BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE (INDIA)

Master of Computer Science M.Sc. (Computer Science)
(CBCS 2018 COURSE)

Under: The Faculty of Science
(To be implemented from June 2018)

The Master of Computer Science, M.Sc. (Computer Science) Program is a full time 94 Credits program offered by Bharati Vidyapeeth Deemed University (BVDU), Pune. The expectations and requirements of the Software Industry are visualized while designing the M.Sc. (Computer Science).

1. Objectives: M.Sc. (Computer Science) Course:

- The main objective of the M.Sc. Computer Science course is to provide the students a clear understanding of the basic concepts and principles of Computer Science as a discipline and the rich and specialized skill sets required to handle the computing systems in an applied branch of knowledge that represent a realistic world.
- All aspects of knowledge acquisition, storage, processing, presentation and transition will be covered in the course.
- Provision for advanced knowledge in Computer Science, exposure to the practical and theoretical concepts of computing, current and emerging trends in technology in the context of networking environment are the major attractions of the programme.
- The course covers almost all the core subjects in Computer Science like Design and Analysis of Algorithm, Network Programming, OOP, Software Engineering, Database Concepts etc, in addition to a few elective subjects.
- The Case Studies in all the three semesters intensively focus on the systematic design and implementation of various technological applications through which the students attain the skills in system development and team spirit.
- As part of the course, the students are advised to take live projects of 120 to 140 days duration from established institutions for implementation during their project term.
- In addition, 'communication skills', 'life skills' which are necessary for career growth and for leading quality life are also imparted.

Learning Outcomes from the M.Sc. (Computer Science)

At the end of the course, the student should be able to

(a) Analyze problems and design effective and efficient software solutions
(b) Develop software under latest Application Development Environments.
(c) Learn new technologies with efficient implementation
(d) Read, write, and contribute to technical literature
(e) Work in team
(f) Socially committed IT professionals

2. Eligibility for Admission to the Course:

A student shall be eligible for admission to the First Year M.Sc. (Computer Science) degree course who has completed B.Sc. (Computer Science) / B.Sc. (Computer Application)/B.Sc. (IT) graduation from any recognized university satisfying the following conditions. The candidate should have secured at least 50% (45% for SC/ST) in aggregate at graduate level university examination.

3. Intake Capacity:

The intake capacity of the course will be 50 seats every year.

4. The broad objectives of the Learning Outcomes-based Curriculum Framework (LOCF) of Master of Science Degree programme in Computer Science

Master's Degree is the well-recognized postgraduate qualification in higher education. The contents of this degree are determined in terms of knowledge and understanding, expertise and skills that a student intends to acquire. Often it does not come within the traditional boundaries recognizable at previous academic levels of study; it is specialised and close to the boundaries of current knowledge.

Master's Degree programmes attract entrants with a bachelor's degree with honors or equivalent, or experience that may or may not be directly relevant to the particular profession. Thus, M.Sc.(Computer Science) aims to equip students to qualify for joining a profession or to provide development opportunities in particular employment settings. Graduates are enabled to enter a variety of jobs or to continue academic study at a higher level.

Qualification descriptors for this Postgraduate Education reflect in-depth and advanced knowledge and understanding of their subjects enriched by scholarship, research and current practice. These include critical awareness of contemporary issues and developments; critical skills, knowledge of professional responsibility, integrity and ethos. Thus, qualification descriptor sets out the broad level of skills and competencies that Master's students are expected to achieve. They include generic information about what all holders of the qualification are able to do, and the qualities and skills that they have. These reflect student's different aspirations, motivations, learning needs and personal circumstances. Programmes assess not only academic skills but also other skills and attributes including what any professional body requires, recognises and accredits the award of Master's Degrees.

The characteristics associated with the specialised study such as M.Sc.(Computer Science) predominantly composed of structured learning opportunities. This programme is devoted to research project, leading to dissertation. Training in latest technologies is involved in this programme of study. Students are likely to be further characterized by their ability to study independently, and to use a range of research methods and techniques applicable to advance scholarship in the subject. The ability to complete a research in the subject includes a critical review of existing IT platforms or other scholarly outputs. They are able to apply research and critical perspective to professional situations both practical and theoretical.

4.1. Aims of Master of Science Degree Programme in Computer Science

It aims to provide students with a rigorous and integrated academic study of Computer Science. Students who complete the Master of Science Degree Programme in Computer Science successfully should:

- acquire an understanding of the principles of various IT platforms and Computer Science;
- acquire an improved ability to think analytically about different subjects in Computer Science and to apply this knowledge in their professional and national settings;
- acquire an improved ability to conduct research in the field of Computer Science;
- institutionalise framework for cross-national professional collaboration and the exchange of information;
- communicate their conclusions clearly;
- demonstrate self-direction and originality in tackling and solving problems, and in collecting and commenting on complex information;
- indicate ways of extending practices in Computer Science and apply various technologies to quickly evolving situations

4.2. Postgraduate Attributes in Computer Science

The postgraduate attributes in Computer Science involve skills expected to be gained by a student through studies that support in sharpening competence for augmenting contemporary knowledge base, acquiring new learning and skills, identifying with future studies, engaging well in a preferred career and performing a positive role as enlightened citizen in the society. The characteristic, profundity and magnitude of the learning experiences made available to the students support them to unfold the quality attributes in the following manner:

- **Disciplinary Knowledge:** Aptitude to manifest wide and extensive knowledge in the field of study and comprehension of one or more disciplines constitute part of postgraduate attributes including how other disciplines relate to the field of knowledge. An international perspective in the area of study also gives a wider learning of the subject. In the specialised course on Computer Science, the constant review and renewal of subject and courses assure coverage of recent developments. Quality education and training build a condition in which learning is exchanged, critically evaluated and used in contemporary situations with the aptitude to review, examine and integrate and utilize actual learning in the appropriate field.

- **Communication Skill:** Classroom discussion and formal presentations render a suitable opportunity to sharpen oral communication and written assessment skills. They create ability to manifest ideas and thoughts in writing and orally to communicate confidently their viewpoints. By expressing adeptness to listen meticulously, they can read and write logically as well as give obscure information in explicit and succinct manner. With practice as a part of interdisciplinary team, students become able to choose and employ the proper form and methods of communication.

- **Critical Thinking:** The ability to apply critical reasoning to issues through independent thought and informed judgment are important postgraduate attributes integrating information from a wide range of sources. The postgraduates are able to apply analytical thought to body of knowledge and critically evaluate ideas, arguments, claims, beliefs on the basis of empirical evidence from open-ended and reasoned perspectives. They become able to identify relevant assumptions or implications and formulate coherent arguments.

- **Research Related Skills:** Research papers and other research tasks are expected to develop a degree of creativity, originality and discovery that benefits a postgraduate programme of the highest quality and to which students are encouraged. An ability is developed to undertake supervised research, including the design and conduct of investigations in a systematic, critical manner. Identification of appropriate problem and research questions, a critical analysis of the literatures, drawing logical conclusion are integral part of research skills. Postgraduate programme in Computer Science is designed to enhance skills in research and analysis, which are tested in all forms of assessment. All postgraduates demonstrate, through subject assessment, their ability to develop substantial research-based scholarship. Research related skill involves a sense of inquiry and capability for asking relevant questions, defining problems, articulation, ability to recognise cause and effect relationship, formulate hypothesis, and to report the result of experiment or investigation.

- **Self-Directed Learning:** The demanding nature of postgraduate attributes requires effective time-management and an ability to work independently. The rigour of

programmes ensure that all postgraduates have developed the ability to work with relative autonomy, which provides a foundation for future leadership roles. Ability to work and learn independently and effectively leads to generating innovative ideas in the changing environment to investigate problems and to have creative solution. Self-learning and application of competence in exploring also help in solving non-familiar problems. This leads to application of one's learning to real life situation and critical sensibility to lived experiences. Well-developed problem-solving abilities also contribute to flexibility of approach.

- **Ethical and Social Understanding:** Profound respect for truth and intellectual integrity including the ethics of scholarship add to the ability to embrace values in conducting one's life and in formulating position about ethical problems from multiple perspectives appreciating environmental and sustainability issues. This postgraduate attribute fosters understanding of social and ethical responsibility and ability to apply ethical standards in order to attain unbiased and truthful actions in all aspects of life. It also involves appreciation of the philosophical and social contexts of a discipline with knowledge of other cultures and appreciation of cultural diversity.
- **Quality of Teamwork:** Teamwork, as postgraduate attributes, creates capacity to value and work effectively and respectfully with diverse team and to facilitate coordinated effort for a common cause. It involves training in mapping out tasks of a team, setting directions and formulating an inspiring vision.

4.3. Qualification Descriptors

The qualification descriptors indicate both disciplinary knowledge and understanding as well as generic skills, including global competencies that all students in postgraduate programmes of study for the award of qualification of M.Sc. Degree in Computer Science should demonstrate.

The students, who complete the course successfully for the Master's Degree in the subject, acquire an understanding of the principles and institutions of Computer Science. The qualification descriptors reflect an improved ability to think analytically about the concept, implementation and development of Computer Science their own professional and national settings. These descriptors also describe an improved ability to conduct research Computer Science in the institutional framework for national or cross-national professional collaboration and the exchange of information.

Postgraduates will have:

- an advanced and integrated knowledge of Computer Science for the protection and promotion of Computer Science;
- an advanced appreciation of the relationship between Computer Science and society, at the international and domestic levels, in the field of Computer Science;
- the cognitive and technical skills to independently examine and critically evaluate current issues by reference to international Computer Science standards.

Further, the postgraduates will also be able to:

- understand and critically examine the interrelationship between international, regional and domestic histories, philosophies, policies and practices of Computer Science

- engage as informed and open-minded participant in debates about Computer Science and its application;
- analyze, interpret and assess the challenges posed to Computer Science in the context of globalization; and
- demonstrate autonomy, expert judgment and responsibility as advocate in the field of Computer Science.

The students who complete the postgraduate programme of study will be awarded a Master's Degree in Computer Science discipline. Some of the qualification descriptors a postgraduate will be capable to demonstrate on completion of Master level programme will include the following:

- systematic, extensive, coherent knowledge and understanding of Computer Science study as a whole with its links to related disciplinary areas; critical comprehension of theories, principles and concepts; and understanding of emerging issues in Computer Science ;
- procedural knowledge related to the study of Computer Science, including research and development;
- skills in one's specialization and contemporary developments in Computer Science study, including critical understanding of latest developments in Computer Science;
- comprehensive knowledge about current research and skills for identifying problem relating to Computer Science study; analysis and interpretation of data using methodologies for formulating evidence based solutions and argument; and skill for critical assessment of wide range of ideas and complex problems relating to Computer Science;
- application of disciplinary knowledge and skills to unfamiliar context with ability to analyse issues and seek solution to real-life problem; and
- Computer Science related skills to job trades and employment opportunities.

4.4. Programme Specific Learning Outcomes M.Sc. (Computer Science**)**

Programme Learning Outcomes in Computer Science course include subject-specific skills and generic skills, including transferable global skills and competencies, the achievement of which students are able to demonstrate for the award of Masters Degree; M.Sc.(Computer Science). It is to develop expertise to:

- explore the conditions and dimensions of empowering and transformative learning processes;
- provide an advanced qualification for students wanting to better understand the nature of international human rights in the face of global political, economic, social, legal, ethical and environmental challenges;
- describe and critique the differing approaches, perspectives, and models of human rights and how they impact the ways in which human rights education is carried out in diverse settings;
- design, conduct, analyze and present findings using diverse research tools and methods in order to create knowledge and awareness about Computer Science;
- identify diverse methodological tools and skills needed to conduct ethical research;

- synthesize contextual understanding, reflective analysis, theoretical frameworks, and methodological training to inform the production of a thesis/project report and field-based research projects;
- demonstrate the aptitude of Computer Programming and Computer based problem-solving skills
- display the knowledge of appropriate theory, practices and tools for the specification, design, implementation
- ability to learn and acquire knowledge through online courses available at different MOOC Providers
- ability to link knowledge of Computer Science with other two chosen auxiliary disciplines of study
- display ethical code of conduct in usage of Internet and Cyber systems
- ability to formulate, to model, to design solutions, procedure and to use software tools to solve real world problems and evaluate
- ability to operate, manage, deploy, configure computer network, hardware, software operation of an organization
- ensure comparability of learning levels and academic standard across universities;
- focus on knowledge and skill for further study, empowerment and citizenship;

4. Course Structure

The M.Sc. (Computer Science) course will be two-year full time course consisting of minimum four semesters and with a minimum of 94 credits. The medium of instruction and examination will be only English. The credit allotment for M.Sc. (Computer Science) course: Semester I (24 Credits), Semester II (26Credits), Semester III (26 Credits), and Semester IV (18 Credits). In each Semester, there will be four papers(three core compulsory and one core elective) of 100 marks each, two Laboratory course and minor project for each Semester of 100 marks each, out of which 40 marks will be for internal assessment and 60 marks for university examination. Fourth semester is internship for 200 marks. Thus M.Sc. (Computer Science) degree examination, four semesters shall be 2400 marks and of minimum 94credits altogether. The following shall be the course structure:

SEMESTER-WISE COURSE INFORMATION
SEMESTER I

Semester	Subject Type	Code	Title of the paper	Hrs/ Week	Credits	Exam Hrs	Maximum Marks		
							Internal Assessment	University Examination	Total
Semester I	Core: Compulsory	PGCS-101	Algorithm Design Patterns	04	04	03	40	60	100
		PGCS-102	Paradigm of programming Languages	04	04	03	40	60	100
		PGCS-103	Advanced Database Concepts	04	04	03	40	60	100
		PGCS-MI	Minor Project –I	04	04	03	40	60	100
	Core: Elective	**Any one from the following:**							
		PGCS-104	Parallel Processing	04	04	03	40	60	100
		PGCS-105	Theory of Automata	04	04	03	40	60	100
		PGCS-106	Digital Image Processing	04	04	03	40	60	100
		Any two from the following:							
	Elective : Practical's	PGCS-107	Lab Course –I	04	02	03	40	60	100
		PGCS-108	Lab Course –II	04	02	03	40	60	100
		PGCS-109	Lab Course –III	04	02	03	40	60	100
			TOTAL	24					

SEMESTER II

Semester	Subject Type	Code	Title of the paper	Hrs/Week	Credits	Exam Hrs	Maximum Marks		
							Internal Assessment	University Examination	Total
Semester II	Core: Compulsory	PGCS-201	Software Project Management	04	04	03	40	60	100
		PGCS-202	Cloud Computing	04	04	03	40	60	100
		PGCS-203	Java Application Programming	04	04	03	40	60	100
		PGCS-MII	Minor Project -II	04	04	03	40	60	100
	Core: Elective	**Any one from the following:**							
		PGCS-204	Network Security	04	04	03	40	60	100
		PGCS-205	Embedded Computing	04	04	03	40	60	100
		PGCS-206	Data Mining	04	04	03	40	60	100
		Any two from the following:							
	Elective Practical's	PGCS-207	Lab Course –IV	04	02	03	40	60	100
		PGCS-208	Lab Course –V	04	02	03	40	60	100
		PGCS-209	Lab Course –VI	04	02	03	40	60	100
	Ability Enhance-ment Course	PGAEC 11	Soft Skills	02	02	02	20	30	50
			Total		26				

SEMESTER III

Semester	Subject Type	Code	Title of the paper	Hrs/Week	Credits	Exam Hrs	Maximum Marks		
							Internal Assessment	University Examination	Total
Semester III	Core: Compulsory	PGCS-301	Artificial Intelligence	04	04	03	40	60	100
		PGCS-302	Mobile Technologies	04	04	03	40	60	100
		PGCS-303	.Net Technologies	04	04	03	40	60	100
		PGCS-MIII	Minor Project –III	04	04	03	40	60	100
	Core: Elective	**Any one from the following:**							
		PGCS-304	Software Architecture	04	04	03	40	60	100
		PGCS-305	Software Testing	04	04	03	40	60	100
		PGCS-306	Advanced Operating System	04	04	03	40	60	100
	Elective Practical's	**Any two from the following:**							
		PGCS-307	Lab Course –VII	04	02	03	40	60	100
		PGCS-308	Lab Course –VIII	04	02	03	40	60	100
		PGCS-309	Lab Course –IX	04	02	03	40	60	100
	Skill Enhance-ment Course	PGSEC 31	Android Programming	02	02	02	20	30	50
			Total		26				

SEMESTER IV

Semester	Code	Title of the course	Credits	Maximum Marks		
				Internal Assessment	University Examination	Total
Semester IV	PGCS-401	Internship	18	80	120	200

5. Scheme of Examination:

The Assessment of Regular students of Master of Computer Science, M.Sc.(Computer Science)course in the academic session 2018-19 and after, shall be based on

(a) University Examinations,
(b) Internal Assessment,
(c) Choice Based Credit System, and
(d) Semester Grade Point Average and Cumulative Grade Point Average system

For each paper of 100 marks, there will be Internal Assessment of 40 marks and the University Examination of 60 marks/3 hours duration at the end of each semester. The 04 credit will be given to a student who secures at least 40% of marks allotted to each paper. A candidate who does not pass the examination in any subject or subjects in one semester will be permitted to reappear in such failed subject or subjects along with the papers of following semesters.

The Internal Assessment (IA) for each paper will be of 40 marks which will be carried out by the department during the term. The Internal Assessment may be in the forms as follows: Attendance, Written tests, seminars, term papers, presentations, assignments, orals or any such others. There will be at least two types of assessments from the types given above.

At the end of each semester, a cumulative grade point average (CGPA) and also Semester grade point average(SGPA) will be calculated as a weighted average of the GPI of all courses in which the student has passed till that semester.

A candidate shall be permitted to proceed from the First Semester up to Final Semester irrespective of his/her failure in any of the Semester examinations subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (subsequent) semester subjects.

Practical and Project Work:

Each practical examination for laboratory course is of 100 marks and three hours duration. The minor projects in Semesters I ,II and III will be evaluated for 100 marks for the allotted credits by a panel consisting of one internal and one external examiner .For both laboratory course and minor project , there will be internal assessment of 40 marks and the university examination of 60 marks. The project work is to be undertaken under guidance of a teacher allotted to a student by the department.

The candidate has to submit the project report before the deadline announced by the department. A candidate who fails to submit the project may resubmit the same in the subsequent semester examination for evaluation. The project work activities must be duly supported by documentary evidences to be endorsed by the Head or the Guide.

6. Scheme of credits:

The M.Sc. (Comp. Sci.) is of 94credits. The distribution of credits over semesters is given below.

Semester	Total credits
Sem I	24
Sem II	26
Sem III	26
Sem IV	18
Total	94

7. Standard of Passing:

For all courses, both UE and IA constitute separate heads of passing. In order to pass in such courses and to earn the assigned credits, a student must obtain a minimum grade point of 5.0 (40% marks) at UE and also a minimum grade point of 5.0 (40% marks) at IA.

Even a student fails in IA, he/she shall be declared 'pass' in the course provided he/she obtains a minimum of 25% in IA and GPA for the course is at least 6.0 (50% in aggregate). The GPA for a course will be calculated only if the student passes at the UE.

A student who fails at UE in a course has to reappear only at UE as a backlog candidate and clear the head of passing. Similarly, a student who fails in a course at IA has to reappear only at IA as a backlog candidate and clear the head of passing.

The 10-point scale Grades and Grade Points according to the following table.

Range of Marks (Out of 100)	Grade	Grade Point
80 ≤ Marks ≤ 100	O	10
70 ≤ Marks < 80	A+	9
60 ≤ Marks < 70	A	8
55 ≤ Marks < 60	B+	7
50 ≤ Marks < 55	B	6
40 ≤ Marks < 50	C	5
Marks < 40	D	0

The performances at UE and IA will be combined to obtain the Grade Point Average (GPA) for the course. The weights for performance at UE and IA shall respectively be 60% and 40%.

GPA is calculated by adding the UE marks out of 60 and IA marks out of 40. The total marks out of 100 are converted to grade point, which will be the GPA.

8. Formula to Calculate Grade Points (GP):

Suppose that '*Max*' is the maximum marks assigned for an examination or evaluation based on which GP will be computed. In order to determine the GP, Set $x = Max/10$ (since we have adapted 10-point system). Then GP is calculated by the formulas shown as below.

Range of Marks at the evaluation	Formula for the Grade Point
$8x \leq$ Marks $\leq 10x$	10
$5.5x \leq$ Marks $< 8x$	Truncate (Marks/x) +2
$4x \leq$ Marks $< 5.5x$	Truncate (Marks/x) +1

Two kinds of performance indicators, namely, the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA) shall be computed at the end of each term. The SGPA measures the cumulative performance of a student in all the courses in a particular semester, while the CGPA measures the cumulative performance in all courses since his/her enrolment to the course. The CGPA of a student when he/she completes the programme is the final result of the student.

The SGPA is calculated by the formula SGPA = $\frac{\sum Ck \times GPk}{\sum Ck}$, where C_k is the credit-value assigned to a course and GP_k is the GPA obtained by the student in the course. In the above, the sum is taken over all the courses that the student has undertaken for the study during the semester, including those in

which he/she might have failed or those for which he/ she remained absent. The SGPA shall be calculated up to two decimal place accuracy.

The CGPA is calculated by the formula CGPA = $\frac{\sum Ck \times GPk}{\sum Ck}$, where C_k is the credit-value assigned to a course and GP_k is the GPA obtained by the student in the course. In the above, the sum is taken over all the courses that the student has undertaken for the study from the time of his/her enrolment to the course and also the during the semester for which CGPA is calculated, including those in which he/she might have failed or those for which he/she remained absent. The CGPA shall be calculated up to two decimal place accuracy.

The Formula to compute equivalent percentage marks for specified CGPA:

% Marks (CGPA) =	10 × CGPA – 10	if 5.00 ≤ CGPA ≤ 6.00
	5 × CGPA+ 20	if 6.00 ≤ CGPA ≤ 8.00
	10 × CGPA – 20	if 8.00 ≤ CGPA ≤ 9.00
	20 × CGPA – 110	if 9.00 ≤ CGPA ≤ 9.50
	40 × CGPA – 300	if 9.50 ≤ CGPA ≤ 10.00

9. Award of honours:

A student who has completed the minimum credits specified for the programme shall be declared to have passed in the programme. The final result will be in terms of letter grade only and is based on the CGPA of all courses studied and passed. The criteria for the award of honours are given below.

Range of CGPA	Final Grade	Performance Descriptor	Equivalent Range of Marks (%)
9.50 ≤CGPA≤ 10.00	O	Outstanding	80 ≤ Marks ≤ 100
9.00 ≤CGPA≤ 9.49	A+	Excellent	70 ≤ Marks < 80
8.00 ≤CGPA≤ 8.99	A	Very Good	60 ≤ Marks < 70
7.00 ≤CGPA≤ 7.99	B+	Good	55 ≤ Marks < 60
6.00 ≤CGPA≤ 6.99	B	Average	50 ≤ Marks < 55
5.00 ≤CGPA≤ 5.99	C	Satisfactory	40 ≤ Marks < 50
CGPA Below 5.00	F	Fail	Marks Below 40

A candidate shall be permitted to proceed further from the First Semester up to Fourth Semester irrespective of his/her failure in any of the Semester examinations subject to the condition that the candidates should register for all the backlog subjects of earlier semesters along with current (subsequent) semester subjects.

10. Gracing:

The gracing shall be done as per existing rules of the University.

11. Verification and Revaluation:

There is provision for verification and revaluation of the result. A student can apply for the verification and revaluation of the result within the two weeks from the declaration of the results with the prescribed fee. The verification and revaluation shall be done as per the existing rules of the University.

12. Format of the transcript:

The student will be given a transcript indicating his/her performance at the end of every semester examination. The transcript shall be given as per the following table along with other necessary details:

Course No.	Course Name	No. of Credits	University Examination		Internal Assessment		Grade Point Average	Result
			Grade	Grade Point	Grade	Grade Point		
1								
2								
3								
4								
5								
Total Cumulative Credits completed			SGPA		CGPA		Equivalent Marks (%)	
Note: GPA is calculated by adding the UE marks out of 60 and IA marks out of 40. The total marks out of 100 are converted to Grade Point, which will be the GPA.								

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