UNIVERSITY OF MUMBAI
No. UG/ J>Tif 2017

CIRCULAR:-

A reference **is invited to** the Syllabi relating to the B.Sc. degree course, vide this office Circular No. UG/42 of 2016-17, dated 5'h August , 2016 and the Principals of the affiliated Colleges in Science are hereby informed that the recommendation made by Ad-hoc-Board of Studies Ln Computer Science at its meeting held on **5/5/2017 has** been accepted by the Academic Council at its meeting held on 11.5.2017 vide item No. 4.210 and that in accordance therewith, in revised syllabus as per the Credit Based Semester and Grading System for S.Y.B.Sc Computer Science (Sem III & IV) which is available on the University's website (www.mu.ac.in) and that the same has been brought into force with effect from the academic year 2016-17.

MUMBAI — 400 032
July, 2017

REGISTRAR

To,

The Principal of the affiliated Colleges in Science and the Head of Recognized Institutions concerned.

A.C/4.210/11.05.2017

›>Io. **UG/)bJ- A** of 2017 .M AJ-40*0 032 ২৮th July, 2017

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l) The Co-ordinator, Faculty of Science.,
2) The Offg. Director of Board of Examinations and Evaluation,
3) The Chairperson, Board of Studies in Botar.y,
4) The Director of Board of Studies Development.
5) The Professor-cum-Director, Ir.stitute of Distance and Open Leamlng.
6) The Co-Ordinator, University Cen.puierization Centre.

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UNIVERSITY OF MUMBAI

Syllabus for SemIV
Program: B.Sc.
Course: Computer Science

(Credit Based Semester and Grading System with effect from the academic year **2017-2018**)

Preamble

The revised and restructured curriculum for the Three-year integrated course is systematically designed considering the current industry needs in terms of skills sets demanded under new technological environment. It also endeavours to align the programme structure and course curriculum with student aspirations and corporate expectations. The proposed curriculum is more contextual, industry affable and suitable to cater the needs of society and nation in present day context.

Second year of this course is about studying core computer science subjects. Theory of Computation course provides understanding of grammar, syntax and other elements of modern language designs. It also covers developing capabilities to design formulations of computing models and its applications in diverse areas.

The course in Operating System satisfies the need of understanding the structure and functioning of system. Programming holds key indispensable position in any curriculum of Computer Science. It is essential for the learners to know how to use object oriented paradigms. There is also one dedicated course Android Developer Fundamentals as a skill enhancement catering to modern day needs of Mobile platforms and applications. The syllabus has Database Systems courses in previous semesters. The course in Database Management Systems is its continuation in third semester. The course has objectives to develop understanding of concepts and techniques for data management along with covers concepts of database at advance level.

The course of Combinatorics and Graph Theory in third semester and the course of Linear Algebra in fourth semester take the previous courses in Mathematics. Graph theory is rapidly moving into the mainstream mainly because of its applications in diverse fields which include can further open new opportunities in the areas of genomics, communications networks and coding theory, algorithms and computations and operations research.

Introducing one of the upcoming concepts Physical Computing and IoT programming will definitely open future area as Embedded Engineer, involvement in IoT projects, Robotics and many more. The RasPi is a popular platform as it offers a complete Linux server in a tiny platform for a very low cost and custom-built hardware with minimum complex hardware builds which is easier for projects in education domain.

S.Y.B.Sc. (Semester III and IV)
Computer Science Syllabus
Credit Based Semester and Grading System
To be implemented from the Academic year 2017-2018

SEMESTER III			
Course	**TOPICS**	**Credits**	**L / Week**
USCS301	Theory of Computation	2	3
USCS302	Core JAVA	2	3
USCS303	Operating System	2	3
USCS304	Database Management Systems	2	3
USCS305	Combinatorics and Graph Theory	2	3
USCS306	Physical Computing and IoT Programming	2	3
USCS307	Skill Enhancement: Web Programming	2	3
USCSP301	USCS302+USCS303+USCS304	3	9
USCSP302	USCS305+USCS306+USCS307	3	9

SEMESTER IV			
Course	**TOPICS**	**Credits**	**L / Week**
USCS401	Fundamentals of Algorithms	2	3
USCS402	Advanced JAVA	2	3
USCS403	Computer Networks	2	3
USCS404	Software Engineering	2	3
USCS405	Linear Algebra using Python	2	3
USCS406	.NET Technologies	2	3
USCS407	Skill Enhancement: Android Developer Fundamentals	2	3
USCSP401	USCS401+ USCS402+ USCS403	3	9
USCSP402	USCS405+ USCS406+ USCS407	3	9

SEMESTER IV

THEORY

Course: **USCS405**	**TOPICS (Credits : 02 Lectures/Week: 03)** **Linear Algebra using Python**	
Objectives: To offer the learner the relevant linear algebra concepts through computer science applications. **Expected Learning Outcomes**: 1. Appreciate the relevance of linear algebra in the field of computer science. 2. Understand the concepts through program implementation 3. Instill a computational thinking while learning linear algebra.		
Unit I	**Field**: Introduction to complex numbers, numbers in Python , Abstracting over fields, Playing with GF(2), Vector Space: Vectors are functions, Vector addition, Scalar-vector multiplication, Combining vector addition and scalar multiplication, Dictionary-based representations of vectors, Dot-product, Solving a triangular system of linear equations. Linear combination, Span, The geometry of sets of vectors, Vector spaces, Linear systems, homogeneous and otherwise	**15L**
Unit II	**Matrix**: Matrices as vectors, Transpose, Matrix-vector and vector-matrix multiplication in terms of linear combinations, Matrix-vector multiplication in terms of dot-products, Null space, Computing sparse matrix-vector product, Linear functions, Matrix-matrix multiplication, Inner product and outer product, From function inverse to matrix inverse **Basis**: Coordinate systems, Two greedy algorithms for finding a set of generators, Minimum Spanning Forest and GF(2), Linear dependence, Basis , Unique representation, Change of basis, first look, Computational problems involving finding a basis Dimension: Dimension and rank, Direct sum, Dimension and linear functions, The annihilator	**15L**

Unit III	**Gaussian elimination**: Echelon form, Gaussian elimination over GF(2), Solving a matrix-vector equation using Gaussian elimination, Finding a basis for the null space, Factoring integers, **Inner Product**: The inner product for vectors over the reals, Orthogonality, **Orthogonalization**: Projection orthogonal to multiple vectors, Projecting orthogonal to mutually orthogonal vectors, Building an orthogonal set of generators, Orthogonal complement, Eigenvector: Modeling discrete dynamic processes, Diagonalization of the Fibonacci matrix, Eigenvalues and eigenvectors, Coordinate representation in terms of eigenvectors, The Internet worm, Existence of eigenvalues, Markov chains, Modeling a web surfer: PageRank.	**15L**

Textbook(s):

1) Coding the Matrix Linear Algebra through Applications to Computer Science Edition 1, PHILIP N. KLEIN, Newtonian Press (2013)

Additional References*:*

1) Linear Algebra and Probability for Computer Science Applications, Ernest Davis, A K Peters/CRC Press (2012).
2) Linear Algebra and Its Applications, Gilbert Strang, Cengage Learning, 4th Edition (2007).
3) Linear Algebra and Its Applications, David C Lay, Pearson Education India; 3rd Edition (2002)

Suggested List of Practical – SEMESTER IV

Course: **USCSP402**	**(Credits : 03 Lectures/Week:09)** **USCS405+ USCS406+ USCS407**	

USCS405: Linear Algebra using Python

1. Write a program which demonstrates the following:
    - Addition of two complex numbers
    - Displaying the conjugate of a complex number
    - Plotting a set of complex numbers
    - Creating a new plot by rotating the given number by a degree 90,180, 270 degrees and also by scaling by a number a=1/2, a=1/3, a=2 etc.
2. Write a program to do the following:
    - Enter a vector u as a n-list
    - Enter another vector v as a n-list
    - Find the vector au+bv for different values of a and b
    - Find the dot product of u and v
3. Write a program to do the following:
    - Enter two distinct faces as vectors u and v.
    - Find a new face as a linear combination of u and v i.e. au+bv for a and b in R.
    - Find the average face of the original faces.
4. Write a program to do the following:
    - Enter an r by c matrix M (r and c being positive integers)
    - Display M in matrix format
    - Display the rows and columns of the matrix M
    - Find the scalar multiplication of M for a given scalar.
    - Find the transpose of the matrix M.
5. Write a program to do the following:
    - Find the vector –matrix multiplication of a r by c matrix M with an c-vector u.
    - Find the matrix-matrix product of M with a c by p matrix N.
6. Write a program to enter a matrix and check if it is invertible. If the inverse exists, find the inverse.
7. Write a program to convert a matrix into its row echelon form.

8. Write a program to do the following:
    - Enter a positive number N and find numbers a and b such that $a^2 – b^2 = N$
    - Find the gcd of two numbers using Euclid's algorithm.
9. Write a program to do the following:
    - Enter a vector b and find the projection of b orthogonal to a given vector u.
    - Find the projection of b orthogonal to a set of given vectors
10. Write a program to enter a given matrix and an eigen value of the same. Find its eigen vector.

Evaluation Scheme

I. Internal Exam - 25 Marks

(i) Test – 20 Marks

20 marks Test – Duration 40 mins
It will be conducted either using any open source learning management system like Moodle (Modular object-oriented dynamic learning environment)

OR

A test based on an equivalent online course on the contents of the concerned course (subject) offered by or build using MOOC (Massive Open Online Course) platform.

(ii) 5 Marks – Active participation in routine class instructional deliveries
Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.

II. External Exam– 75 Marks

III. Practical Exam – 50 Marks

- Each course carry 50 Marks : 40 marks + 05 marks (journal) + 05 marks (viva)
- Minimum 75 % practical from each paper are required to be completed and written in the journal**.**

(Certified Journal is compulsory for appearing at the time of Practical Exam)