Measuring Attainment of Course Outcomes and Program Outcomes for MCA

1. **Introduction**

   Master of Computer Applications (MCA) is a two-year (four semesters) professional Master Degree program in computer applications. The program is designed to meet the growing demand for qualified professionals in the field of Information Technology. It is a postgraduate program that can be taken up after obtaining a Bachelor's Degree. The MCA program is inclined more towards Application Development and thus has more emphasis on the latest programming language and tools to develop better and faster applications. It covers various aspects of computational theory, programming, algorithm design and optimization, network and database management, mobile technologies, cyber security, information system audit, etc.

- Discipline Specific elective courses and General Electives to be offered in functionalareas have to depend on student preferences and needs of the user systems in the region in which the educational institution is located.

- The MCA program is a mixture of computer-related and general business courses. The computer related courses include Programming Techniques, Database Managements and Data Analytics techniques. The general business courses include the emerging areas in management like Digital Marketing, Industry 4.0 norms and Entrepreneurship Development including Start-ups.

- The program would emphasis on Experiential Learning which aims at creation of business applications. Inclusion of projects improves student's technical orientation, understanding of IT environment and domain knowledge. It will provide helpful platform for students to become a successful Software professional. This would improve domain knowledge of various areas, which would help the students to build software applications on it. The students are exposed to software development in the data processing environment with special emphasis on Software Project Management and Software Engineering for small and medium organizations.

- Subjects such as IS Audit, Design Thinking, Digital Forensics, Cyber Security and Big Data Management will work as new application domains. Major focus is given on Data Analytics so that student can choose Data Analyst as their career options. Also, exposure to Web applications, Web 2.0, Web Mining and Web Application Security is also provided. Advanced technology includes Internet of Things, Mobile computing and variety of new technologies. Business communication, personality development and seminar will lead to overall personality development of the student and that will help them in their career development and to sustain in the dynamic environment of Information Technology.

- MOOC courses help students for self-learning of emerging technologies and trends in market with the help of online platform. List of various certifications possible through SWAYAM is published on Shivaji University's Web site. Students should try to do maximum Value Added certifications during their learning phase through MOOCs like SWAYAM platform to make their resume rich.

- The new curricula would focus on Outcome Based Education including Cognitive and Affective skills with the help of Discipline specific skills, Ability Enhancement Skills and Hands on experience.

- The inclusion of projects ensures the Experiential Learning where students can apply their skills at respective levels. It will provide opportunity for students to work on various emerging technologies. It will provide appropriate platform for students to work in IT Industry. It will also improve documentation, Coding and Design standards capabilities in students. Inclusion of project for subject such as Web Technology and Mobile Computing will definitely improve students' innovativeness and creativity.

- The Institutes should organize placement program for the MCA students by interacting with the industries and software consultancy houses in and around the region in which the educational Institution is located. The Institute should also promote entrepreneurship skills through Entrepreneurship Development Cell or Incubation Centre.

2. PO and CO Mappings:

Program Outcomes: Program outcomes are attributes of the graduates from the program that are indicative of the graduates' ability and competence to work as an IT professional upon graduation. Program Outcomes are statements that describe what students are expected to do now or do by the time of post-graduation. They must relate to knowledge and skills that the students acquire fromthe program. The achievement of all outcomes indicates that the student is well prepared to achieve the program educational objectives down the road. Master of Computer Applications program has following PO's.

PO1. Computational Knowledge: Understand and apply mathematical foundation, computing and domain knowledge for the conceptualization of computing models from defined problems.

PO2. Problem Analysis: Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.

PO3. Design / Development of Solutions: Ability to transform complex business scenarios and contemporary issues into problems, investigate, understand and propose integrated solutions using emerging technologies

PO4. Conduct Investigations of Complex Computing Problems: Ability to devise and conduct experiments, interpret data and provide well informed conclusions.

PO5. Modern Tool Usage: Ability to select modern computing tools, skills and techniques necessary for innovative software solutions

PO6. Professional Ethics: Ability to apply and commit professional ethics and cyber regulations in a global economic environment.

PO7. **Life-long Learning**: Recognize the need for and develop the ability to engage in continuous learning as a Computing professional.

PO8. Project Management and Finance: Ability to understand, management and computing principles with computing knowledge to manage projects in multidisciplinary environments.

PO9. Communication Efficacy: Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.

PO10. **Societal & Environmental Concern:** Ability to recognize economical, environmental, social, health, legal, ethical issues involved in the use of computer technology and other consequential responsibilities relevant to professional practice.

PO11. Individual & Team Work: Ability to work as a member or leader in diverse teams in multidisciplinary environment.

PO12. Innovation and Entrepreneurship: Identify opportunities, entrepreneurship vision and use of innovative ideas to create value and wealth for the betterment of the individual and society.

3. Course Outcome(s): Every individual course under this program has course outcomes (CO). The course outcomes rationally match with program educational objectives. The mapping of PEO, PO and CO is as illustrated below:

ProgramOutcome	Course Outcome
PO1,PO2,PO3,PO4 andPO5	All Core and Labcourses
PO6 ,PO7, PO8 PO9 and PO12	All AEC courses
PO10,PO11	All Electives

4. **Program Specific Outcomes (PSO's)**

   PSO 1. Ability to pursue careers in IT industry/ consultancy/ research and development, teaching and allied areas related to computer applications.

   PSO 2. Comprehend, explore and build up computer programs in the areas allied to Algorithms, System Software, Multimedia, Web Design and Big Data Analytics for efficient design of computer-based systems of varying complexity.

5. First correlation is established between Course outcomes - POs and PSOs in the scale of 1 to 3, 1 being the slight (Low), 2 being the Moderates (medium), 3 being the Substantial (high). Faculty has prepared the mapping matrix for each course and verified by respective HOD of the department.
   TABLE I below shows Program level Course-PO, PSO mapping Matrix.

The Table I shows the Mapping of Course outcomes with Program outcome and Program specific outcome.

		Course Outcomes
Core	CC301	1: Explain and Apply the Object Oriented Concepts for Solving Real Problem
		2: Create, Debug and Run Simple Java Programs using the Java SDK Environment.
		3: Develop the Small Applications using networking and Multithreading.
		4: Apply Events Management and Layout Managers Using AWT, Swing for Developing the Software for Various Problems.

First correlation is established between COs – POs and COs - PSOs in the scale of 1 to 3.

1 being the slight (Low), 2 being the moderates (Medium), 3 being the substantial (High).

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CC3011	3	3	3	3	3	..	..	..	..	..	..	..	2.5	2.5
CC3012	3	3	3	3	3	..	..	..	..	..	..	..	2.5	2.5
CC3013	3	3	3	3	3	..	..	..	..	..	..	..	2.5	2.5
CC3014	3	3	3	3	3	..	..	..	..	..	..	..	2.5	2.5
CC301	3	3	3	3	3								2.5	2.5

Once mapping of each course is done then Program level mapping of Course-PO POS matrix is done for all the courses. TABLE II below shows Program level Course-PO, PSO" mapping Matrix.

TABLE II Program level Course-PO, PSO Mapping Matrix.

Courses		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Core	CC101														
Core	CC102														
Core	CC103														
AEC	AEC 104						3	3	3	3			3		
AEC	AEC 105						3	3	3	3			3		
AEC	AEC 106						3	3	3	3			3		
GE	GE107										3	3			
Core	CC108														
Core	CC109														
Core	CC110														
Core	CC201	3	3	3	3	3								2.5	2.5
Core	CC202														
Core	CC203														
Core	CC204														
Core	CC205														
GE	GE206														
Core	CC207														
Core	CC208														
Core	CC209														
Core	CC301	3	3	3	3	3								2.5	2.5
Core	CC302														
Set Target		**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.5**	**2.5**

6. Attainment of COs

Course outcomes are specific, measurable and can be demonstrated by students on completion of the course. Direct measurement of CO attainment levels based on the Progressive assessment and on the result of the end semester examination ESE (TH, PR) conducted by University. Progressive assessment of theory contains Assignment, Lab Work, Library Assignments, Mid test. For the calculation of attainment of COs first calculate attainment level of COs in Assignment, Lab Work, Library Assignments, Mid test, ESE (TH), ESE (PR), and then decide the direct attainment level of CO.

6.1 Attainment of COs through Internal assessment

Attainment levels are decided as follows. Attainment Level - 1: 60% students scoring more than 60% marks out of the relevant maximum marks is considered to be attainment of "1" Attainment Level - 2: 70% students scoring more than 60% marks out of the relevant maximum marks is considered to be attainment of "2" Attainment Level - 3: 80% students scoring more than 60% marks out of the relevant maximum marks is considered to be attainment of "3". Table III shows sample process of computing CO attainment for the internal assessment of CC301.

Table III. Attainment of COs for the internal assignment of CC301.

Course Name: Web Technology: CC301

Assignments

Subject: CC201-Web Technology

Roll No.		CO Mapped	CO-1	CO-2	CO-3	CO-4	Total Marks
		Target Set	3	3	3	3	
		Maximum Weight	5	5	5	5	
1	Nidhi vaibhav Kothari		5	5	5	5	20
2	Swati nitin hosmani		0	0	0	0	0
3	Priyanka umesh marathe		5	5	5	5	20
4	Mrunali rajendra patane		5	5	5	5	20
5	Sadhana shrirang khot		5	5	5	5	20
6	Tejaswini dattatray chougule		5	5	5	5	20
7	Yogini kedar khadilkar		5	5	5	5	20
8	Sumit gangaram rapshe		5	5	5	5	20
9	Nikita arvind chavan		5	5	5	5	20
10	Angha sukumar kamble		5	5	5	5	20
11	Vaishnavi vijay patil		5	5	5	5	20
12	Vaibhavi virbhadra vibhute		5	5	5	5	20
13	Ankita sunil ghatage		5	5	5	5	20
14	Suraj sanjay jadhav		5	5	5	5	20
15	Shubham yashwant kamble		5	5	5	5	20
16	Aditya shashikant kumbhojkar		5	5	5	5	20
17	Shrutika shrishail araballi		5	5	5	5	20
18	Shweta suresh sawant		5	5	5	5	20
19	Saloni dilip bukate		5	5	5	5	20
20	Altamash akatar dhalait		5	5	5	5	20
21	Shrijeet Manohar Savadikar		5	5	5	5	20
22	Vaishnavi Jeevan Gavali		5	5	5	5	20
23	Neha Digambar Khandare		5	5	5	5	20
24	Kulsoom Shamsuddin Patwegar		5	5	5	5	20
25	Nayan Pandurang Patil		5	5	5	5	20
26	Prajakta Chandrakant Jadhav		5	5	5	5	20

27	Aishwarya Sambhaji Mane	5	5	5	5	20
28	Akshay Namdev Patil	5	5	5	5	20
29	Shrutakirti Shamrao Patil	5	5	5	5	20
30	Nitin Dattatrey Birajdar	5	5	5	5	20
31	Jyoti Ramchandra Bankar	5	5	5	5	20
32	Snehal Vishwas Nyaynirgune	5	5	5	5	20
33	Prajakta Manik Pawar	5	5	5	5	20
34	Nikita Sanjay Shinde	5	5	5	5	20
35	Rushikesh Ashok Pawar	5	5	5	5	20
36	Pooja Jitendra Sutar	5	5	5	5	20
37	Pritam Shreyansh Dige	5	5	5	5	20
38	Amruta Rajaram Kore	5	5	5	5	20
39	Prajkta Sanjay Vetam	5	5	5	5	20
40	Mandar Rajendra Yevale	5	5	5	5	20
41	Vishvajit Vitthal Mane	5	5	5	5	20
42	Umesh Ashok Sawant	5	5	5	5	20
43	Divyani Dilip More	5	5	5	5	20
44	Lalitkumar Vedu Kadambande	5	5	5	5	20
45	Vijay Prakash Jadhav	5	5	5	5	20
46	Kishori Krishna Khot	5	5	5	5	20
47	Saurabh Digambar Mali	5	5	5	5	20
48	Rohit Sanjay Jadhav	5	5	5	5	20
49	Sujay Govind Bapat	5	5	5	5	20
50	Ravindra Balaso Kamble	5	5	5	5	20
51	Devayani Vijay Nandrekar	5	5	5	5	20
52	Shweta Sanjay Mali	5	5	5	5	20
53	Khairunisa Iliyas Korbu	5	5	5	5	20
54	MohammadSafwan Mujahidulislam Siddiqui	5	5	5	5	20
55	Satyawan Jaywant Jadhav	5	5	5	5	20
56	Swati Anil Vibhute	5	5	5	5	20
57	Priyanka Sharad Patil	5	5	5	5	20
58	Rutuja Chandrashekhar Kadane	5	5	5	5	20
59	Abhijeet Balaji Waghmare	5	5	5	5	20
60	Suhel Aayub Soudagar	5	5	5	5	20
61	Faijan Irshad Momin	0	0	0	0	0
62	Sejal Sanjay Pachakatte	5	5	5	5	20
63	Ankita Chougounda Balikai	5	5	5	5	20
64	Mayuri Ankush Bisure	5	5	5	5	20
Attainment calculation						
	No. of student attempted Assignments	64	64	64	64	
	No. of student got >= 60%	62	62	62	62	
	% of student got>=60%	96.87	96.87	96.87	96.87	
	Attainment level	L-3	L-3	L-3	L-3	

For the calculation of attainment of COs through Mid test, Lab work & Library activity, same method is used. % of students who achieve a set target for COs that are covered is computed which decide attainment level of each COs.

6.2 Attainment of COs through End Semester Examination

After declaration of University result, compute the attainment level for ESE (PR) & (TH). Attainment levels for the same is as follows. Attainment Level-1: 60% students scoring more than board average percentage marks in the final examination is considered to be attainment of "1"

Attainment Level-2: 70% students scoring more than board average percentage marks in the final examination is considered to be attainment of "2"

Attainment Level- 3: 80% students scoring more than board average percentage marks in the final examination is considered to be attainment of "3"

It is difficult to know the coverage of COs question wise, so consider the obtained marks of each students for each COs.

Table IV shows sample process of computing CO attainment for the End semester examination (ESE).

End Semester Examination (ESE)

Subject: CC201-Web Technology

Roll No.	CO Mapped	CO-1	CO-2	CO-3	CO-4
	Target Set	3	3	3	3
	Maximum Weight	70	70	70	70
1	Nidhi vaibhav Kothari	62	62	62	62
2	Swati nitin hosmani	50	50	50	50
3	Priyanka umesh marathe	50	50	50	50
4	Mrunali rajendra patane	62	62	62	62
5	Sadhana shrirang khot	53	53	53	53
6	Tejaswini dattatray chougule	53	53	53	53
7	Yogini kedar khadilkar	59	59	59	59
8	Sumit gangaram rapshe	50	50	50	50
9	Nikita arvind chavan	59	59	59	59
10	Angha sukumar kamble	56	56	56	56
11	Vaishnavi vijay patil	56	56	56	56
12	Vaibhavi virbhadra vibhute	64	64	64	64
13	Ankita sunil ghatage	67	67	67	67
14	Suraj sanjay jadhav	64	64	64	64
15	Shubham yashwant kamble	59	59	59	59
16	Aditya shashikant kumbhojkar	62	62	62	62
17	Shrutika shrishail araballi	64	64	64	64
18	Shweta suresh sawant	67	67	67	67
19	Saloni dilip bukate	67	67	67	67
20	Altamash akatar dhalait	57	57	57	57
21	Shrijeet Manohar Savadikar	64	64	64	64
22	Vaishnavi Jeevan Gavali	67	67	67	67
23	Neha Digambar Khandare	67	67	67	67
24	Kulsoom Shamsuddin Patwegar	62	62	62	62
25	Nayan Pandurang Patil	56	56	56	56
26	Prajakta Chandrakant Jadhav	62	62	62	62
27	Aishwarya Sambhaji Mane	64	64	64	64
28	Akshay Namdev Patil	62	62	62	62
29	Shrutakirti Shamrao Patil	67	67	67	67
30	Nitin Dattatrey Birajdar	62	62	62	62
31	Jyoti Ramchandra Bankar	45	45	45	45

32	Snehal Vishwas Nyaynirgune	62	62	62	62
33	Prajakta Manik Pawar	59	59	59	59
34	Nikita Sanjay Shinde	64	64	64	64
35	Rushikesh Ashok Pawar	59	59	59	59
36	Pooja Jitendra Sutar	67	67	67	67
37	Pritam Shreyansh Dige	64	64	64	64
38	Amruta Rajaram Kore	64	64	64	64
39	Prajkta Sanjay Vetam	59	59	59	59
40	Mandar Rajendra Yevale	50	50	50	50
41	Vishvajit Vitthal Mane	62	62	62	62
42	Umesh Ashok Sawant	64	64	64	64
43	Divyani Dilip More	64	64	64	64
44	Lalitkumar Vedu Kadambande	62	62	62	62
45	Vijay Prakash Jadhav	62	62	62	62
46	Kishori Krishna Khot	64	64	64	64
47	Saurabh Digambar Mali	64	64	64	64
48	Rohit Sanjay Jadhav	67	67	67	67
49	Sujay Govind Bapat	67	67	67	67
50	Ravindra Balaso Kamble	76	76	76	76
51	Devayani Vijay Nandrekar	59	59	59	59
52	Shweta Sanjay Mali	59	59	59	59
53	Khairunisa Iliyas Korbu	67	67	67	67
54	**Mohammad Safwan** Mujahidulislam Siddiqui	56	56	56	56
55	Satyawan Jaywant Jadhav	59	59	59	59
56	Swati Anil Vibhute	64	64	64	64
57	Priyanka Sharad Patil	64	64	64	64
58	Rutuja Chandrashekhar Kadane	62	62	62	62
59	Abhijeet Balaji Waghmare	56	56	56	56
60	Suhel Aayub Soudagar	67	67	67	67
61	Faijan Irshad Momin	59	59	59	59
62	Sejal Sanjay Pachakatte	36	36	36	36
63	Ankita Chougounda Balikai	64	64	64	64

Attainment calculation					
No.of student attempted Assignments	63	63	63	63	
No. of student got >= 60%	62	62	62	62	
% of student got>=60%	98.41	98.41	98.41	98.41	
Attainment level	L-3	L-3	L-3	L-3	

For the end semester examination (ESE) % of students who achieve a set target for COs that are covered is computed which decide attainment level of each COs. From this table set target for each co is level-3. % of students score more than 40% marks for CO-1, CO-2, CO-3, CO-4 is 98%. Hence attainment level of CO-1, CO-2, CO-3, CO-4, CO-5 are level-3.

7. Overall course outcome Attainment:
The overall CO attainment level in the course is calculated as Overall CO attainment level = 30% of CO attainment level in Internal assessment + 70% of COs attainment level in ESE. Here University decided the

weightages for ESE and internally assessment. For the overall calculation of CO attainment level consider the attainment level of Internal assessment(Assignment, Lab Work, Library Assignments, Mid test) and attainment level in End Semester Examination(ESE(PR),ESE(TH)). Table V shows the sample calculations of overall CO attainment level in Java Programming course

TABLE: V Overall CO attainment level in Java Programing

Core	CC 201	Direct Attainment											
		Internal Assessment					ESE			Total Direct Attainment	Target Set	Attainment Gap
		Assignments	Presentation/ Activity based Learning/Lab Work/ Group Exercise	Library Activity/ Designing Apps, Models/Field Work/ Online learning Activity	Mid Test	Average	ESE (TH)	ESE (PR)	Average			
		3	3	3	3	3	3	2	2.5	2.65	3	0.35
		3	3	3	3	3	3	2	2.5	2.65	3	0.35
		3	3	3	3	3	3	2	2.5	2.65	3	0.35
		3	3	3	3	3	3	2	2.5	2.65	3	0.35
						3			**2.5**	**2.65**	**3**	**0.35**

Sample calculation of CO – 1 (CC201-1) is as

Direct attainment of CO1= (0.3*Average of Internal assessment) + (0.7*Average of ESE)

Direct attainment of CO1= (0.3*3) + (0.7*2.5) = 2.65

Here Set Target CO of Java Programming is 3, Attainment is 2.65.So gap is 0.35.

8. Attainment of POs, PSOs

Program outcomes (POs) are broader statements than COs that describe what student are expected to know and be able to do upon the MCA. POs and PSOs are attained through the attainment of Cos using attainment level of each course and indirect attainment for program, compute the attainment of POs and PSOs. Indirect attainment level of POs is based on the student exit survey.

TABLE: VI Overall PO attainment level

	Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Core	CC101														
Core	CC102														
Core	CC103														
AEC	AEC 104						3	3	3	3				3	
AEC	AEC 105						3	3	3	3				3	
AEC	AEC 106						3	3	3	3				3	
GE	GE107										3	3			
Core	CC108														
Core	CC109														
Core	CC110														
Core	CC201	3	3	3	3	3								2.5	2.5
Core	CC202														
Core	CC203														
Core	CC204														

Category	Code														
Core	CC205														
GE	GE206														
Core	CC207														
Core	CC208														
Core	CC209														
Core	CC301	3	3	3	3	3								2.5	2.5
Core	CC302														
Core	CC303														
DSE	DSE 304														
AEC	AEC305														
AEC	AEC306														
Core	CC307														
Core	CC308														
Core	CC309														
Core	CC401														
Core	CC402														
Core	CC403														
Direct Attainment		3	3	3	3	3	3	3	3	3	3	3	3	2.5	2.5
Indirect Attainment		3	3	2.89	2.78	2.67	2.67	2.78	2.67	2.67	2.56	2.67	2.67	2.78	2.78
Overall Attainment		3	3	2.98	2.96	2.93	2.93	2.96	2.93	2.93	2.91	2.93	2.93	2.56	2.56
Set Target		3	3	3	3	3	3	3	3	3	3	3	3	2.5	2.5

Overall PO calculation = 80% weightage for direct attainment and 20% weightage for indirect attainment. Over all Attainment of PO1 = (0.8*3) + (0.2*3) = 3. Attainment level PO1 is achieved. Compute the other POs, PSOs using same method. If the attainment level of PO is not achieved the target then put action plan accordingly.