"Social Transformation through Dynamic Education"

Bharati Vidyapeeth (Deemed to be University), Pune
YASHWANTRAO MOHITE COLLEGE ARTS, SCIENCE & COMMERCE
Erandwane, Pune- 411 038

Accredited with 'A+' Grade (2017) by NAAC 'A' Grade University Status by MHRD, Govt. of India Accredited (2004) & Reaccredited (2011) with 'A' Grade by NAAC

M.Sc. (Computer Science)

Course Structure

As per NEP 2020

(To Be Implemented From Academic Year 2023-24)

BHARATI VIDYAPEETH DEEMED UNIVERSITY, PUNE (INDIA)

Master of Computer Science M.Sc.(Computer Science)
Learning Outcomes-Based Curriculum

for 1/2 years M. Sc. (Computer Science) Programme

as per guidelines of

NEP-2020

for

M. Sc. (Computer Science)-I

With effect from Academic Year

2023-2024 (NEP 2020 Policy)

Under : The Faculty of Science
(To be implemented from July 2023)

The Master of Computer Science, M.Sc (Computer Science) Program is a full time 88 Credits program offered by Bharati Vidyapeeth Deemed University (BVDU), Pune as per the guidelines of National Education Policy 2020. The expectations and requirements of the Software Industry and inculcating Research temperament among the students are visualized while designing the M.Sc(Computer Science).

1. 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.

2. 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;

- institutionalize 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

3. Postgraduate Attributes

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. Programme Outcomes

The Programme Outcomes 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 Programme Outcomes reflect an improved ability to think analytically about the concept, implementation and development of Computer Science their own professional and national settings. These outcomes 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.

At the end of the Postgraduate Programme the students will have:

PO1: an advanced and integrated knowledge of Computer Science for the protection and promotion of Computer Science;

PO2 an advanced appreciation of the relationship between Computer Science and society, at the international and domestic levels, in the field of Computer Science;

PO3: the cognitive and technical skills to independently examine and critically evaluate current issues by reference to international Computer Science standards.

Further, the postgraduates will be able to :

PO4: understand and critically examine the interrelationship between international, regional and domestic histories, philosophies,
policies and practices of Computer Science

PO5: engage as informed and open-minded participant in debates about Computer Science and its application;

PO6: analyze, interpret and assess the challenges posed to Computer Science in the context of globalization; and

PO7: demonstrate autonomy, expert judgment and responsibility as advocate in the field of Computer Science.

PO8: link the systematic, extensive, coherent knowledge and understanding of Computer Science study as a whole to related
disciplinary areas;

PO9: critically comprehend the theories, principles and concepts by understanding of emerging issues in Computer Science ;

PO10: apply the procedural knowledge related to the study of Computer Science, including research and development;

PO11: critically analyze and understanding of latest developments in Computer Science;

PO12: apply the comprehensive knowledge about current research and skills for identifying problem relating to Computer Science study;

PO13: analyze and interpret the 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;

PO14: apply disciplinary knowledge and skills to unfamiliar context with ability to analyze issues and seek solution to real-life proble

PO15: Create Computer Science related skills for job trades and employment opportunities.

5.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). At the end of the programme the students will be able to :

PSO1. explore the conditions and dimensions of empowering and transformative learning processes;

PSO2. focus on knowledge and skill for further study, empowerment, and citizenship;

PSO3. 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;

PSO4. design, conduct, analyze and present findings using diverse research tools and methods in order to create knowledge and awareness about Computer Science;

PSO5. identify diverse methodological tools and skills needed to conduct ethical research;

PSO6. synthesize contextual understanding, reflective analysis, theoretical frameworks, and methodological training to inform the production of a thesis/project report and field-based research projects;

PSO7. demonstrate the aptitude of Computer Programming and Computer based problem-solving skills

PSO8. display the knowledge of appropriate theory, practices and tools for the specification, design, implementation

PSO9. learn and acquire knowledge through online courses available at different MOOC Providers

PSO10. Apply knowledge of Computer Science with other two chosen auxiliary disciplines of study

PSO11. display ethical code of conduct in usage of Internet and Cyber systems

PSO12. formulate, to model, to design solutions, procedure and to use software tools to solve real world problems and evaluate

PSO13. operate, manage, deploy, configure computer network, hardware, software operation of an organization

PSO14. ensure comparability of learning levels and academic standard across universities;

6. 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)/ Bachelor in Computer Application/Bachelor of Engineering in Computer Science / Information Technology / Electronic Telecommunication . B. Sc. In Entire Computer Science with 50% marks / B. Voc. in Software Development / Information Technology and B. Sc. Degree with Computer science as Principal subject or Computer Science as one of the subject at T. Y. B. Sc. Level for student with general B. Sc. 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.

A Students who has completed B.Sc. Honours /B.Sc Honours with research degree in Computer Science can take admission to M.Sc.(Computer Science)-II directly

7. Intake Capacity:

The intake capacity of the course will be 40 seats every year.

8. Course Structure

The M.Sc. (Computer Science) course will be one/two-year full-time course consisting of minimum two / maximum four semesters and with a minimum of 44 credits and maximum 88 credits. The medium of instruction and examination will be only English.

Credit Distribution of M.Sc. (Computer Science) program:

The overall structure and credit distribution of the course to be implemented from the academic year 2023-2024 onwards is as follows.

Year (2 Yr PG)	**Level**	**Sem**	**Major Subject**				**RM**	**OJT/ FP**	**RP**	**Cu. Cr.**	**Degree**
			Mandatory		**Electives**						
			T	P	T	P	T				
I	**6**	I	3 Courses x 4 credit	1 Courses x 2 credits	1 Course x 2 credits	1Course x 2 credits	4	-	-	22	44 PG Diploma (After 3 years degree)
		II	3 Courses x 4 credit	1 Courses x 2 credits	1 Course x 2 credits	1 Course x 2 credits	-	4	-	22	
			Exit Option : PG Diploma (44 Credits) after Three year UG degree								
II	**6.5**	III	2 Courses x 4 credit	2 Courses x 2 credits	1 Course x 4 credits	1Course x 2 credits	-	-	4	22	88 PG Degree (After 3 years UG **OR** PG degree after 4 year UG)
		IV	3 Courses x 4 credit		1 Course x 4 credits	-	-	-	6	22	

SEMESTER-WISE COURSE INFORMATION: SEMESTER I

M.Sc.(Computer Science) : Semester-I							Maximum Marks		
Level	**Type**	**Course Code**	**Course Name**	**Credits**	**No. of Lecture Hrs.**	**Exam. Hrs**	**Internal Assessment**	**University Examination**	**Total**
6.0	Major Mandatory	MJ-CS 101	Advanced Database Management System	**4**	**60**	2.5	40	60	100
		MJ-CS 102	Software Project Management	**4**	**60**	2.5	40	60	100
		MJ-CS 103	Digital Image Processing	**4**	**60**	2.5	40	60	100
		MJ-CS 104	Computer Science Practical I	**2**	**60**	03	20	30	50
	Major Elective	MJ-CS 105	**Elective(Any one from the following)** a)Paradigms of Programming Language b)Algorithm Design Pattern	**2**	**30**	1.5	20	30	50
		MJ-CS 106	Computer Science Practical II(Angular JS)	**2**	**60**	03	20	30	50
	RM	MJ-CS 107	Research Methodology	**4**	**60**	2.5	40	60	100
			Total Credits	**22**					

SEMESTER-WISE COURSE INFORMATION: SEMESTER II

M.Sc.(Computer Science) : Semester-II							Maximum Marks		
Level	**Type**	**Course Code**	**Course Name**	**Credits**	**No. of Lecture Hrs.**	**Exam Hrs**	**Internal Assessment**	**University Examination**	**Total**
	Major Mandatory	MJ-CS 201	Big Data Analytics	**4**	**60**	2.5	40	60	100
		MJ-CS 202	Cloud Computing	**4**	**60**	2.5	40	60	100
6.0		MJ-CS 203	Block Chain Technology	**4**	**60**	2.5	40	60	100
		MJ-CS 204	Computer Science Practical III	**2**	**60**	03	20	30	50
	Major Elective	MJ-CS 205	**Elective(Any one from the following)** **a)** Software Testing b) Soft Computing	**2**	**30**	1.5	20	30	50
		MJ-CS 206	Computer Science Practical IV(Software testing)	**2**	**60**	03	20	30	50
	OJT/FP	MJ-CS 207	On Job Training	**4**	**-**	-	40	60	100
			Total Credits	**22**					
Exit Option : PG Diploma (44 Credits) after 3 year UG Degree									

SEMESTER-WISE COURSE INFORMATION: SEMESTER III

M.Sc.(Computer Science) : Semester-III							Maximum Marks		
Level	**Type**	**Course Code**	**Course Name**	**Credits**	**No. of Lecture Hrs.**	**Exam Hrs**	**Internal Assessment**	**University Examination**	**Total**
6.5	Major Mandatory	MJ-CS 301	Artificial Intelligence	**4**	**60**	2.5	40	60	100
		MJ-CS 302	Full Stack -I	**4**	**60**	2.5	40	60	100
		MJ-CS 303	Cyber Security	**4**	**60**	2.5	40	60	100
		MJ-CS 304	Computer Science Practical V	**2**	**60**	03	20	30	50
	Major Elective	MJ-CS 305	**Elective(Any one from the following)** **a)**Android b) Advanced Operating System	**2**	**30**	1.5	20	30	50
		MJ-CS 306	Computer Science Practical VI	**2**	**60**	03	20	30	50
	RP	MJ-CS 307	Research Project	**4**	**-**	-	40	60	100
			Total Credits	**22**					

SEMESTER-WISE COURSE INFORMATION: SEMESTER IV

Level	Type	Course Code	Course Name	Credits	No. of Lecture Hrs.	Exam Hrs.	Internal Assessment	University Examination	Total
6.5	Major Mandatory	MJ-CS 401	.Net Technology	**4**	**60**	2.5	40	60	100
		MJ-CS 402	Full Stack-II	**4**	**60**	2.5	40	60	100
		MJ-CS 403	Software Architecture	**4**	**60**	2.5	40	60	100
	Major Elective	MJ-CS 404	**Elective(Any one from the following)** a) Tableau and Power BI b) Web Analytics	**2**	**30**	1.5	20	30	50
		MJ-CS 405	Computer Science Practical VII	**2**	**60**	03	20	30	50
	RP	MJ-CS 406	Research Project	**6**	**-**	-	40	60	100
			Total Credits	**22**					
2 Years-4 Sem PG Degree (88 Credits) After 3 year UG Degree OR 1-year-2 Sem PG degree(44 credits) after 4 year UG Degree									

Abbreviations:

a) **OJT: On Job Training/Internship/Apprenticeship**
b) **FP: Field Project**
c) **RM: Research Methodology**
d) **RP: Research Project**

9. General Rules

1. The M. Sc. programme is for 2 academic years and 4 semesters. The minimum total number of credits requirements for each Semester is 22 credits. 44 credits for two semesters and 88 for the complete program

2. A two-year PG programme with one exit option for those who have completed the three-year Bachelor's Degree Programme.

3. The students, after successful completion of 44 credits in the first year of a two-year PG programme may opt for the exit. Such students will be awarded the PG Diploma in that relevant subject. They need to re-enter the programme from where they left off, in the college or may admit to any other HEIs within three years of exit and complete the degree programme within a maximum period of 05 years from the date of admission in the first year of the PG Programme.

4. The M.Sc. degree will be awarded to the students who complete a total of 88 credits in a minimum of two years by completing an average of 22 credits per semester .

5. The curricular design of the first year of the two-year PG Programme is aligned with that of the fourth year of the four-year Honour Degree Programme in Computer Science. Research Methodology (aligned with the seventh semester of the fourth year of Honours and Honours with Research Degree of four-year UG Programme) and Internship of 4 credits (aligned with the eighth semester of the fourth year of Honours Degree of four-year UG Programme) are introduced in the first semester and the second semester, respectively of the first year of Two-Year PG Programme.

6. Second Year PG Programme, M.Sc.(Computer Science) will include Research Projects of 10 Credits divided into 4 plus 6 over the third and fourth semesters. This is also applicable to the students admitted to one year PG Programme after completion of four year UG Programme in Computer Science as Major subject.

7. Each theory credit is equivalent to 15 clock hours of teaching and each practical, project, and internship credit is equivalent to 30 clock hours of engagement in work in a semester.

8. Semester Grade Points Average (SGPA) will be calculated based on 22 credits and Final Cumulative Grade Point Average (CGPA) will be calculated based on 88 credits from all four semesters.

9. All the students admitted to the Post graduation programme in M.Sc.(Computer Science) should register themselves on the Academic Bank of Credits (ABC) portal and create their ABC ID. Students also need to share their ABC ID to the college examination cell at the

beginning of the academic year. Without this a student will not be able to be a part of National Academic Repository.

10.The one year M.Sc.(Computer Science) will begin with effect from the Academic Year 2027-28.

10. Scheme of Examination:

The Assessment of Regular students of Master of Computer Science, M.Sc.(Computer Science)course in the academic session 2023-24 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 all the courses the evaluation will be as follows :
Internal Assessment: 40 %
University evaluation: 60%
For each course of 100 marks, there will be Internal Assessment of 40 marks and the University Examination of 60 marks/2.5 hours duration at the end of each semester. The 04 credits will be awarded to a student who secures at least 40% of marks allotted to each paper. For a paper having 2 credits there will be Internal Assessment of 20 marks and the University Examination of 30 marks/1.5 hours duration at the end of each semester. The 02 credits will be awarded 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/20 marks which will be carried out by the department during the term. The Internal Assessment may be in the forms as follows:
Mid Semester : 20 Marks/10 Marks
Written tests/seminars/home assignment/presentations/orals : 20 Marks/10 Marks

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.

11. 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.

12. 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 ≤ 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

13. 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.

14. Gracing:

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

15. 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.

16. 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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M.Sc.(Computer Science)
SEMESTER I
(NEP 2023 COURSE)
MJ-CS 101 Advanced Database Management System

Course Outcomes (COs) : On Completion of the course, a student will be able to:

		Bloom's Taxonomy level
CO1	Identify complex conceptual data models into logical and physical database designs	1
CO2	Understand relational databases and database applications.	2
CO3	Apply advance database concepts and techniques on designed database .	3
CO4	Analyze location, replication and fragmentation independence	4

Total Credits: 04 **Total lectures: 60**
Course content:

UNIT I:Advanced Data Management techniques:
(10L)
Advanced Database Access protocols, Discretionary Access Control Based on Granting and Revoking Privileges, Mandatory Access Control and RoleBased Access Control. Overview of Advanced Database models like Mobile databases, Temporal databases, Spatial databases.

UNIT II: Object Oriented Databases
(10L)
Overview of Object Oriented Concept ,Object Identity ,Object Structure , Object Definition Language, Types of Constructors , object database conceptual design, OODBMS advantages, Object query language examples of OODBMS

UNIT III: Distributed Databases
(10L)
Introduction to Distributed data processing, Homogeneous and heterogeneous systems ,Distributed DBMS Architecture, fragmentation , Distributed database design , Overview of Query processing, Query decomposition and data localization

UNIT IV: Distributed DBMS reliability
(10L)
Reliability concepts & measures, Failures & fault tolerance in distributed systems, Local reliability protocols, Distributed reliability protocols, Network partitioning

UNIT V:Parallel Databases
(10L)
Parallel database concepts, Parallel database system architecture, Query parallelism, parallel Data processing and parallel query optimization

UNIT VI: Emerging Database Technologies & Applications
(10L)
Multimedia Databases, Mobile Databases, Geographical Information Systems, Spatio – temporal patterns, Intervals and scalar operators in temporal databases, web databases,

Deductive databases

Reference Books:-

1. Fundamentals of Database Management Systems By Navathe & Elmasri (3rd Edition, Pearson Education)
2. Principles of Distributed Database Systems by Patrick Valduriez (3rd Edition' Pearson Education)
3. Introduction to Database Systems by C G Date (7th Edition Pearson Education)

M.Sc.(Computer Science)
SEMESTER I
(NEP 2023 COURSE)

MJ-CS 102: Software Project Management

Course Outcomes (COs) : On Completion of the course, a student will be able to:

		Bloom's Taxonomy level
CO1	Identify IT project risks and develop risk mitigation strategies.	1
CO2	Understand how to apply different life-cycle models t design IT projects.	2
CO3	Apply general project management competencies to IT projects	3
CO4	Analyze the nature of projects that plan plan-driven and agile development	4

Total Credits: 04 **Total lectures: 60**

Course content:

UNIT I: Introduction to competencies: (12L)

Product development technique, management skills, product development life cycle , software development process and models, The SEI CMM, international organization for standardization

UNIT II: Domain Process: (12 L)

Managing domain process project selection models, project portfolio management ,financial process selecting a project team, goal and scope of software project ,project planning creating the work breakdown structure ,approaches to building a WBS, project milestones work packages-buildinga WBS for software

UNIT III: Software Development (12 L)

Tasks and activities, software size and reuse estimating, the SEI CMM, problems and task , cost estimation, effort measures , COCOMO: A regret ion model ,COCOMO II ,SLIM: a mathematical model, organizational planning, project roles and skills needed.

UNIT IV: Scheduling activities (12L)

Project management recourse activities, organizational form and structures software development dependences, brainstorming scheduling fundamentals, PERT and CPM, leveling recourses assignment, mark the schedule to a real calendar , critical chain scheduling

UNIT V: Quality assurance (12 L)

Quality requirements, the SEI CMM, guideline, challenges quality function deployment, building the software quality assurance, plan software, configuration management:

principals, requirements, planning and organizing, tools and benefits - legal issues in software, case study.

References Books:

1. Robert T.Futrell, Donald F. Shafer, Linda I. Safer, "Quality Software Project Management",Pearson Education, Asia, 2002.
2. Pankaj Jalote,"Software Project, Manegment in Practice", Addison Wesley, 2002
3. Hughes," Software Project Management,3/E",Tata McGraw-Hill,2004

M.Sc.(Computer Science)
SEMESTER I
(NEP 2023 COURSE)

MJ-CS 103: Digital Image Processing

Course Outcomes:On Completion of the course, a student will be able to:

		Bloom's Taxonomy level
CO1	analyze general terminology of digital image processing	2
CO2	examine various types of images, intensity transformations and spatial filtering	3
CO3	develop Fourier transform for image processing in frequency domain	5
CO4	evaluate the methodologies for image segmentation, restoration etc	4
CO5	implement image process and analysis algorithms	6
CO6	learn different feature extraction techniques for image analysis and recognition	1

Total Credits: 04 **Total lectures: 60**

Course content

Unit I: What is Digital Image Processing: (4L)

Low level image processing, High level image processing, The origins of Digital Image Processing, Examples of fields that use Digital Image Processing, X-Ray Imaging, Imaging in the Ultraviolet Band, Visible and Infrared Band, Microwave Band, Radio Band, Fundamental steps in Digital Image Processing, Components/Elements of Digital Image Processing

Unit II: Elements of Visual perception: (6L)

Light and electromagnetic spectrum, Image sensing and acquisition, Image acquisition using a single sensor, Image acquisition using sensor strips ,Image acquisition using sensor array, A single image formation model, Image sampling and quantization, Basic concepts of sampling and quantization, Spatial and gray level resolution, Aliasing and moiré patterns, Zooming and shrinking of digital image, Some basic ,relationship between pixels, Neighbors of a pixel, Adjacency, Connectivity, Regions, Boundaries, Distance measures, Linear and non linear operations

Unit III: Image Enhancement in the Spatial domain: (10L)

Introduction, Some basic grey level transformation Image negatives ,Log transformation, Power law(Gamma) transformations ,Piece wise linear transformation functions, Histogram processing, Histogram equalization ,Histogram matching(specification),Local enhancement, Image enhancement using arithmetic and logical operation, Image subtraction, Image averaging, Basics of spatial filtering, Smoothing spatial filters, Order statistic (non linear) filters, Sharpening spatial filters, Use of second derivative for enhancement-the Laplacian, Use of first derivatives for enhancement – the gradient, Combining spatial enhancement methods

Unit IV: Image Enhancement in the Frequency domain: (10L)

Introduction to the Fourier Transform and the Frequency Domain, One Dimensional Fourier Transform,2-D Discrete Fourier Transform (DFT)and its Inverse, Filtering in the Frequency Domain, Correspondence between Filtering in the Spatial and frequency domain, Smoothing Frequency –Domain Filters

Unit V: Image Restoration: (12L)

Introduction, Noise Models, Gaussian Noise, Rayleigh Noise, Erlang Noise ,Exponential noise, Uniform noise, Impulse Noise, Periodic noise, Restoration in the presence of noise only spatial filtering, Periodic noise reduction by frequency domain filtering, Band reject alters, Bandpass filters, Notch filters, Estimating the Degradation Function, Estimation of Degradation Function by Image Observation, Estimation of Degradation Function by Experimentation, Estimation of Image degradation by Modeling Geometric mean Filter, Inverse Filtering, Minimum Mean square error(Wiener)filtering ,Geometric Transformation

Unit VI: Morphological Image Processing: (8L)

Some basic concepts from set theory, Reflection and Translation, Logic operation involving Binary Images, Erosion and Dilation, Erosion, Dilation Duality, Opening and Closing, The Hit –or-Miss Transformation

Unit VII: Image Segmentation Fundamentals: (4L)

Detection of Discontinuities, Thresholding , Region –based Segmentation

Unit VIII: Representation and Description: (6L)

Representation, Simple Boundary Descriptors, Simple Regional Descriptors, Use of principal components for description, Relational Descriptors

Reference books :

1. Fundamental of Digital Image Processing by Anil k. Jain Prentice -Hall
2. Digital Image Processing by R.C. Gonzalez and Woods
3. Digital Image Processing using Matlab by R.C. Gonzalez and Woods,S .L Eddnins
4. Digital Image Processing PIKS Scientific Inside by William .K.Pratt ,WILEY India
5. Digital Image Processing and Computer Vision by Sonka ,Hlavac,Boyle, CENGAGE Learning

M.Sc.(Computer Science)
SEMESTER I
(NEP 2023 COURSE)
MJ-CS 104 Computer science practical – I

Course Outcomes (COs) : On Completion of the course, a student will be able to:

		Bloom's Taxonomy level
CO2	Understand how MongoDB stores data and how to queries against MongoDB instance.	2
CO3	Apply data manipulation techniques on stored data	3
CO4	Analyze database design and data representations	4

Total Credits: 02
Assignments :
1 Model the Department database and write MongoDB queries to insert at least 10 documents display the documents.

2. Model the following books system as a document database. Consider a set of books and publishers. A publisher can publish more than one book .Assume appropriate attributes and collections as per the query requirements .Insert at least 10 documents in each collection. And perform following Queries.
a. List all Publishers which are located in Mumbai
b.List the details of books with a cost >1000.
c.List all the book which are written by "Raghu Ramkrishnan" and published in 2017
d.List all the books published by "O Reilly" and are written either in English or Marathi

3. Write MongoDB queries for implementing aggregation
a. Write a MongoDB query to use push and addToAet expression.
b.Write a MongoDB query to use sum,avg,min and max expression.
c.Write a MongoDB query to use first and last expression

4.Create a document and perform MongoDB projection.

5.Create a document and perform limiting database, indexing and sorting database.

6. Model the database and perform MongoDB replication and sharding .

7. Create MongoDB data backup and deployment

8. MongoDB Database connectivity

9 Perform queries based on MongoDB relationships

10. Perform Query analyzing using MongoDB

M.Sc.(Computer Science)
SEMESTER I
(NEP 2023 COURSE)
MJ-CS 105 Paradigm of Programming Language

Course Objectives:

1. To Prepare student to think about programming languages analytically
2. Separate syntax from semantics
3. Compare programming language designs
4. Understand basic language implementation techniques
5. Learn small programs in different programming Languages

Course Outcomes (COs) : On Completion of the course, a student will be able to:

		Bloom's Taxonomy level
CO1	Identify features of Programming languages	1
CO2	Understand syntax ,grammar and semantics	2
CO3	Execute programming oriented application	3
CO4	Compare the procedure, oops and functional programming language	4
CO5	Check the knowledge of various programming language	5

Total credits:02 **Total lectures: 30**

Course Content

UNIT I: **Introduction to Programming Language** **(05 L)**

The Art of Language Design, the Programming Language Spectrum, Study Programming Languages Compilation and Interpretation, Programming Environments, Programming Language Syntax, Stages of Translation, Language Semantics , Grammars.

UNIT III : Elements of Programming Laguage **(10 L)**

Primitive Data Types , Numeric Types : Integer, Floating point, Complex , Decimal, Boolean Types, Character Types ,Character String Types , Design Issues, Strings and Their Operations, String Length Operations, Evaluation, Implementation of Character String Types, User defined Ordinal types Enumeration types, Designs Evaluation Sub range types, Ada's design Evaluation Implementation of user defined ordinal types ,Array types , Design issues, Arrays and indices, Subscript bindings and array categories, Heterogeneous arrays, Array initialization, Array operations, Rectangular and Jagged arrays, Slices, Evaluation, Implementation of Array Types , Associative Arrays , Structure and operations, Implementing associative arrays, Record types , Definitions of records, References to record fields, Operations on records, Evaluation, Implementation of Record types, Pointer and Reference Types, Design issues, Pointer operations, Pointer problems, Dangling pointers, Lost heap dynamic variables, Pointers in C and C++, Reference types, control structure

UNIT IV : Subprograms and Implementing Subprograms **(05 L)**

Fundamentals of Subprograms, Design Issues for subprograms, Local Referencing Environments, Parameter-Passing Methods , Overloaded Subprograms , Generic Subroutines, Generic Functions in C++, Methods in Java, C#

UNIT V : Data Abstraction and Object Orientation (10L)

Object-Oriented Programming, Encapsulation and Inheritance Modules, Classes, Nesting (Inner Classes), Type Extensions, Extending without Inheritance , Initialization and Finalization Choosing a Constructor, References and Values, Execution Order, Garbage Collection , Dynamic Method Binding , Virtual- and Non-Virtual Methods, Abstract Classes, Member Lookup, Polymorphism, Object Closures , Types of Inheritance

References:

1 Programming Language Pragmatics, Michel L. Scott Kaufmann Publishers, An Imprint of Elsevier, USA

2 Concepts of Programming Languages, Eighth Edition Robert W. Sebesta Pearson Education

3.Programming Languages Design and Implemention ,Pearson,Pratt,Zelkowitz,Gopal

M.Sc.(Computer Science)
SEMESTER I
(NEP 2023 COURSE)
MJ-CS 105(b) :Algorithm Design Pattern

Course Outcomes (COs) : On Completion of the course, a student will be able to:

		Bloom's Taxonomy level
CO1	Identify various strategies of developing algorithm	1
CO2	understand different algorithm design techniques and their features	2
CO3	Execute existing algorithms for real world problems	3
CO4	Compare the algorithmic strategies and their time complexities	4
CO5	implement techniques for synthesis & analysis of algorithms	5

Total Credits: 02 **Total lectures: 30**
Course content:

1 .Introduction: **(2L)**
Algorithm Concept, Writing structured programs, Analyzing algorithms

2. Divide & conquer: **(4L)**
The General method, Binary search, Finding the maximum &minimum selection, merge sort

3. The greedy method: **(6L)**
The general method, Optimal storage on tapes, Knapsack problem, Job Sequencing with deadlines, Optimal merge patterns, Minimum spanning tree

4. Dynamic programming: **(6L)**
The general method, Multistage Graphs, All pairs shortest path, Optimal binary search tree, Flow shop scheduling

5. Basic search & traversal techniques: **(6L)**
The techniques, code optimization, AND/OR graphs Game tree, Backtracking. The general method, The 8-queens problems, Sun of subsets, Graph coloring, Hamilton cycles

6. Branch-and-Bound: **(4L)**
Strategy, The method 0/1 knapsack problem, Traveling salesperson, LIFOBB, FIFOBB

7. NP-HARD&NP- COMPLETE problem: **(2L)**
Basic concepts, cook's theorem, NP-HARD graph problem, NP-HARD scheduling problem

References Books:-
1) Fundamentals of computer Algorithms – Coreman
2) Algorithm Design – Kleinberg and Tardos
3) Computer algorithms – Ellis Horitz and Sartaj Sahani

M.Sc.(Computer Science)
SEMESTER I
(NEP 2023 COURSE)
MJ-CS 106 : Computer Science Practical –II

Course Outcomes (COs) : On Completion of the course, a student will be able to:

		Bloom's Taxonomy level
CO1	Understand key feature of Angular JS	1
CO2	Analyze directives lke DOM elemnts,class	2
CO3	Design web app	3
CO4	Apply data binding concept	4
CO5	Create a web application for certain application	5

Credits :2

This practical is based on angular JS assignments where students should learn web development based on

1) Directives(DOM elements etc.)
2) Service representation
3) Data binding
4) Interpolation
5) Integrating with HTML

M.Sc.(Computer Science)
SEMESTER I
(NEP 2023 COURSE)
MJ-CS 107 : Research Methodology

Course Learning Outcomes:

Course Outcomes (COs) : On Completion of the course, a student will be able to:

CO 1:	Understand the basic concepts of Research.
CO 2:	Understand the importance of literature review and define research problem.
CO 3:	Understand the research design and its need
CO 4:	Analyze the data using statistical tools
CO 5:	Test the hypothesis and draw the inferences.
CO 6:	Develop the process of scientific documentation

Total Credits: 04 **Total Lectures: 60Hrs**

Course Contents:

1. **Basic concepts of Research**

   Research-definition, objective. Motivation, Types of Significance of research, Research methods vs methodology, Research process, Criteria for good research.

2 **Literature Review**

   Introduction of Resources or search engines available for searching literature in related area, critical review of available literature and its consolidation, finding research gaps and thrust areas, introduction of h-index, and i-index, Impact factor etc.

3. **Defining a research problem**

   How to define research problem? Necessity and technique of defining a research problem

4. **Design of research**

   what is research design? Need of research design, Important features of good research design, Important concept related to research design, basic principles of experimental design.

5. **Methods of data collection**

   primary and secondary data. Different methods for data collection.

6. **Analysis and interpretation of data**

Statistical methods for data analysis- measure of central tendency, measures of dispersion, skewness and kurtosis, correlation and regression analysis, association of attributes and other measures.

7. **Hypothesis Testing**

What is hypothesis? Test of hypothesis, Important parametric test, Hypothesis testing of mean, Chi – square test as a non-parametric test

8. **Report writing**

Pre writing considerations, Thesis writing, Formats of report writing, Formats of publications in Research journals, plagiarism, research ethics.

9. **Introduction to Intellectual Property Rights**

Nature of intellectual property, patents, designs, trademarks and copyright, process of patenting and development, technological research, innovation, patenting, development.

References

1. Kothari C.R., Research Methodology- methods and Techniques, New Wiley Eastern Ltd., Delhi.
2. Panneselvam, R., Research Methodology Prentice Hall of India, New Delhi.
3. Fisher, Hafner, Design of Experiments.
4. Ranjit Kumar., Research Methodology.
5. Day Robert A., How to write and publish a scientific paper.
6. GibaldiJoseph:, MLA Handbook for writers of Research papers.
7. MOOC: online courses for self-learning.

M.Sc.(Computer Science)
SEMESTER II
(NEP 2023 COURSE)
MJ CS-201 Big Data Analytics

Course Outcomes (COs) : On Completion of the course, a student will be able to:

		Bloom's Taxonomy level
CO1	Understand Big Data and its analytics in the real world	1
CO2	Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics	2
CO3	Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm	3
CO4	Design and Implementation of Big Data Analytics using pig and spark to solve data intensive problems and to generate analytics	4
CO5	Implement Big Data Activities using Hive	5

Total credits:04 **Total lectures: 60**

Course Content

UNIT I : Introduction (12L)

Introduction to Big Data, Characteristics of Data, and Big Data Evolution of Big Data, Definition of Big Data, Challenges with big data, Why Big data? Data Warehouse environment, Traditional Business Intelligence versus Big Data. State of Practice in Analytics, Key roles for New Big Data Ecosystems, Examples of big Data Analytics. Big Data Analytics, Introduction to big data analytics, Classification of Analytics, Challenges of Big Data, Importance of Big Data, Big Data Technologies, Data Science, Responsibilities, Soft state eventual consistency. Data Analytics Life Cycle

UNIT II : Clustering and Association (12L)

Analytical Theory and Methods: Clustering and Associated Algorithms, Association Rules, Apriori Algorithm, Candidate Rules, Applications of Association Rules, Validation and Testing, Diagnostics, Regression, Linear Regression, Logistic Regression, Additional
Regression Models.

UNIT III: Classification (12L)

Analytical Theory and Methods: Classification, Decision Trees, Naïve Bayes, Diagnostics of Classifiers, Additional Classification Methods, Time Series Analysis, Box Jenkins methodology, ARIMA Model, Additional methods. Text Analysis, Steps, Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency-Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments

UNIT IV: Hadoop (12L)

Data Product, Building Data Products at Scale with Hadoop, Data Science Pipeline and Hadoop Ecosystem, Operating System for Big Data, Concepts, Hadoop Architecture, Working with Distributed file system, Working with Distributed Computation,

Framework
for Python and Hadoop Streaming, Hadoop Streaming, MapReduce with Python, Advanced MapReduce. In-Memory Computing with Spark, Spark Basics, Interactive Spark with pyspark, writing spark applications

UNIT V: Distributed Analysis and Patterns (12L)

Distributed Analysis and Patterns, Computing with Keys, Design Patterns, Last-Mile Analytics, Data Mining and Warehousing, Structured Data Queries with Hive, HBase, Data
Ingestion, Importing Relational data with Sqoop, Ingesting stream data with flume. Analytics with higher level APIs, Pig, Spark's higher level APIs.

REFERENCES:

1.Big Data and Analytics, Subhashini Chellappan Seema Acharya, Wiley,1996
2.Data Analytics with Hadoop An Introduction for Data Scientists O'Reilly, 2016
3.Big Data and Hadoop, V.K Jain, Khanna,Publishing, 2018

M.Sc.(Computer Science)
SEMESTER II
(NEP 2023 COURSE)
MJ-CS202 : Cloud Computing

Course outcomes: At the end of this course, a student will be able to:

		Bloom's Taxanomy
CO1	Identify the core issues of cloud computing such as security, privacy, and interoperability	1,2
CO2	the appropriate technologies, algorithms, and approaches for the related issues	3
CO3	analyze the functioning of different components involved in web services cloud platform	4
CO4	identify problems and explain, analyze, and evaluate various cloud computing solutions	5,6

Total Credits: 04 **Total lectures: 60**
Course content :

UNIT I: Cloud Introduction (12L)
Cloud Computing Fundamentals: Cloud Computing definition, Types of cloud, Cloud services: Benefits and challenges of cloud computing, Evolution of Cloud Computing , usage scenarios and Applications , Business models around Cloud – Major Players in Cloud Computing - Issues in Cloud - Eucalyptus - Nimbus - Open Nebula, CloudSim.

UNIT II: Cloud Services And File System (12L)
Types of Cloud services: Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service - Monitoring as a Service – Communication as services. Service providersGoogle App Engine, Amazon EC2, Microsoft Azure, Sales force. Introduction to MapReduce, GFS, HDFS, Hadoop Framework.

UNIT III: Collaborating With Cloud (12L)
Collaborating on Calendars, Schedules and Task Management – Collaborating on Event Management, Contact Management, Project Management – Collaborating on Word Processing, Databases – Storing and Sharing Files- Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Collaborating via Social Networks – Collaborating via Blogs and Wikis. 185 CS-Engg&Tech-SRM-2013

UNIT III: Virtualization For Cloud (12L)
Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization – System Vm, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - Hypervisors – Xen, KVM , VMWare, Virtual Box, Hyper-V.

UNIT IV: Security, Standards, And Applications: (12L)
Security in Clouds: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud.

Reference Books :

1. Bloor R., Kanfman M., Halper F. Judith Hurwitz “Cloud Computing ” Wiley India Edition,2010
2. John Rittinghouse & James Ransome, “Cloud Computing Implementation Management and Strategy”, CRC Press, 2010
3. Antohy T Velte ,Cloud Computing : “A Practical Approach”, McGraw Hill,2009
4. Michael Miller, Cloud Computing: “Web-Based Applications That Change the Way You Work and Collaborate Online”, Que Publishing, August 2008.
5. James E Smith, Ravi Nair, “Virtual Machines”, Morgan Kaufmann Publishers, 2006.

M.Sc.(Computer Science)
SEMESTER II
(NEP 2023 COURSE)
MJ-CS 203 : Blockchain Technology

Course Outcomes: On completion of the course, a student will be able to :

		Bloom's Taxonomy level
CO1	Interpret the fundamentals and basic concepts in Blockchain	02
CO2	Compare the working of different blockchain platforms	04
CO3	Use Crypto wallet for cryptocurrency based transactions	03
CO4	Analyze the importance of blockchain in finding the solution to the real-world problems	04
CO5	Illustrate the Ethereum public block chain platform	03
CO6	Study the applications of Hyperledger	02
CO7	Understand what constitutes a smart contract, what are its legal implications and what it can and cannot do, now and in the near future	02
CO8	Evaluate the setting where a blockchain based structure may be applied, its potential and its limitations	05
CO9	Develop Blockchain DApp	06

Total Credits: 04 **Total lectures: 60**

Course content

Unit I: Fundamentals of Blockchain (8L)

Introduction, origin of Block Chain, Blockchain solution, Components of Blockchain, Block in Blockchain, The technology and the future. Blockchain types and consensus mechanism: decentralization and distribution, Types of Blockchain, Consensus Protocol. Cryptocurrency: Bitcoin, Altcoin and Token: . Bitcoin and Cryptocurrency, Cryptocurrency basics, Types of Cryptocurrency, Cryptocurrency usage

Unit II: Ethereum (14L)

Three parts of blockchain, Ether as currency and commodity, Building trustless systems. The Mist browser: Wallets as a Computing Metaphor, The Bank Teller Metaphor, Breaking with Banking History, How Encryption Leads to Trust, System Requirements, Using Parity with Geth, Anonymity in Cryptocurrency. Ethereum Virtual Machine(EVM): Central Bank Network, Virtual Machines, EVM Applications, State Machines, Guts of the EVM, Blocks, Mining's Place in the State Transition Function, Renting Time on the EVM, Gas, Working with Gas, Accounts, Transactions, and Messages, Characteristics of Transactions and Messages, Estimating Gas Fees for Operations, Opcodes in the EVM.

Solidity Programming: Introduction, Global Banking Made(Almost) Real, Complementary Currency, Learning to Programming the EVM, Design Rationale, Importance of Formal Proofs, Automated Proofs, Testing, Formatting Solidity Files, Tips for Reading Code, Statements and Expressions in Solidity, Value Types, Global Special Variables, Units, and Functions

Unit III: Hyperledger (10L)

Overview, Hyperledger Platform: fabric, INDy, Sawtooth, grid, hyperledger fabric and tools. Smart Contracts and Tokens: EVM as Back End, Assets Backed by Anything, Cryptocurrency Is a Measure of Time, Function of Collectibles in Human Systems, Platforms for High-Value Digital Collectibles, Tokens as Category of Smart Contract, Creating a Token, Deploying the Contract, Playing with Contracts.

Unit IV: Mining Ether (6L)

What's the point? Ether's Source, Defining Mining, Difficulty, Self-Regulation, and the Race for Profit, How Proof of Work Helps Regulate Block Time, DAG and Nonce, Faster Blocks, Stale Blocks, Difficulties, Ancestry of Blocks and Transactions, Ethereum and Bitcoin, Forking, Mining. Cryptoecnomics: Introduction, Usefulness of cryptoeconomics, Speed of blocks, Ether Issuance scheme, Common Attack Scenarios.

Unit V: Blockchain Application Development (16L)

Decentralized Applications, Blockchain Application Development, Interacting with the Bitcoin Blockchain, Interacting Programmatically with Ethereum—Sending Transactions, Creating a Smart Contract, Executing Smart Contract Functions, Public vs. Private Blockchains, Decentralized Application Architecture, Building an Ethereum DApp: The DApp, Setting Up a Private Ethereum Network, Creating the Smart Contract, Deploying the Smart Contract, Client Application.DApp deployment: Seven Ways to Think About Smart Contracts, Dapp Contract Data Models, EVM back-end and front-end communication, JSON-RPC, Web 3, JavaScript API, Using Meteor with the EVM, Executing Contracts in the Console, Recommendations for Prototyping, Third-Party Deployment Libraries.

Unit VI: Applications of Blockchain (6L)

Banking and Finance, education, energy, healthcare, real-estate, supply chain IoT

Reference Books:

1. Blockchain Technology,Chandramouli Subramanian, Asha A. George, Abhilash K A and Meena Karthikeyan, University Press 2022
2. Beginning Blockchain A Beginner's Guide to Building Blockchain Solutions Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda Apress 2018
3. Introducing Ethereum and Solidity Chris Dannen Apress 2017
4. The Blockchain Developer Elad Elrom Apress 2019
5. Mastering Ethereum Andreas M. Antonopoulos Dr. Gavin Wood O'Reilly First 2018
6. Blockchain Enabled Applications Vikram Dhillon David Metcalf Max Hooper Apress 2017

M.Sc.(Computer Science)
SEMESTER II
(NEP 2023 COURSE)
MJ-CS 204 Computer Science Practical- III (Cloud Computing)

Course Outcomes: On completion of the course, a student will be able to:

		Bloom's Taxanomy
CO1	Explain the core concepts of the cloud computing paradigm	1,2
CO2	Apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost	4
CO3	Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing	3
CO4	Analyze various cloud programming models and apply them to solve problems on the cloud	5

Credit : 2

LIST OF EXPERIMENTS

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.

2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.

3. Install Google App Engine. Create hello world app and other simple web applications using python/java.

4. Use GAE launcher to launch the web applications.

5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.

6. Find a procedure to transfer the files from one virtual machine to another virtual machine.

7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)

8. Install Hadoop single node cluster and run simple applications like wordcount.

M.Sc.(Computer Science)
SEMESTER II
(NEP 2023 COURSE)
MJ-CS 205 Software Testing

Course Outcomes (COs) : On Completion of the course, a student will be able to:

		Bloom's Taxonomy level
CO1	Identify different approaches of quality management, assurance, and quality standard to software system.	1
CO2	Understand fundamental concepts in software testing such as manual testing and design and develop project test plan, test cases, test data, and conduct test operations.	2
CO3	Apply the concepts different testing techniques.	3
CO4	Analyze the test automation concepts and apply automation tools for software testing	4

Total Credits: 02 **Total lectures: 30**

Course content

1: The S/W Development Process: (6L)
Realities of S/W testing, Life Cycle Models, Building a s/w testing process. Realities of S/W testing, Types of testing. Testing terms and definitions. Developing a test plan, Requirements verification checklist. Case study, Workbench, Do Procedures, Check Procedures.

2: Testing Methods: (5L)
Verification Testing, Validation Testing, creating test cases. Test case planning overview, reducing the number of test cases.

3: Testing Process Overview: (5L)
Clean Sheet Approach, Issues in requirements testing. Black-box, White-box, Static and Dynamic Testing.

4: Examining code, Issues in Code Testing. Static methods, Case Study (6L)
Dynamic testing, Coverage Types. Validation, Validation Testing, Controlling validation Costs, Alpha & Beta Testing, Software Testing tools, Types continued, Need for Tools, Types.

5: Test Documentation & Reporting (8L)
Bug Reporting, Bug Tracking Systems, Measurement Types. Metrics, Recommendations. Types of testing: More categories, Flow Testing, Path testing, Syntax Testing, Transition Testing, Compatibility Testing, Usability Testing, Configuration Testing, Web Site Testing, Foreign LanguageTesting, Software Quality Assurance

Reference Books:
1. Software Testing: Ron Patton

2. Effective Methods for Software Testing: William E Perry, Wiley
3. Software Testing in the Real World: Edward Kit
4. Introducing Software Testing: Louise Tamres
5. Software testing Techniques: Boris Beizer
6. Effective Methods for Software Testing: William Perry, Wiley
7. Software Testing: Renu Rajani

M.Sc.(Computer Science)
SEMESTER II
(NEP 2023 COURSE)
MJ-CS 205 : Soft Computing

Course Outcomes (COs) : On Completion of the course, a student will be able to:

		Blooms Taxanomy
CO1	Understand Fuzzy logic and its applications	**1**
CO2	Study single-objective optimization problems using GAs	**2**
CO3	analyze multi-objective optimization problems using Evolutionary algorithms	**3,4**
CO4	Apply different applications of Soft computing to solve problems in varieties of application	**5**

Credits: 2 **Lectures: 30**

1.Introduction to Soft Computing **(6L)**

- Concept of computing systems.
- "Soft" compiting versus "Hard" computing
- Characteristics of Soft computing
- Some applications of Soft computing techniques

2.Fuzzy logic **(6L)**

- Introduction to Fuzzy logic.
- Fuzzy sets and membership functions.
- Operations on Fuzzy sets.
- Fuzzy relations, rules, propositions, implications and inferences.
- Defuzzification techniques.
- Fuzzy logic controller design.
- Some applications of Fuzzy logic.

3.Genetic Algorithms **(6L)**

- Concept of "Genetics" and "Evolution" and its application to proablistic search techniques
- Basic GA framework and different GA architectures.
- GA operators: Encoding, Crossover, Selection, Mutation, etc.
- Solving single-objective optimization problems using GAs.

4.Multi-objective Optimization Problem Solving **(6L)**

- Concept of multi-objective optimization problems (MOOPs) and issues of solving them.
- Multi-Objective Evolutionary Algorithm (MOEA).
- Non-Pareto approaches to solve MOOPs
- Pareto-based approaches to solve MOOPs
- Some applications with MOEAs.

5.Artificial Neural Networks (6L)

- Biological neurons and its working.
- Simulation of biological neurons to problem solving.
- Different ANNs architectures.
- Training techniques for ANNs.
- Applications of ANNs to solve some real life problems.

References:-

1.Fuzzy Logic: A Pratical approach, F. Martin, , Mc neill, and Ellen Thro, AP professional,2000
2.Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey,2010
3.Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering, Nikola K. Kasabov, MIT Press, 1998
4.An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000

M.Sc.(Computer Science)
SEMESTER II
(NEP 2023 COURSE)
MJ-CS 206 Computer Science Practical –IV

Course Outcomes (COs) : On Completion of the course, a student will be able to:

		Bloom's Taxonomy level
CO1	Identify software testing knowledge and engineering methods	1
CO2	Understand software test process for a software testing project.	2
CO3	Apply testing techniques.	3

Total Credits :02

1.Design entry and exit criteria for test case, design test cases in excel.

2. Write simple programs make use of loops and control structures. Write Test Cases for above programs using Selenium.

3. Install Selenium and set up the necessary drivers for your preferred browser. Write a simple Selenium test script to open a web page, verify its title, and close the browser.

4. Locators and Element Interaction
Create test scripts that interact with web elements using various locators (e.g., ID, name, XPath, CSS selectors). Perform actions like clicking buttons, filling out forms, and extracting text from elements.

5. Test Case Design
Choose a basic web application and design test cases for essential functionalities like login, registration, and basic user interactions. Write Selenium test scripts to execute these test cases and verify the expected behavior. Include assertions to validate the outcomes.

6. Testing Conditional Statements
Develop test cases to verify the correctness of a function that determines the grade based on a student's score. Test different scenarios, such as passing grades, failing grades, and boundary values. Ensure that the function handles edge cases like negative scores or scores exceeding the maximum allowed.

7. Create test cases to validate a function that calculates the factorial of a given positive integer. Test the function with various inputs, including small and large numbers.

8. Testing Switch Case
Write test cases to evaluate a program that converts a given day of the week (e.g., "Monday," "Tuesday") into its corresponding abbreviation (e.g., "Mon," "Tue"). Test all possible day inputs, as well as invalid or misspelled inputs.

9. Test Reporting
Enhance your test scripts to generate comprehensive test reports. Demonstrate how to include essential information like test status, execution time, and failures in the reports.

10. Conduct exploratory testing on a web site of your choice using Selenium.

M.Sc.(Computer Science)
SEMESTER II
(NEP 2023 COURSE)
MJ-CS 207 On Job Training (OJT)
Course Outcomes (COs) : On Completion of the course, a student will be able to:

		Bloom's Taxonomy level
CO1	Understand concepts, rules or procedures of the trainee firm and adapt	2
CO2	Applying theoretical concepts for real world problems	3
CO3	Enhance work competencies, and discipline as they relate to people in the workplace	5
CO4	get an insight into the working of the real organizations/companies	2
CO5	Conduct preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility	3
CO6	Summarize and learn from and network with experienced professionals	6
CO7	Analyze global standards competencies and handle new challenges and complex tasks or problems	4
CO8	Experiment and solve the problem using Tools and latest Technologies	5
CO9	Inculcate Communication and team work skills needed for successful professional career	3

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Total Credits: 04 **Total hours spent: 120**

Course Requirement:

On Job Training should be completed by the students during the summer break, after the completion of the second semester of the first year. A student has to spend 120 hours for completing the OJT. On Job Training should be carried out in the Company /Institute with whom MoU is signed by the college or any other relevant Company or Institute of their choice. The OJT Project will be assessed through viva-voce by the University panel comprising of internal examiner, external examiner (who can be an industry expert/academician).

Second semester is On Job Training for 100 marks of which internal assessment will be of 40 marks and University assessment of 60 marks.

Students should take guidance from an internal guide and prepare a Project Report on On Job Training completed in 2 copies to be submitted in the department. The Report should contain an Introduction to Project, which should clearly explain the project scope in detail. Also, Data Dictionary, DFDs, ERDs, File designs and a list of output reports should be included.

General Instructions Regarding Preparation of OJT Report for M.Sc.(Comp. Sci.)

TYPING
1. The typing shall be standard 12 pts in double spaced using black ink only
2. Margins must be Left 2 inches Right 1.5 inches Top 2 inches Bottom 1.5 inches
3. Paper A4 size Bond Paper

COPIES
Two hard-bound copies
(Black Rexine with Golden Embossing as per format displayed herewith)
one for the college and one for himself/herself for future reference

All the copies must be duly signed by the in-charge faculty as per the schedule provided to you. One copy of the OJT Report must be retained by the student which should be produced before the examiner at the time of the Viva-voice. The student must bring the soft copy of the projects as desired by the external examiner at the time of the viva voce.
OJT can be done in any Computer language/ platform / package . Students can develop applications using tools/languages/Software which may be in use in their current organization where they may be undertaking the OJT(not mandatory)

M.Sc.(Computer Science) Paper Pattern
As per NEP 2023-24

Q 1.
a) (08)
b) (07)

OR

a) (08)
b) (07)

Q 2. Answer **ANY One** of the following - (08)
a)
b)

Q 3. Answer **ANY One** of the following - (07)
a)
b)

Q 4. Answer **ANY Three** of the following - (15)
a)
b)
c)
d)
e)

Q 5. Write short notes on **ANY Three** of the following- (15)
a)
b)
c)
d)
e)