometrical interpretation of partial differential equations.	PO1
	Know Cauchy problems of partial differential equations, initial and boundary value problems.	PO3, PO4
	Construct mathematical model to a real-life problem and solve them. Enhance the capability to continue research in applied mathematics, engineering, and physics.	PO4, PO5, PO6

**Course code: BMH5CC12**

**Course Name: Mechanics I**

SL. No	Outcomes	PO addressed
CO14	Learn coplanar forces, equilibrium of a particle on a rough curve, general condition of equilibrium and the stability and instability of equilibrium.	PO3, PO4
	Recall simple harmonic motion and gain detailed knowledge by solving associated problems.	PO2
	Learn moments and products of inertia, D' Alembert's principle and its application.	PO3, PO4
	Understand the conservation of momentum and energy. The acquired knowledge help to solve practical problems.	PO5, PO6
	Enhance the ability to solve problems related to physics and engineering and capable to study further in these fields.	PO4, PO6

**Course code: BMH5DSE12**

**Course Name: Number theory**

SL. No.	Course outcome	PO Addressed
CO15	Apply mathematical induction and other types of techniques to prove theorems or mathematical results.	PO1
	Apply the concepts and results of divisibility of integers effectively	PO2, PO6
	Understand research problems related to number theory	PO3, PO4

	Learn various theorems on primes, congruence and residues which are used in cryptography.	PO3
	Solve problems related to Chinese remainder theorem, Fermat's Little theorem	PO2

**Course code: BMH5DSE21**

**Course Name: Probability and Statistics**

SL. No	Outcomes	PO addressed
CO16	Understand the concepts of sample space, the laws of probability and the Baye's theorem and learn discrete and continuous random variables.	PO2, PO3
	Learn different types of distribution and can solve related problems.	PO1, PO2
	Derive correlation, regression, and rank correlation coefficient and learn partial and multiple correlations.	PO1, PO3, PO4
	Gain the concepts in sampling and know the estimation of parameters.	PO1, PO2, PO3
	Able to continue further study in the field of applied mathematics, statistics, and biostatistics. Enhance the ability to solve practical problems.	PO3, PO4, PO5, PO6

**Semester -VI**

**Course code: BMH6CC13**

**Course Name: Metric Spaces and Complex Analysis**

SL. No	Outcomes	PO addressed
CO17	Recall the concepts of metric space, Cauchy sequence and complete metric space.	PO2, PO3
	Know continuous mappings, sequential criterion and other characterizations of continuity, uniform continuity, and connectedness.	PO3
	Understand Banach Fixed point theorem and its application to ordinary differential equations.	PO2, PO3
	Know the Cauchy-Reimann equations and the sufficient condition for differentiability. Enhance the problem-solving skills through its applications.	PO2, PO3, PO4, PO6
	Using the tools and techniques of complex analysis, demonstrate the ability to study further in the field of real mathematics.	PO3, PO4

**Course code: BMH6CC14**

**Course Name: Ring Theory and Linear Algebra II**

SL. No	Outcomes	PO addressed
	Recall the concepts and terminologies of Ring theory and linear algebra.	PO2

CO18	Learn factorization of polynomials, reducibility and irreducibility tests Einstein Criterion, and unique factorization in $\mathbb{Z}(x)$ .	PO2, PO3
	Understand eigen spaces of a linear operator, invariant subspaces, and the Cayley Hamilton theorem. Enhance the ability to solve associated problems.	PO2, PO3, PO4
	Learn inner product spaces and norms, Gram-Schmidt orthogonalization process and learn its application through various examples.	PO3, PO4
	Understand least square approximations and minimal solutions to systems of linear equations.	PO2

**Course code: BMH6DSE43**

**Course Name: Group Theory II**

SL. No	Outcomes	PO addressed
CO19	Recall the concepts of different types of groups and homomorphisms.	PO2, PO3
	Learn group action, stabilizers and kernels and their applications, Generalized Cayley's theorem and index theorem.	PO3, PO4
	Learn class equations and consequences, Sylow's theorems and consequences and Cauchy's theorems.	PO3, PO4
	Enhance the problem-solving skill by solving various problems on Group theory.	PO2, PO6
	Acquired knowledge help to study further in the fields of mathematics.	PO3, PO4

**Course code: BMH6PW01**

**Course Name: Project**

SL.No.	Course outcome	PO Addressed
CO20	Choose a topic of their own interest	PO4
	Formulate, analyse, and interpret mathematical models	PO1
	Build confidence and develop communication skills through the presentation of their project work	PO2, PO6
	Get preliminary concept of research in mathematics	PO3, PO4
	Gain in-depth knowledge independently in the specific topic	PO3
	Understand the core findings of their project and their applicability in practice	PO5

# CO PO Matrix

CO PO Matrix: 1st Year				
	CO1	CO2	CO3	CO4
PO1	5	1	3	5
PO2	1	4	5	5
PO3	4	5	4	5
PO4	4	1	4	4
PO5	1	4	4	4
PO6	4	4	4	1

CO PO Matrix: 2nd Year								
	CO5	CO6	CO7	CO8	CO9	CO10	CO11	CO12
PO1	1	1	5	3	2	3	2	3
PO2	4	4	5	5	5	4	4	4
PO3	5	5	4	5	5	4	5	5
PO4	5	4	5	3	3	3	3	4
PO5	4	1	4	1	3	3	3	3
PO6	3	1	4	1	3	5	3	3

CO PO Matrix: 3rd Year									
	CO13	CO14	CO15	CO16	CO17	CO18	CO19	CO20	
PO1	5	1	3	5	1	1	1	5	
PO2	4	3	4	5	5	5	4	3	
PO3	4	4	4	5	5	5	5	4	
PO4	4	4	3	4	4	4	5	3	
PO5	3	3	1	3	1	1	1	4	
PO6	3	4	3	3	3	1	3	4	

- 5- very highly correlated
- 4- highly correlated
- 3- moderately correlated
- 2- poorly correlated
- 1- Very poorly correlated

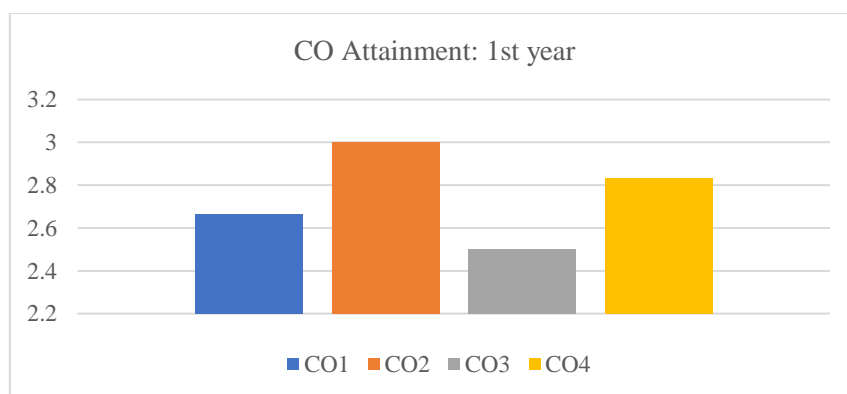
## Attainment of Course Outcomes (2021-22)

### Student wise GPA for course outcomes: 1<sup>st</sup> Year

Name	University Roll Number	CO1	CO2	CO3	CO4
XXXXXX	210311700004	10	10	9	9
XXXXXX	210311700006	7	9	7	8
XXXXXX	210311700010	9	10	10	10
XXXXXX	210311700017	10	10	9	9
XXXXXX	210311700020	10	10	9	9
XXXXXX	210311700036	9	9	7	9

### Student wise attainment level for course outcomes: 1<sup>st</sup> Year

Name	University Roll Number	CO1	CO2	CO3	CO4
XXXXXX	210311700004	3	3	3	3
XXXXXX	210311700006	1	3	1	2
XXXXXX	210311700010	3	3	3	3
XXXXXX	210311700017	3	3	3	3
XXXXXX	210311700020	3	3	3	3
XXXXXX	210311700036	3	3	1	3
CO attainment		1.375	2.666667	3	2.333333



The above chart depicts the attainment levels of CO1, CO2, CO3 and CO4. It shows, although the attainment level of CO2, and CO4 is high, it is comparatively low for CO1 and CO3. Therefore, to improve the attainment level of this course in the subsequent years the following actions have been taken –

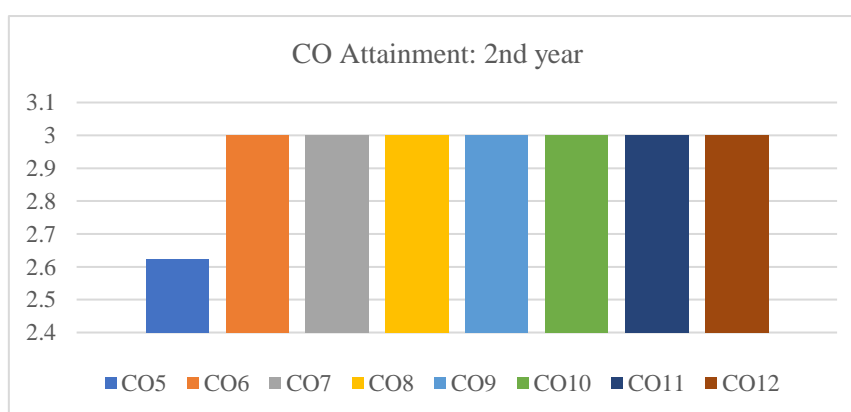
- The number of classes for these courses will be increased.
- The faculty members were requested to take remedial classes for those students who failed to achieve satisfactory scores in the internal assessments or class tests.

## Student wise GPA for course outcomes: 2<sup>nd</sup> Year

Name	University Roll Number	CO5	CO6	CO7	CO8	CO9	CO10	CO11	CO12
XXXXX	200311700008	9	10	10	9	9	<b>9</b>	<b>10</b>	10
XXXXX	200311700011	9	10	10	9	10	<b>10</b>	<b>10</b>	10
XXXXX	200311700021	9	10	10	9	10	<b>9</b>	<b>10</b>	10
XXXXX	200311700023	9	10	10	9	10	<b>9</b>	<b>10</b>	10
XXXXX	200311700038	9	10	10	9	10	<b>9</b>	<b>10</b>	10
XXXXX	200311700044	8	10	9	10	9	<b>9</b>	<b>10</b>	10
XXXXX	200311700045	7	10	9	9	9	<b>9</b>	<b>10</b>	9
XXXXX	200311700052	9	10	10	9	10	<b>9</b>	<b>10</b>	10

## Student wise attainment level for course outcomes: 2<sup>nd</sup> Year

Name	University Roll Number	CO5	CO6	CO7	CO8	CO9	CO10	CO11	CO12
XXXXX	200311700008	3	3	3	3	3	3	3	3
XXXXX	200311700011	3	3	3	3	3	3	3	3
XXXXX	200311700021	3	3	3	3	3	3	3	3
XXXXX	200311700023	3	3	3	3	3	3	3	3
XXXXX	200311700038	3	3	3	3	3	3	3	3
XXXXX	200311700044	2	3	3	3	3	<b>3</b>	<b>3</b>	3
XXXXX	200311700045	1	3	3	3	3	<b>3</b>	<b>3</b>	3
XXXXX	200311700052	3	3	3	3	3	<b>3</b>	<b>3</b>	3
<b>CO attainment</b>		<b>2.666667</b>	2.625	3	3	3	3	3	3



The above chart shows the attainment of course outcomes for the 2<sup>nd</sup> year students in 2021-22. We noticed a drastic improvement of the course outcomes CO8 than the previous year. But the attainment of CO5 get declined than the previous year. Therefore, the following actions will be taken to improve it –

- i. Extra classes and mock test will be taken.
- ii. Previous year questions will be discussed.

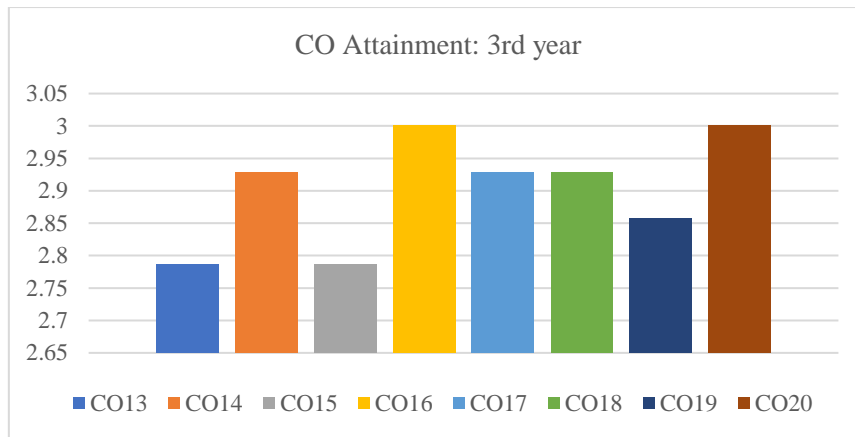
### Student wise GPA for course outcomes: 3<sup>rd</sup> Year

Name	University Roll Number	CO13	CO14	CO15	CO16	CO17	CO18	CO19	CO20
XXXXX	190311700001	10	<b>10</b>	<b>10</b>	10	10	10	10	10
XXXXX	190311700008	10	<b>10</b>	<b>10</b>	10	10	10	10	10
XXXXX	190311700011	10	<b>10</b>	<b>10</b>	10	10	10	10	10
XXXXX	190311700013	10	<b>10</b>	<b>10</b>	10	10	10	10	10
XXXXX	190311700027	10	<b>10</b>	<b>10</b>	10	10	10	10	10
XXXXX	190311700028	10	<b>9</b>	<b>10</b>	10	10	9	10	10
XXXXX	190311700029	9	<b>9</b>	<b>10</b>	10	9	9	10	10
XXXXX	190311700030	8	<b>8</b>	<b>8</b>	10	8	8	8	10
XXXXX	190311700032	10	<b>10</b>	<b>10</b>	10	10	10	10	10
XXXXX	190311700034	10	<b>10</b>	<b>10</b>	10	10	10	10	10
XXXXX	190311700035	10	<b>9</b>	<b>10</b>	10	10	9	10	10
XXXXX	190311700039	10	<b>9</b>	<b>9</b>	10	10	9	9	10
XXXXX	190311700048	10	<b>9</b>	<b>10</b>	10	10	9	10	10
XXXXX	190311700049	10	<b>10</b>	<b>10</b>	10	10	10	10	10

### Student wise attainment level for course outcomes: 3<sup>rd</sup> Year

Name	University Roll Number	CO13	CO14	CO15	CO16	CO17	CO18	CO19	CO20
XXXXX	190311700001	3	<b>3</b>	<b>3</b>	3	3	3	3	3
XXXXX	190311700008	1	<b>3</b>	<b>1</b>	3	3	3	2	3
XXXXX	190311700011	3	<b>3</b>	<b>3</b>	3	3	3	3	3
XXXXX	190311700013	3	<b>3</b>	<b>3</b>	3	3	3	3	3
XXXXX	190311700027	3	<b>3</b>	<b>3</b>	3	3	3	3	3
XXXXX	190311700028	3	<b>3</b>	<b>3</b>	3	3	3	3	3
XXXXX	190311700029	3	<b>3</b>	<b>3</b>	3	3	3	3	3
XXXXX	190311700030	2	<b>2</b>	<b>2</b>	3	2	2	2	3
XXXXX	190311700032	3	<b>3</b>	<b>3</b>	3	3	3	3	3
XXXXX	190311700034	3	<b>3</b>	<b>3</b>	3	3	3	3	3
XXXXX	190311700035	3	<b>3</b>	<b>3</b>	3	3	3	3	3
XXXXX	190311700039	3	<b>3</b>	<b>3</b>	3	3	3	3	3
XXXXX	190311700048	3	<b>3</b>	<b>3</b>	3	3	3	3	3
XXXXX	190311700049	3	<b>3</b>	<b>3</b>	3	3	3	3	3
<b>CO attainment</b>		<b>2.714286</b>	2.785714	2.928571	2.785714	3	2.928571	2.928571	2.857143





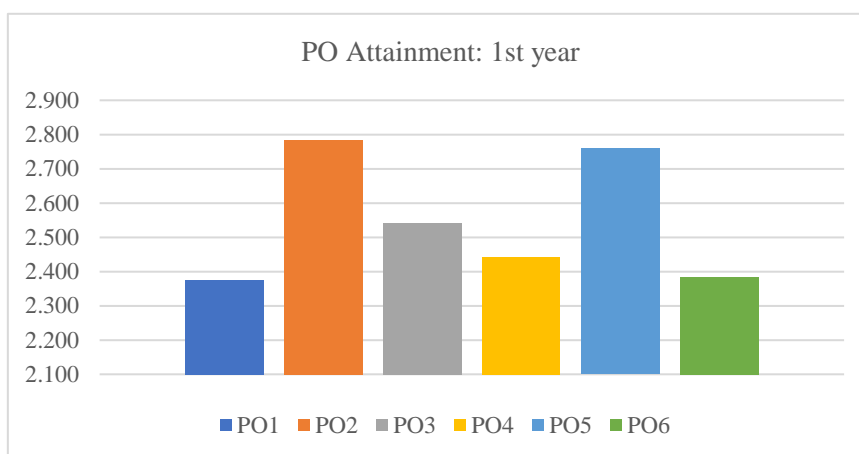
The above chart depicts the course attainment of the 3<sup>rd</sup> year. Although the poor attainment level of the course outcomes for CO13 and CO15 were noticed, it's got improved than the previous year. Therefore, for further improvement of the attainment level of these two courses for the next year students, the following actions were taken -

1. Remedial classes and doubt clearing classes will be arranged.
2. Extra study materials and reference books will be provided.
3. Previous year questions will be discussed.

# Attainment of Programme Outcomes (2021-22)

## Calculation of attainment of Programme Outcomes: 1<sup>st</sup> year

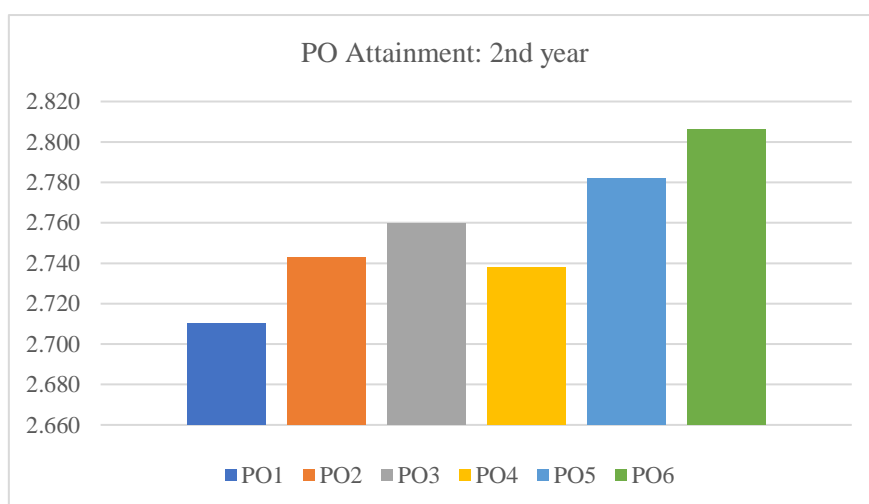
Course Variables	Course Outcomes	CO1	CO2	CO3	CO4	Programme Wise Total Correlation Value	PO Attainment Level
	Average Attainments	2.667	3.000	2.334	2.833		
Programme Outcomes	PO1	5	1	3	5	14	2.375
	PO2	1	4	5	5	15	2.783
	PO3	4	5	4	5	18	2.542
	PO4	4	1	4	4	13	2.442
	PO5	1	4	4	4	13	2.760
	PO6	4	4	4	1	13	2.385



The above line graph represents the program attainment of 1<sup>st</sup> year in 2021-22. All the faculty members were requested to take the necessary actions mentioned above for the improvement of course outcomes of 3<sup>rd</sup> year, for the consequent improvement of the program outcomes.

## Calculation of attainment of Programme Outcomes: 2<sup>nd</sup> year

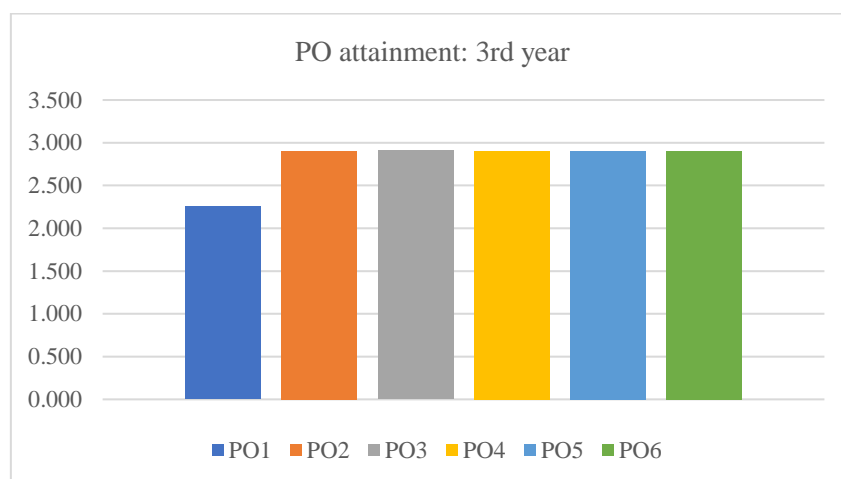
Course Variables	Course Outcomes	C05	C06	C07	C08	C09	C010	C011	C012	Programme Wise Total Correlation Value	PO Attainment Level
	Average Attainments	2.625	3	3	3	3	3	3	3		
Programme Outcomes	PO1	1	1	5	3	2	3	2	3	20	2.710
	PO2	4	4	5	5	5	4	4	4	35	2.743
	PO3	5	5	4	5	5	4	5	5	38	2.760
	PO4	5	4	5	3	3	3	3	4	30	2.738
	PO5	4	1	4	1	3	3	3	3	22	2.782
	PO6	3	1	4	1	3	5	3	3	23	2.806



The above line graph represents the PO attainment for the 2<sup>nd</sup> year in 2021-22. It shows an improvement in all the outcomes than the previous year. This improvement was due to an average improvement of the course outcomes in this year.

## Calculation of attainment of Programme Outcomes: 3<sup>rd</sup> year

Course Variables	Course Outcomes	CO13	CO14	CO15	CO16	CO17	CO18	CO19	CO20	Programme Wise Total Correlation Value	PO Attainment Level	
	Average Attainments	2.786	2.929	2.786	3.000	2.929	2.928	2.857	3.000			
Programme Outcomes	PO1	5	1	3	5	1	1	1	5	22	2.873	
	PO2	4	3	4	5	5	5	4	3	33	2.904	
	PO3	4	4	4	5	5	5	5	4	36	2.908	
	PO4	4	4	3	4	4	4	4	5	3	31	2.908
	PO5	3	3	1	3	1	1	1	1	4	17	2.907
	PO6	3	4	3	3	3	1	3	4	4	24	2.905



The above chart shows the PO attainment of 3rd year for the session 2021-22. The attainment level improves drastically than the previous year. We will adhere to the actions taken for the progress of course outcomes to keep this progress.