

University of Mumbai



No. AAMS_UGS/ICC/2024-25/145

CIRCULAR:-

Attention of all the Principals of the Affiliated Colleges, Directors of the Recognized Institutions and the Heads, University Departments is invited to this office Circular No. AAMS_UGS/ICC/2024-25/170 dated 30th September, 2024 relating to the syllabus of **B.Voc (Big Database and Cloud Computing) (Sem – I to II) (CBCS).**

They are hereby informed that the recommendations made by the **Board of Studies in Information Technology** at its meeting held on 22nd August, 2024 and subsequently passed by the Board of Deans at its meeting held on 3rd September, 2024 vide item No. 6.20 (N) have been accepted by the Hon'ble Vice Chancellor as per the power confirmed upon him under section 12(7) of the Maharashtra Public Universities Act, 2016 and that in accordance therewith **to introduce syllabus B.Voc (Big Database and Cloud Computing) Sem – III & IV** with effect from the academic year 2024-25.

(The Circular is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
30th September, 2024


(Dr. Prasad Karande)
REGISTRAR

To

All the Principals of the Affiliated Colleges, Directors of the Recognized Institutions and the Heads, University Departments.

BOD 6.20(N) 03/09/2024

Copy forwarded with Compliments for information to:-

- 1) The Chairman, Board of Deans,
- 2) The Dean, Faculty of Technology,
- 3) The Chairman, **Faculty of Information Technology**
- 4) The Director, Board of Examinations and Evaluation,
- 5) The Director, Department of Students Development,
- 6) The Director, Department of Information & Communication Technology,
- 7) The Director, Centre for Distance and Online Education (CDOE) Vidyanagari,
- 8) The Deputy Registrar, Admission, Enrolment, Eligibility & Migration Department (AEM),

Copy forwarded for information and necessary action to :-	
1	The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Dept)(AEM), dr@eligi.mu.ac.in
2	The Deputy Registrar, Result unit, Vidyanagari drresults@exam.mu.ac.in
3	The Deputy Registrar, Marks and Certificate Unit,. Vidyanagari dr.verification@mu.ac.in
4	The Deputy Registrar, Appointment Unit, Vidyanagari dr.appointment@exam.mu.ac.in
5	The Deputy Registrar, CAP Unit, Vidyanagari cap.exam@mu.ac.in
6	The Deputy Registrar, College Affiliations & Development Department (CAD), deputyregistrar.uni@gmail.com
7	The Deputy Registrar, PRO, Fort, (Publication Section), Pro@mu.ac.in
8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
9	The Deputy Registrar, Research Administration & Promotion Cell (RAPC), rapc@mu.ac.in
10	The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA) dy.registrar.tau.fort.mu.ac.in ar.tau@fort.mu.ac.in
11	The Deputy Registrar, College Teachers Approval Unit (CTA), concolsection@gmail.com
12	The Deputy Registrars, Finance & Accounts Section, fort draccounts@fort.mu.ac.in
13	The Deputy Registrar, Election Section, Fort drelection@election.mu.ac.in
14	The Assistant Registrar, Administrative Sub-Campus Thane, thanesubcampus@mu.ac.in
15	The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan, ar.seask@mu.ac.in
16	The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri, ratnagirisubcentar@gmail.com
17	The Director, Centre for Distance and Online Education (CDOE), Vidyanagari, director@idol.mu.ac.in
18	Director, Innovation, Incubation and Linkages, Dr. Sachin Laddha pinkumanno@gmail.com
19	Director, Department of Lifelong Learning and Extension (DLLE), dlleuniversityofmumbai@gmail.com

Copy for information :-	
1	P.A to Hon'ble Vice-Chancellor, vice-chancellor@mu.ac.in
2	P.A to Pro-Vice-Chancellor pvc@fort.mu.ac.in
3	P.A to Registrar, registrar@fort.mu.ac.in
4	P.A to all Deans of all Faculties
5	P.A to Finance & Account Officers, (F & A.O), camu@accounts.mu.ac.in

To,

1	The Chairman, Board of Deans pvc@fort.mu.ac.in
2	Faculty of Humanities, Dean 1. Prof.Anil Singh Dranilsingh129@gmail.com Associate Dean 2. Dr.Suchitra Naik Naiksuchitra27@gmail.com 3.Prof.Manisha Karne mkarne@economics.mu.ac.in
	Faculty of Commerce & Management, Dean 1. Dr.Kavita Laghate kavitalaghate@jbims.mu.ac.in Associate Dean 2. Dr.Ravikant Balkrishna Sangurde Ravikant.s.@somaiya.edu 3. Prin.Kishori Bhagat kishoribhagat@rediffmail.com

	Faculty of Science & Technology Dean 1. Prof. Shivram Garje ssgarje@chem.mu.ac.in Associate Dean 2. Dr. Madhav R. Rajwade Madhavr64@gmail.com 3. Prin. Deven Shah sir.deven@gmail.com
	Faculty of Inter-Disciplinary Studies, Dean 1. Dr. Anil K. Singh aksingh@trcl.org.in Associate Dean 2. Prin. Chadrashekhhar Ashok Chakradeo cachakradeo@gmail.com
3	Chairman, Board of Studies,
4	The Director, Board of Examinations and Evaluation, dboee@exam.mu.ac.in
5	The Director, Board of Students Development, dsd@mu.ac.in DSW directr@dsw.mu.ac.in
6	The Director, Department of Information & Communication Technology, director.dict@mu.ac.in

UNIVERSITY OF MUMBAI



Title of the U.G. Program
B. Voc. (Big Database and Cloud
Computing)

Syllabus for
Semester III & IV

(As per AICTE guidelines with effect from the
academic year 2024–2025)

UNIVERSITY OF MUMBAI



Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	B.Voc. (Big Database and Cloud Computing)
2	Eligibility for Admission	After Passing First Year Engineering as per the Ordinance 0.6242
3	Passing Marks	40%
4	No. of Years / Semesters	Sem. III & IV
5	Level	P.G. / U.G./Diploma / Certificate (Strike out which is not applicable)
6	Pattern	Yearly / Semester (Strike out which is not applicable)
7	Status	New / Revised (Strike out which is not applicable)
8	To be implemented from Academic Year	With effect from Academic Year: 2024-2025

Offg. Associate Dean
Dr. Deven Shah
Faculty of Science and Technology
Technology University of Mumbai

Offg. Dean
Prof. Shivram S. Garje
Faculty of Science and
University of Mumbai

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of the accreditation process is to measure the outcomes of the program that is being accredited. In line with this, the Faculty of Science and Technology (in particular Engineering) of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance the learner's learning process. Choice based Credit and grading systems enables a much-required shift in focus from teacher-centered to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum was more focused on providing information and knowledge across various domains of the said program, which led to heavy loading of students in terms of direct contact hours. In this regard, the faculty of science and technology resolved that to minimize the burden of contact hours, total credits of the entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self-learning. Therefore, in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in the second and third year of programs, which will definitely facilitate self-learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for the First Year of Engineering from the academic year 2023-24. Subsequently this will be carried forward for Second Year and Third Year Engineering in the academic years 2024-25, 2025-26, respectively.

Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge components, skill based activities and project based activities. Self-learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of 'C' scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of the AICTE model curriculum, overall credits are reduced to 171, to provide opportunities of self-learning to learners. Learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD's/ Faculties of all the institutes are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Preface by Board of Studies in Big Database and Cloud Computing

Dear Students and Teachers, we, the members of Board of Studies B.Vocational, are very happy to present the First Year B.Vocational (Big Database and Cloud Computing) syllabus effective from the Academic Year 2023-24. We are sure you will find this syllabus interesting and challenging.

Big Database and Cloud Computing is one of the most sought-after courses amongst engineering students hence there is a continuous requirement of revision of syllabus. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas. It is intended to provide a modern, industry-oriented education in Big Database and Cloud Computing. It aims at producing trained professionals who can successfully become acquainted with the demands of the industry worldwide. They obtain skills and experience in up-to-date knowledge to analysis, design, implementation, validation, and documentation of computer software and systems.

The syllabus falls in line with the objectives of affiliating University, AICTE, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

The salient features of the syllabus are:

1. Syllabus is designed to ensure that students have more time for extracurricular activities, innovations, and research.
2. Introduction of Skill Based Lab and Mini Project to showcase their talent by doing innovative projects that strengthen their profile and increase the chance of employability.
3. Students are encouraged to take up part of course through MOOCs platform SWAYAM

We would like to place on record our gratitude to the faculty, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

Board of Studies in Computer Engineering

: Chairman

: Member

: Member

: Member

: Member

: Member

: Member

: Member

: Member

: Member

Program Structure for First Year Big Database and Cloud Computing

UNIVERSITY OF MUMBAI (With Effect from 2023-2024)

Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
General Education Component									
BV-BDCCG 101	Professional Skill-I (Communication skills)	3	--	1*	3	--	1	4	
BV-BDCCG 102	Applied Mathematics	3	--	1*	3	--	1	4	
BV-BDCCG 103	Object Oriented Programming – C++	3	2	--	3	1	--	4	
	Total	9	2	2	9	1	2	12	
Skill Component									
BV-BDCCS 101	Data Structures and Algorithm	3	2	--	3	1	--	4	
BV-BDCCS 102	Computer Network	3	2	--	3	1	--	4	
BV-BDCCS 103	Operating System	3	2	--	3	1	--	4	
BV-BDCCS 104	On-Job Training/ Skill based Internship	--	12	--	--	6#	--	6	
	Total	9	18	--	9	9	--	18	
Grand Total		18	20	2	18	10	2	30	
Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract & oral	Total	
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
General Education Component									
BV-BDCCG 101	Professional Skill-I (Communication skills)	10	10	10	40	2	--	--	50
BV-BDCCG 102	Applied Mathematics	20	20	20	80	3	25	--	125
BV-BDCCG 103	Object Oriented Programming – C++	20	20	20	80	3	25	25	150
Skill Component									
BV-BDCCS 101	Data Structures and Algorithm	20	20	20	80	3	25	25	150
BV-BDCCS 102	Computer Network	20	20	20	80	3	25	25	150
BV-BDCCS 103	Operating System	20	20	20	80	3	25	25	150
BV-BDCCS 104	On-Job Training/ Skill based Internship	--	--	--	--	--	50#	--	50
Total		--	--	110	440	--	175	100	825

*Should be conducted batch wise

indicates practical and oral marks includes report and presentation

Program Structure for First Year Big Database and Cloud Computing
UNIVERSITY OF MUMBAI (With Effect from 2023-2024)
Semester II

Semester II									
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
General Education Component									
BV-BDCCG 201	Professional Skill-II (Business communication Ethics)	3	--	1*	3	--	1	4	
BV-BDCCG 202	Probability and Statistics	3	--	1*	3	--	1	4	
BV-BDCCG 203	Introduction to Data Science	3	2	--	3	1	--	4	
	Total	9	2	2	9	1	2	12	
Skill Component									
BV-BDCCS 201	Advanced Operating System	3	2	--	3	1	--	4	
BV-BDCCS 202	Introduction to Cloud Computing	3	2	--	3	1	--	4	
BV-BDCCS 203	Software Engineering	3	2	--	3	1	--	4	
BV-BDCCS 204	On-Job Training/ Skill based Internship	--	12	--	--	6#	--	6	
	Total	9	18	--	9	9	--	18	
Grand Total		18	20	2	18	10	2	30	
Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract & oral	Total	
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
General Education Component									
BV-BDCCG 201	Professional Skill-II (Business communication Ethics)	10	10	10	40	2		50	
BV-BDCCG 202	Probability and Statistics	20	20	20	80	3	25	--	125
BV-BDCCG 203	Introduction to Data Science	20	20	20	80	3	25	25	150
Skill Component									
BV-BDCCS 201	Advanced operating system	20	20	20	80	3	25	25	150
BV-BDCCS 202	Introduction to Cloud Computing	20	20	20	80	3	25	25	150
BV-BDCCS 203	Software Engineering	20	20	20	80	3	25	25	150
BV-BDCCS 204	On-Job Training/ Skill based Internship	--	--	--	--	--	50#	--	50
Total		--	--	110	440	--	175	100	825

*Should be conducted batch wise

indicates practical and oral marks includes report and presentation

Program Structure for First Year Big Database and Cloud Computing

UNIVERSITY OF MUMBAI (With Effect from 2023-2024)

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
General Education Component									
BV-BDCCG 301	Professional Skill-III (Entrepreneurship)	3	--	1*	3	--	1	4	
BV-BDCCG 302	Computer Organization and architecture	3	--	1*	3	--	1	4	
BV-BDCCG 303	Statistics for Data Science	3	2	--	3	1	--	4	
	Total	9	2	2	9	1	2	12	
Skill Component									
BV-BDCCS 301	Python Programming	3	2	--	3	1	--	4	
BV-BDCCS 302	Database Management Systems	3	2	--	3	1	--	4	
BV-BDCCS 303	Web Development	3	2	--	3	1	--	4	
BV-BDCCS 304	On-Job Training/ Skill based Internship	--	12	--	--	6#	--	6	
	Total	9	18	--	9	9	--	18	
Grand Total		18	20	2	18	10	2	30	
Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract & oral	Total	
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
General Education Component									
BV-BDCCG 301	Professional Skill-III (Entrepreneurship)	10	10	10	40	2	--	--	50
BV-BDCCG 302	Computer Organization and architecture	20	20	20	80	3	25	--	125
BV-BDCCG 303	Statistics for Data Science	20	20	20	80	3	25	25	150
Skill Component									
BV-BDCCS 301	Python Programming	20	20	20	80	3	25	25	150
BV-BDCCS 302	Database Management Systems	20	20	20	80	3	25	25	150
BV-BDCCS 303	Web Development	20	20	20	80	3	25	25	150
BV-BDCCS 304	On-Job Training/ Skill based Internship	--	--	--	--	--	50#	--	50
Total		--	--	110	440	--	175	100	825

*Should be conducted batch wise and

indicates practical and oral marks includes report and presentation

Program Structure for First Year Big Database and Cloud Computing

UNIVERSITY OF MUMBAI (With Effect from 2023-2024)

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
General Education Component									
BV-BDCCG 401	Professional Skill-IV (Aptitude and Logic Building)	3	--	1*	3	--	1	4	
BV-BDCCG 402	Soft Computing	3	--	1*	3	--	1	4	
BV-BDCCG 403	Information Storage Concept	3	2	--	3	1	--	4	
	Total	9	2	2	9	1	2	12	
Skill Component									
BV-BDCCS 401	Data Mining and Data ware Housing	3	2	--	3	1	--	4	
BV-BDCCS 402	Introduction to Big Data	3	2	--	3	1	--	4	
BV-BDCCS 403	Network Security & Cryptography	3	2	--	3	1	--	4	
BV-BDCCS 404	On-Job Training/ Skill based Internship	--	12	--	--	6#	--	6	
	Total	9	18	--	9	9	--	18	
Grand Total		18	20	2	18	10	2	30	
Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract & oral	Total	
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
General Education Component									
BV-BDCCG 401	Professional Skill-IV (Aptitude and Logic Building)	10	10	10	40	2		50	
BV-BDCCG 402	Soft Computing	20	20	20	80	3	25	--	125
BV-BDCCG 403	Information Storage Concept	20	20	20	80	3	25	25	150
Skill Component									
BV-BDCCS 401	Data Mining and Data Warehousing	20	20	20	80	3	25	25	150
BV-BDCCS 402	Introduction to Big Data	20	20	20	80	3	25	25	150
BV-BDCCS 403	Network Security & Cryptography	20	20	20	80	3	25	25	150
BV-BDCCS 404	On-Job Training/ Skill based Internship	--	--	--	--	--	50#	--	50
Total		--	--	110	440	--	175	100	825

*Should be conducted batch wise and

indicates practical and oral marks includes report and presentation

Program Structure for First Year Big Database and Cloud Computing

UNIVERSITY OF MUMBAI (With Effect from 2023-2024)

Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
General Education Component									
BV-BDCCG 501	Professional Skill-V (R-Programming)	3	--	1*	3	--	1	4	
BV-BDCCG 502	Management Information System	3	--	1*	3	--	1	4	
BV-BDCCG 503	Information Retrieval system	3	2	--	3	1	--	4	
	Total	9	2	2	9	1	2	12	
Skill Component									
BV-BDCCS 501	Machine Learning-1	3	2	--	3	1	--	4	
BV-BDCCS 502	Cloud Network and Security	3	2	--	3	1	--	4	
BV-BDCCS 503	Big data analytics	3	2	--	3	1	--	4	
BV-BDCCS 504	Major Project-I (Cloud Computing or Big Data)	--	12	--	--	6#	--	6	
	Total	9	18	--	9	9	--	18	
Grand Total		18	20	2	18	10	2	30	
Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract & oral	Total	
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
General Education Component									
BV-BDCCG 501	Professional Skill-V (R-Programming)	10	10	10	40	2		50	
BV-BDCCG 502	Management Information System	20	20	20	80	3	25	--	125
BV-BDCCG 503	Information Retrieval system	20	20	20	80	3	25	25	150
Skill Component									
BV-BDCCS 501	Machine Learning-1	20	20	20	80	3	25	25	150
BV-BDCCS 502	Cloud Network and Security	20	20	20	80	3	25	25	150
BV-BDCCS 503	Big data analytics	20	20	20	80	3	25	25	150
BV-BDCCS 504	Major Project-I (Cloud Computing or Big Data)	--	--	--	--	--	50#	--	50

Total	--	--	110	440	--	175	100	825
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*Should be conducted batch wise and

\$ indicates workload of Learner (Not Faculty), Students can form groups with minimum 2 (Two) and not more than 4 (Four),
Faculty Load: 1 hour per week per four groups

indicates practical and oral marks includes report and presentation

Program Structure for First Year Big Database and Cloud Computing

UNIVERSITY OF MUMBAI (With Effect from 2023-2024)

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
General Education Component									
BV-BDCCG 601	Professional Skill-I (Cloud Computing using any one platform AWS, Azure, etc)	3	--	1*	3	--	1	4	
BV-BDCCG 602	Environment Management	3	--	1*	3	--	1	4	
BV-BDCCG 603	Internet of Things	3	2	--	3	1	--	4	
	Total	9	2	2	9	1	2	12	
Skill Component									
BV-BDCCS 601	Cyber Security	3	2	--	3	1	--	4	
BV-BDCCS 602	Distributed Computing	3	2	--	3	1	--	4	
BV-BDCCS 603	Machine Learning-II	3	2	--	3	1	--	4	
BV-BDCCS 604	Major Project-II (Cloud Computing or Big Data)	--	12	--	--	6#	--	6	
	Total	9	18	--	9	9	--	18	
Grand Total		18	20	2	18	10	2	30	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract & oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
General Education Component									
BV-BDCCG 601	Professional Skill-I (Cloud Computing using any one platform AWS, Azure, etc)	10	10	10	40	2			50
BV-BDCCG 602	Environment Management	20	20	20	80	3	25	--	125
BV-BDCCG 603	Internet of Things	20	20	20	80	3	25	25	150
Skill Component									
BV-BDCCS 601	Cyber Security	20	20	20	80	3	25	25	150
BV-BDCCS 602	Distributed Computing	20	20	20	80	3	25	25	150

BV-BDCCS 603	Machine Learning-II	20	20	20	80	3	25	25	150
BV-BDCCS 604	Major Project-II (Cloud Computing or Big Data)	--	--	--	--	--	50#	--	50
Total		--	--	110	440	--	175	100	825

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indicates practical and oral marks includes report and presentation

Program Structure for First Year Big Database and Cloud Computing

UNIVERSITY OF MUMBAI (With Effect from 2024-2025)

Semester III

Semester III

Course Code:	Course Title	Credit
BVBDCCG 301	Professional Skill-III (Entrepreneurship)	4

Prerequisite: Business Communication Ethics

Course Objectives:

- | | |
|---|---|
| 1 | To provide a detailed overview of entrepreneurship as the foundation of business growth |
| 2 | To teach to adopt entrepreneurship as value creation in the national economy. |
| 3 | It provides multiple constructs for entrepreneurs to be successful. |
| 4 | It provides multiple pathways for their companies to achieve sustainable growth. |

Course Outcomes:

- | | |
|---|--|
| 1 | To understand key concepts underpinning entrepreneurship |
| 2 | To apply knowledge in the recognition and exploitation of product/ service/ process opportunities |
| 3 | To demonstrate key concepts underpinning innovation and the issues associated with developing and sustaining innovation within organizations |
| 4 | To understand, how to design creative strategies for pursuing, exploiting and further developing new opportunities |
| 5 | To understand Issues associated with securing and managing financial resources in new and established organizations. |

Module		Content	Hrs
1		Introduction to Entrepreneurial Journey	8
	1.1	Entrepreneurial Journey	
	1.2	Entrepreneurial Discovery	
2		Ideation and Prototyping	8
	2.1	Ideation and Prototyping.	
	2.2	Testing, Validation and Commercialization, Disruption as a Success Driver	
3		Technological Innovation and Entrepreneurship	8
	3.1	Technological Innovation and Entrepreneurship – 1	
	3.2	Technological Innovation and Entrepreneurship – 2 ,Raising Financial Resources	
4		Education and Entrepreneurship	7
	4.1	Education and Entrepreneurship.	
	4.2	Beyond Founders and Founder-Families, India as a Start-up Nation	
5		National Entrepreneurial Culture	7
	5.1	National Entrepreneurial Culture.	

	5.2	Entrepreneurial Thermodynamics, Entrepreneurship and Employment.	
6		Start-up Case Studies.	7
	6.1	Discuss at least five case studies.	
		Total	45

Textbooks:

1	Peter Thiel “Zero to One: Notes on Startups, or How to Build the Future”, Crown, 16 Sept 2014 - Business & Economics - 224 pages.
2	Eric Ries “The Lean Startup: How Today’s Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses” published January 1, 2011, Board Book

Referecebooks:

1	C B Rao “India as Global Start-up Hub: Mission with Passion” Notion Press, 2018,
2	Ashlee Vance ,”Elon Musk: Tesla, SpaceX, and the Quest for a Fantastic Future”, Ecco Press, Publish Year: 2015
3	Walter Isaacson “Steve Jobs”, October 1, 2011

Assessment:

Internal Assessment:

Assessment consists of two class tests of 10 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1	Question paper will comprise of total six questions.
2	All question carries equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four question need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Useful Links

1	https://onlinecourses.nptel.ac.in/noc20_mg35/preview .
2	https://www.business-school.ed.ac.uk/msc/entrepreneurship-innovation/overview/learning-outcomes

List of Tutorial:

Tutorial Number	Tutorial Topic
1	Field study of Industries offices in vicinity.
2	Visit to Atal incubation Center.
3	Create Business Model on any project.

Course Code	Course Name	Credits
BVBDCCG 302	Computer Organization and Architectures	4

Course Objectives: The course aims:

1	To conceptualize the basics of organizational and architectural issues of a digital computer.
2	To analyze performance issues in processor and memory design of a digital computer.
3	To understand various data transfer techniques in digital computer.
4	To analyze processor performance improvement using instruction level parallelism.

Course Outcomes: On successful completion, of course, learner/student will be able to:

1	To understand basic structure of computer.
2	To perform computer arithmetic operations.
3	To understand control unit operations.
4	To design memory organization that uses banks for different word size operations.
5	To understand the concept of cache mapping techniques.

Module	Detailed Contents	Hours
1	Overview of Computer Architecture & Organization	8
	1.1 Introduction of Computer Organization and Architecture.	
	1.2 Basic organization of computer and block level description of the functional units, Evolution of Computers, Von Neumann model.	
	1.3 Performance measure of Computer Architecture.	
	1.4 Introduction to buses and connecting I/O devices to CPU and Memory, bus structure	
2	Data Representation and Arithmetic Algorithms:	7
	2.1 Number representation: Binary Data representation, two's complement representation and Floating-point representation. IEEE 754 floating point number representation	
	2.2 Integer Data computation: Addition, Subtraction. Multiplication: Signed multiplication, Booth's algorithm.	
	2.3 Division of integers: Restoring and non-restoring division	
3	Processor Organization and Architecture	8
	3.1 CPU Architecture, Register Organization, Instruction formats, basic instruction cycle. Instruction interpretation and sequencing.	
	3.2 Control Unit: Soft wired (Micro-programmed) and hardwired control unit design methods. Microinstruction sequencing and execution. Micro operations, concepts of nano programming.	

	3.3	Introduction to RISC and CISC architectures and design issues.	
	3.4	Case study on 8085 microprocessor: Features, architecture, pin configuration and addressing modes.	
4	Memory Organization:		8
	4.1	Introduction to Memory and Memory parameters. Classifications of primary and secondary memories. Types of RAM and ROM, Allocation policies, Memory hierarchy and characteristics.	
	4.2	Cache memory: Concept, architecture (L1, L2, L3), mapping techniques. Cache Coherency, Interleaved and Associative memory.	
	4.3	Virtual Memory: Concept, Segmentation and Paging , Page replacement policies	
5	I/O Organization and Peripherals:		7
	5.1	Input/output systems, I/O modules and 8089 IO processor	
	5.2	Types of data transfer techniques: Programmed I/O, Interrupt driven I/O and DMA.	
	5.3	Peripheral Devices: Introduction to peripheral devices, scanner, plotter, joysticks, touch pad.	
6	Introduction to parallel processing systems:		7
	6.1	Introduction to parallel processing concepts	
	6.2	Flynn's classifications	
	6.3	Pipeline processing, instruction pipelining,	
	6.4	Pipeline stages, pipeline hazards.	
Total			45

Text Books:

1	Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGraw-Hill.
2	John P. Hayes, "Computer Architecture and Organization", Third Edition.
3	William Stallings, "Computer Organization and Architecture: Designing for Performance", Eighth Edition, Pearson
4	B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, Tata McGraw-Hill.

References:

1	Dr. M. Usha, T. S. Srikanth, "Computer System Architecture and Organization", First Edition, Wiley-India
2	"Computer Organization" by ISRD Group, Tata McGraw-Hill
3	Ramesh Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085, Penram

Useful Links

1	https://archive.nptel.ac.in/content/storage2/courses/106103068/
2	https://www.javatpoint.com/computer-organization-and-architecture-tutorial

Term Work:

General Instructions:

1	Batch wise tutorials have to be conducted. The number of students per batch will be as per University pattern for practical.
2	Students must be encouraged to write at least 6 class tutorials on the entire syllabus.
3	A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation of 10-15 minutes.
Internal Assessment Test: The assessment consists of two class tests of 20 marks each. The 1st class test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2nd class test has to be conducted (Internal Assessment II) when an additional 35% syllabus is Completed. The duration of each test will be for one hour.	
End Semester Theory Examination:	
1	The question paper will comprise a total of 6 questions, each carrying 20 marks.
2	Out of the 6 questions, 4 questions have to be attempted.
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Credit
BVBDCCG 303	Statistics for Data Science	4

Course Objective: The course aims:	
1	To understand basic statistical foundations for roles of Data Scientist.
2	To develop problem-solving skills.
3	To infer about the population parameters using sample data and perform hypothesis testing.
4	To understand importance and techniques of predicting a relationship between data and determine the goodness of model fit
Course Outcome: On successful completion, of course, learner/student will be able to:	
1	Develop various visualizations of the data in hand.
2	Analyze a real-world problem and solve it with the knowledge gained from sampling and probability distributions.
3	Analyze large data sets and perform data analysis to extract meaningful insights.
4	Develop and test a hypothesis about the population parameters to draw meaningful conclusions.
5	Fit a regression model to data and use it for prediction

Module	Detailed Content	Hours
1	Introduction to Statistics:	
	1.1 Categorical and Quantitative Data, Cross-Sectional and Time Series Data.	8

	1.2	Descriptive Statistics: Tabular and Graphical Summarizing Categorical Data, Summarizing, Quantitative Data, Cross Tabulations and Scatter Diagram. Statistical Inference,	
	1.3	Descriptive Statistics: Numerical Measures: Measures of Location, Measures of Variability, Measures of Distribution Shape, Relative Location, and Detecting Outliers, Box Plot, Measures of Association Between Two Variables	
2		Measures of Central Tendency:	8
	2.1	Mean, Median, Mode Measures of Dispersion: Range, Variance, Standard Deviation	
	2.2	Data Visualization: Histograms, Box Plots, Scatter Plots, introduction to Statistical Software Packages: R, Python	
3		Probability	8
	3.1	Events, Sample Space, Probability Rules	
	3.2	Probability Distributions: Binomial, Poisson, Normal Central Limit Theorem and its Importance in Statistics, Confidence Intervals and Margin of Error	
4		Inferential Statistics	10
	4.1	Hypothesis Testing: Null and Alternative Hypotheses, Type I and II Errors	
	4.2	Parametric Tests: t-Test, ANOVA,	
	4.3	Non-parametric Tests: Chi-Square Test, Correlation and Regression Analysis	
5		Multivariate Analysis and Machine Learning	7
	5.1	Multiple Regression and Logistic Regression	
	5.2	Factor Analysis and Principal Component Analysis	
	5.3	Cluster Analysis and Discriminant Analysis	
6		Advanced Statistical Techniques	4
	6.1	Time Series Analysis: ARIMA Models, Forecasting Bayesian Statistics: Bayes' Theorem	
Total			45

Textbooks:	
1	Mathematics and Statistics for Economics, 2/e, G.S. Monga, Vikas Publishing
2	Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons
3	An Introduction to Probability Theory and its Applications, W. Feller Wiley
4	Engineering Mathematics Veerarajan T. Tata McGraw-Hill
5	A textbook of Engineering Mathematics, N.P. Bali and Manish, Goyal Laxmi Publications
References:	
1	Applied Multivariate Statistical Analysis, Richard A. Johnson, Dean W. Wichern Pearson
2	STATISTICS FOR BUSINESS AND ECONOMICS, 11th Edition, David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, South-Western Cengage Learning
3	Probability and Statistics for Engineering and the Sciences, Jay L. Devore, Cengage Publications.
4	Data Science for Dummies Paperback, Wiley Publications, Lillian Pierson
5	Storytelling with Data: A Data Visualization, Guide for Business Professionals, Wiley Publications, Cole Nussbaumer Knaflic

Assessment:**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1	Question paper will comprise a total of six questions.
2	All question carries equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four questions need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Useful Links

1	https://study.iitm.ac.in/ds/course_pages/BSMA1002.html
2	https://study.iitm.ac.in/ds/course_pages/BSMA1004.html
3	https://onlinecourses.swayam2.ac.in/imb23_mg64/preview

suggested List of Experiments

1	Descriptive Statistics: Given a dataset, Compute and interpret the mean, median, mode, variance, and standard deviation
2	Data Visualization: Generate a histogram, box plot, and scatter plot for a given dataset? What insights can you infer from these visualizations
3	Probability Distributions: Identify whether a given dataset follows a normal distribution? If not, can you determine which distribution it follows
4	Hypothesis Testing: Conduct a t-test on a given dataset? What conclusions can you draw at a 5% significance level
5	Correlation: Compute the correlation between two variables in a dataset? How would you interpret the correlation coefficient
6	Simple Linear Regression: Build a simple linear regression model on a given dataset? How would you evaluate the fit of your model
7	Multiple Linear Regression: Construct a multiple linear regression model on a dataset? How do the results compare with the simple linear regression model
8	Logistic Regression: Implement a logistic regression model on a given dataset? How would you assess the classification performance of your model
9	ANOVA: Perform an Analysis of Variance (ANOVA) on a given dataset? What conclusions can you draw from the ANOVA table
10	Chi-Square Test: Conduct a Chi-Square test of independence on a given dataset? Can you determine if there is a significant relationship between the variables

Course Code:	Course Title	Credit
BVBDCCS301	Python Programming	3

Prerequisite: Programming principles with C

Course Objectives:

- | | |
|---|---|
| 1 | Implementing data types, statement, operators and strings |
| 2 | Implementing OOPs concept in Python |
| 3 | To learn exception & file handling in Python. |
| 4 | Connecting with databases |

Course Outcomes: On successful completion of course, learner will be able to

- | | |
|---|---|
| 1 | Apply the concept of Program structure, Interactive Shell. |
| 2 | To understand Data Structures and Program control flow, |
| 3 | Apply the concept Functions and Modules & Packages for list manipulation and string manipulation. |
| 4 | Understand Classes & Objects for User Defined Data Type, Objects as Instances of Classes. |
| 5 | Test Exception Handling & File Operations for Default Exception and Errors. |
| 6 | Apply the concept of Database, GUI & Turtle Programming. |

Module		Content	Hrs
1		Introduction to Python	8
	1.1	History & need of Python, Application of Python, Advantages of Python, Disadvantages of Python,	
	1.2	Installing Python, Program structure, Interactive Shell, Executable or script files, 1.3 User Interface or IDE Working with Interactive mode, Working with Script mode, 1.4 Python Character Set, Python Tokens, Keywords, Identifiers, Literals, Operators, Variables and Assignments, Input and Output in Python, DataTypes.	
2		Data Structures and Program control flow	8
	2.1	Data Structures: String Manipulation, List Manipulation, Tuples and Dictionaries, Set and Frozenset.	
	2.2	Program Control Flow:	
	2.3	Conditional Statements: if Statement, if-else Statement, if-elif Statement, Nested if Statements, Python Indentation.	
	2.4	Looping and Iteration: For Loop, While Loop, Loop else Statement, Nested Loops, Break and Continue.	
	2.5	Range Function: Introduction to range(), Types of range() function, Use of range() function.	
3		Functions and Modules & Packages	8

	3.1	Built-In Functions: Introduction to Functions, Python Function Types, Structure of Python Functions, E.g. - map, zip, reduce, filter, any, chr, ord, sorted, globals, locals, all, etc.	
	3.2	User Defined Functions: Structure of a Python Program w.r.t. UDF, Types of Functions, Invoking UDF, Flow of Execution, Arguments and Parameters, Default Arguments, Named Arguments, Scope of Variables, Lambda function	
	3.3	Recursion Function: Use of recursion function	
	3.4	Modules & Packages: Importing Modules in Python Programs, Working with Random Modules, E.g. - builtins, os, time, datetime, calendar, sys, etc	
4		Classes & Objects	6
	4.1	Introduction to OOP's: Procedural Vs Modular Programming, Object Oriented Programming, Data Abstraction, Data Hiding, Encapsulation, Modularity, Inheritance, Polymorphism	
	4.2	Classes & Objects: Classes as User Defined Data Type, Objects as Instances of Classes, Creating Class and Objects, Creating Objects By Passing Values, Variables & Methods in a Class	
5		Exception Handling & File Operations	8
	5.1	Exception Handling: Default Exception and Errors, Catching Exceptions, Raise an exception, Try -except statement, Raise, Assert, Finally blocks, User defined exception.	
	5.2	File Operations: opening a file, Reading and Writing Files, Other file tools, Regular Expressions.	
6		Database, GUI	7
	6.1	Database and GUI.	
	6.2	Database: Introduction to MySQL, PYMYSQL Connections, Executing queries, Transactions, Handling error.	
	6.3	GUI Programming: Introduction, Tkinter programming, Tkinter widgets, Frame, Button, Label, Entry	
Total			45

Textbooks:	
1	Dr. R. Nageswara Rao: Core Python Programming, Dreamtech Press Wiley Publication, 2018 2 nd Edition.
2	Zed A. Shaw: Learn Python 3 The Hard Way, Pearson Education, 2017 1 st Edition.
References:	
1	Paul Barry: Head First Python: A Brain-Friendly Guide, Shroff/ O. Reilly, 2016 2 nd Edition.
2	Charles Dierbach: Introduction to Computer Science Using Python: A Computational Problem-Solving Focus, Wiley Publication, 2012 1 st Edition.
Useful Links for E-resources:	
1	https://www.tutorialspoint.com/python/python_basics_syntax.html
2	https://machinelearningmastery.com/machine-learning-in-python-step-by-step/
3	https://towardsdatascience.com/beginners-guide-to-machine-learning-with-python-b9ff35bc9c51
4	https://nptel.ac.in/courses/106106145

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise of total six questions.
2	All question carries equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four question need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lectures hours as mention in the syllabus.

List of Practical/ Experiments:

Sr. No	Topic
1	To implement Python program to check whether the given number is even or not.
2	To implement Python program to convert the temperature in degree centigrade to Fahrenheit
3	Python program to find the area of a triangle whose sides are given
4	To Python program to find out the average of a set of integers
5	Python program to find the product of a set of real numbers
6	To implement Python program to find the circumference and area of a circle with a given radius.
7	Python program to check whether the given integer is a multiple of 5
8	To implement Python program to check whether the given integer is a multiple of both 5 and 7.

9	To implement Python program to find the average of 10 numbers using while loop.
10.	To implement Python program to display the given integer in a reverse manner.
11	To implement Python program to find the geometric mean of n numbers.
12	To implement Python program to find the sum of the digits of an integer using a while loop.
13	To implement Python program to display all the multiples of 3 within the range 10 to 50.

Term Work:

1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments on content of theory and practical of “Software Engineering”
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Oral & Practical exam

	Based on the entire syllabus.
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Course Code	Course Name	Credit
BVBDCCS 302	Database Management Systems	4

Course Objective: The course aims:

1	Students will be able to identify and recall the fundamental concepts, principles, and applications of database systems.
2	Students will be able to interpret and describe the principles of relational database design and the roles of various SQL commands.
3	Students will be able to implement and use ER and Relational data models in database design, and construct queries using SQL.
4	Students will be able study and implement transaction management in a database.

Course Outcome: On successful completion, of course, learner/student will be able to:

1	Describe core concepts of database and model a database management system through ER modeling.
2	Apply knowledge of relational algebra and structured query language to retrieve and manage data from relational database.
3	Demonstrate the use of normalization for database design.
4	Use modern database techniques such as NoSQL.

Module		Detailed Content	Hours
1		Introduction	
	1.1	Database System Applications,	8
	1.2	Purpose of Database Systems, View of Data, Database Languages	
	1.3	Data Models, Database Users and Administrator	
2		Database Design and the E-R Model	8
	2.1	Overview of the Design Process, The Entity-Relationship Model, Constraints, Entity Relationship Diagrams	
	2.2	Reduction to Relational Schemas, Schema Diagrams, Entity-Relationship Design Issues, Extended ER features	
3		Introduction to the Relational Model	8
	3.1	Structure of Relational Databases, Database Schema,	
	3.2	Keys, Relational Algebra, Basic operators of Relational Algebra	
	3.3	Modification of Databases using Relational Algebra, Database Constraints	
4		Structured Query Language	6
	4.1	Overview of the SQL Query Language, SQL Data Definition,	
	4.2	SQL Constraints, Basic Structure of SQL Queries, Additional Basic Operations	
	4.3	DML operations, Set operations, Aggregate Functions, Nested Sub-queries, Joins, views.	

5		Relational Database Design	8
	5.1	Features of Good Relational Designs, Problems with bad design, Decomposition using concept of functional dependencies, Armstrong's axioms	
	5.2	Closure of functional dependency, Closure of attribute	
	5.3	Introduction to process of Normalization and denormalization, Normal Forms- 1NF, 2NF, 3NF, BCNF, Denormalization	
6		Transactions	7
	6.1	What is Transactions? Properties of transaction, Transaction states,	
	6.2	Issues with concurrent executions, Schedules, Serializability- Conflict and View	
Total			45

Textbooks:

- 1 Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", 7th Edition, McGraw Hill Education, 2019.
- 2 Gaurav Vaish, Getting Started with NoSQL, 1st edition, Packt Publication, March 2013
- 3 Brad Daylel, NoSQL with MongoDB in 24 Hours, 1st edition, Sams Teach Yourself, January 2015

References:

- 1 R. Elmasri and S. Navathe," Fundamentals of Database Systems", 7th Edition, Pearson Education, 2017.
- 2 Bob Bryla, Kevin Loney Oracle Database 12C The Complete Reference, 1st edition, Tata McGraw Hill, 2017

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

- 1 Question paper will comprise a total of six questions.
- 2 All question carries equal marks
- 3 Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
- 4 Only Four questions need to be solved.
- 5 In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Useful Links

- 1 <https://www.geeksforgeeks.org/dbms/>
- 2 <https://www.javatpoint.com/dbms-tutorial>
- 3 <https://www.tutorialspoint.com/dbms/index.htm>

Sr	Suggested List of Experiments
1	Explore various fundamental concepts of DBMS and its future prospective. Introduction to the Oracle, mysql.
2	Apply Data Definition language [DDL] on the relational model designed and apply below constraints on the relational model designed. • Primary key • Unique constraint • Not Null constraint • Foreign key • Check constraint The DDL commands to be implemented are • Create • Alter • Drop
3	Apply Data Manipulation language [DML] on the relational model designed and apply certain constraints on the relational model designed. The commands to be implemented are • Select (without where clause) • Delete • Update
4	To design Entity Relationship and relational model for the given case study.
5	Apply DML select statement with where clause, and, or, not, in, between and like clauses and implement built in functions of SQL.
6	To apply order by clause and concept of different types of Joins for solving queries.
7	To implement group by, having clause, aggregate functions for solving queries.
8	To implement sub queries, set operation and views for solving queries.
9	Demonstrate the use of normalization.
10	To study transaction management commands like commit, Rollback.

Course Code	Course Name	Credits
BV-BDCCS 303	Web Development	3

Course Objectives: The course aims:

1	To gain proficiency in HTML5 syntax and semantics, as well as CSS3 for styling and layout, including modern techniques like responsive design and animations.
2	To learn JavaScript basics and DOM manipulation, enabling students to create dynamic and interactive web applications.
3	To understand the role of server-side scripting using PHP and data handling with XML, including database interactions.
4	To familiarize with popular front-end frameworks like React, Angular, and Vue, and understand their benefits and use cases.
5	To understand and utilize XML, including DTD, XML Schema, DOM and SAX parsers, and XSL for data presentation and transformation.
6	To learn how to set up, customize, and manage WordPress blogs, including themes, plugins, and various content management features.

Course Outcomes: On successful completion of course

1	Students will be able to create well-structured HTML5 documents and apply CSS3 for visual design, including advanced features like animations and media queries.
2	Students will demonstrate the ability to write JavaScript code for basic programming tasks, handle events, and manipulate the DOM to create interactive web pages.
3	Students will develop server-side scripts using PHP and interact with databases.
4	Students will be able to set up and develop applications using front-end frameworks like React, manage state, and implement routing.
5	Students will manage data in XML format, utilizing both DOM and SAX parsers.
6	Students will be able to install and configure WordPress, customize themes, use plugins, and create and manage various types of content on a WordPress site.

Module	Detailed Contents	Hours
1	Introduction to Web Development	10
	1.1 Introduction to Internet: World wide web, Internet Addressing ,Browser, URL, Web Server , website , homepage , Domain Name	
	1.2 Software for Web Designing: Notepad/Notepad++,Dreamweaver , Blue Griffon, Net beans, Sea Monkey, Word press, Sublime	

	1.3	HTML5: fundamental syntax, Tables, Lists, Image, HTML5 control elements, Drag and Drop, Audio, Video controls.	
	1.4	CSS3 :Inline, embedded and external style sheets – Rule cascading, Inheritance, Backgrounds, Border Images, Colors, Shadows, Text, Transformations, Transitions, Animation, Basics of Bootstrap.	
2	JavaScript and DOM Manipulation		7
	2.1	JavaScript Basics: Variables, data types, and operators, Functions, loops, and conditionals Event handling	
	2.2	Document Object Model (DOM): DOM tree and manipulation , Selecting and modifying elements, Event listeners and event delegation	
3	PHP		8
	3.1	Introduction to PHP, PHP Programming Techniques (Data types, Operators, Arrays, Loops, Conditional statements, Functions, Regular expressions).	
	3.2	Form Data Handling with PHP, Database connectivity and handling using PHP-MySQL.	
4	Front-End Frameworks and Libraries		10
	4.1	Introduction to Front-End Frameworks: Overview of popular frameworks (React, Angular, Vue), Pros and cons of using frameworks	
	4.2	React Basics: Components, JSX, and props, State and lifecycle methods ,Hooks (useState, useEffect)	
	4.3	Building a Simple React Application: Project setup and tooling , Routing with React Router , State management with Context API or Redux	
5	XML		5
	5.1	XML –DTD (Document Type Definition), XML Schema, Presenting XML, Using XML Parsers: DOM and SAX, XSL-eXtensible Stylesheet Language	
6	WORDPRESS		5
	6.1	What is WordPress?, Installing WordPress ,Themes , WordPress Plug-ins, Theme Customiser , Menus	
	6.2	Menus, Posts ,Widgets, Posts, Creating pages ,Contact Form 7	
Total			45

Textbooks:	
1	Ralph Moseley, M.T. Savliya, “Developing Web Applications”, Willy India, Second Edition, ISBN: 978-81-265-3867-6
2	“Web Technology Black Book”, Dremtech Press, First Edition, 978-7722-997
3	Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition, O'REILLY, 2014.
4	Alex Banks and Eve Porcello, Learning React Functional Web Development with React and Redux, O'REILLY, First Edition
References:	
1	Achyut S Godbole and Atul Kahate, —Web Technologies, Second Edition, Tata McGraw Hill, 2012.
2	Thomas A Powell, Fritz Schneider, —JavaScript: The Complete Reference, Third Edition, Tata McGraw Hill, 2013
3	Steven Holzner —The Complete Reference - PHP, Tata McGraw Hill, 2008

Useful Links	
1	www.w3schools.com
2	https://books.goalkicker.com/ReactJSBook/
3	https://archive.nptel.ac.in/courses/106/105/106105084/

Internal Assessment Test:	
The assessment consists of two class tests of 20 marks each. The 1 st class test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2 nd class test has to be conducted (Internal Assessment II) when an additional 40% syllabus is Completed. The duration of each test will be for one hour.	
End Semester Theory Examination:	
1	The question paper will comprise a total of 6 questions, each carrying 20 marks.
2	Out of the 6 questions, 4 questions have to be attempted.
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Suggested List of Practical/ Experiments:

Practical Number	Practical/ Experiment
1	Design a home page which displays information about your college department using headings, HTML entities and paragraphs
2	Create a web page having two frames, Frame 1 containing links and another with contents of the link. When link is clicked appropriate contents should be displayed on Frame 2.
3	Demonstrate difference between "get" and "post" method of form tag in a form with name and password text fields
4	Design an admission form for any course in your college with text, password fields, drop-down list, check-boxes, radio buttons, submit and reset button etc.
5	Create a HTML form with the use of cascading style sheets.
6	Write a JavaScript program to check whether a given positive number is a multiple of 3.
7	Write a JavaScript program to change the case of a string.(i.e upper case to lower case and vice-versa).
8	Develop and demonstrate a HTML file that includes JavaScript script for taking a number n as input using prompt and display first n Fibonacci numbers in a paragraph.
9	Design HTML form for keeping student record, apply JavaScript validation in it for restriction of mandatory fields, numeric field, email-address field, specific value in a field etc.
10	Create a simple React application that displays the current date and time.
11	Create an Angular application that calculates and displays the area of a triangle based on user input.
12	Create a PHP application to insert and display student records from a MySQL database.
13	Setting Up and Customizing a WordPress Site

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments on content of theory and practical of “Software Engineering”
3	The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Oral & Practical exam	
	Based on the entire syllabus.

Program Structure for First Year Big Database and Cloud Computing

UNIVERSITY OF MUMBAI (With Effect from 2023-2024) Semester IV

Course Code:	Course Title	Credit
BVBDCCG 401	Professional Skill-IV (Aptitude and Logic Building)	4

Prerequisite:

Course Objectives:

1	This course aims to provide an exposure in creating and delivering effective multimedia presentations that,
2	To convey the key points for effective communications
3	Able to analyzing data in spreadsheet and writing a technical report.

Course Outcomes:

1	Understand Programs and Computers
2	Learn how programs and codes operate by using code and scratch.
3	To develop your critical thinking and reasoning skills.
4	The capacity to comprehend searching and sorting
5	Capacity to use formal mathematics to define computer programs (such as recursive functions)
6	Determine the truth value of unquantified phrases by using logical principles to define sets using the list or set builder notation and connecting symbolic laws of logic.

I	Introduction to Computers	Computer Systems, Computer Languages, Software Development, Operating System, Number Systems and their conversion, Crypt arithmetic Problems, Pseudocode and Flowchart	8
II	Introduction to Code and Scratch	Introduction to code (Sequence, if..else and Loops) Design a small code in scratch(animation)	8

III	Critical thinking and logical reasoning	Critical Thinking: What does it mean to think critically? An overview of definition, Computer programming and logical thinking	8
IV	Searching and Sorting Techniques	Searching Techniques: Linear Search, Binary Search Sorting Techniques: Selection, Insertion,	10
V	Quantitative Abilities	Problems on Ages Problems on Profit and Loss Problems on Simple and Compound Interest Problems on Time and Distance	6
VI	Logical Reasoning & Verbal Reasoning	Number Series Alpha Numerical, Letter & Symbol Series Numerical and Alphabet Puzzles Seating Arrangement Para – Jumble, Text Completion	5
Total			45

Textbooks:

1	Computational Thinking, Karl Beecher BCS, The Chartered Institute for IT, 1th Edition,2017
2	Introduction to Algorithm ,Thomas Corman,PHI,3th Edition,2010

References:

1	Think Smarter: Critical Thinking to Improve Problem-Solving and Decision-Making Skills Michael Kallet, Wiley, 2nd Edition, 2014
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Assessment:

Internal Assessment:

Assessment consists of two class tests of 10 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and the second class test when an additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1	Question paper will comprise a total of six questions.
2	All question carries equal marks

3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four questions need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Useful Digital Links	
1	https://www.tutorialspoint.com/basics_of_computers/basics_of_computers_introduction.htm
2	https://plato.stanford.edu/entries/critical-thinking/
3	https://studio.code.org/s/courseb-2020
4	https://scratch.mit.edu/projects/editor/?tutorial=getStarted
5	https://www.careerride.com/mcq/logical-reasoning-quantitative- aptitude-mcq-questions-319.aspx

Suggested List of Experiments	
Sr. No.	Title of Experiment
1	A Case study of comparison of different Computer Languages
2	A case study on different Operating Systems
3	Design Pseudocode and Flowchart for a given problem
4	Perform practical on code (Sequence)
5	Perform practical on code (if..else)
6	Perform practical on code (Loops)
7	Perform different events of scratch(animation)
8	Design an animation in scratch.
9	Problems based on Searching Techniques: Linear Search, Binary Search Sorting Techniques: Selection, Insertion,
10	Problems based on Quantitative Abilities and Logical Reasoning & Verbal Reasoning

Course Code	Course Name	Credit
BV-BDCCG 402	Soft Computing	4

Prerequisite: Probability and Statistics, C++/Java/ Matlab

Course Objectives:

1	To familiarize with soft computing concepts.
2	To introduce the fuzzy logic concepts, fuzzy principles and relations.
3	To Basics of ANN and Learning Algorithms.
4	Ann as function approximation.
5	Genetic Algorithm and its applications to soft computing.
6	Hybrid system usage, application and optimization.

Course Outcomes:

1	List the facts and outline the different process carried out in fuzzy logic, ANN and Genetic Algorithms.
2	Explain the concepts and meta-cognitive of soft computing.
3	Apply Soft computing techniques the solve character recognition, pattern classification, regression and similar problems.
4	Outline facts to identify process/procedures to handle real world problems using soft computing.
5	Evaluate various techniques of soft computing to defend the best working solutions.
6	Design hybrid system to revise the principles of soft computing in various applications.

I	Fuzzy Set Theory	Fuzzy Sets: Basic definition and terminology, Basic concepts of fuzzy sets, Fuzzy set operations, Fuzzy relations: Cardinality of fuzzy relations, operations on fuzzy relations, properties of fuzzy relations, Fuzzy composition Fuzzification and Defuzzification: Features of the membership Functions, Fuzzification, Lambda-Cuts for Fuzzy Sets, Lambda-Cuts for Fuzzy Relations, Defuzzification methods	5
II	Fuzzy Rules, Reasoning, and Inference System	Fuzzy Rules: Fuzzy If-Then Rules, Fuzzy Reasoning Fuzzy Inference System (FIS): Mamdani FIS, Sugeno FIS, Comparison between , Mamdani and Sugeno FIS.	4

III	Neural Network -I	What is a Neural network? Fundamental Concepts, Basic Models of Artificial Neural Networks, Artificial Intelligence and Neural Networks, McCulloch-Pitts Neuron Learning: Error-Correction Learning, Memory based Learning, Hebbian learning, Competitive Learning, Boltzmann Learning Perceptron: Perceptron Learning Rule, Perceptron Learning Algorithm, Perceptron Convergence Theorem, Perceptron learning and Non-separable sets. Rule-Based Approach: Classification, Tests, Rules Artificial Neural Network:	6
IV	Neural Networks -II	Back propagation: Multilayered Network Architecture, Back propagation Algorithm, Practical Consideration in imple Implementing the Back propagation Algorithm. Back propagation and XOR problem. Adaptive resonance Theory: Noise-Saturation Dilemma, Solving the Noise-Saturation Dilemma, Recurrent On-center-Off-surround Networks, Adaptive Resonance Theory I (ART I), Neurophysiological Evidence for ART Mechanism Character Recognition: Introduction, General Algorithm Architecture for Character Recognition:	10
V	Genetic Algorithm	An Introduction to genetic Algorithms: What Are Genetic Algorithms? Robustness of Traditional Optimization and Search Methods, The Goals of Optimization, How Are Genetic Algorithms Different from Traditional Methods?, A Simple Genetic Algorithm Genetic Algorithms at Work. Genetic Algorithms: Mathematical Foundations Who Shall Live and Who Shall Die? The Fundamental Theorem, Schema Processing at Work: An Example by Hand Revisited, The Two-armed and ∞ -armed Bandit Problem, Implementation of a Genetic Algorithm: Data Structures, Reproduction, Crossover, and Mutation, Algorithm for Handwriting Recognition Using GA Generation of Graph, Fitness Function of GA: Deviation between Two Edges, Deviation of a Graph, Crossover: Matching of Points, Generate Adjacency Matrix, Find Paths, Removing and Adding Edges, Generation of Graph.	10
VI	Hybrid Computing	Introduction, Neuro-Fuzzy Hybrid Systems, Adaptive Neuro-Fuzzy Inference System (ANIFS): Introduction, ANFS Architecture, Hybrid Learning Algorithm, ANFIS as a Universal Approximator, Simulation Examples: Two-input Sinc Function and Three Input Nonlinear Function Genetic Neuro-Hybrid Systems: Properties of Genetic Neuro-Hybrid Systems, genetic Algorithm based Back-propagation Network, Advantages of Neuro-Genetic Hybrids, Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems	10

		Genetic Fuzzy Rule based Systems, Advantages of Genetic Fuzzy Hybrids	
Total			45

Textbooks:	
1	1. . S.N. Sivanandan and S.N. Deepa, Principles of Soft Computing, Wiley India, 2007, ISBN: 10: 81-265-1075-7.
2	J.-S. R. Jang, C. –T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing, A Computational Approach to Learning and Machine Intelligence, PHI Learning Private Limited-2014
3	Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004/2007
4	Simon Haykin, Neural Networks A Comprehensive Foundation, Second Edition, Pearson Education-2004
5	David E. Goldberg, Genetic Algorithms, in search, optimization and Machine Learning, Pearson
References:	
1	Anupam Shukla, Ritu Tiwari, Rahul Kala, Real Life Applications of Soft Computing, CRC Press,Taylor & Francis Group, 2010.
2	Genetic Algorithms and Genetic Programming Modern Concepts and Practical Applications © 2009 Michael Affenzeller, Stephan Winkler, Stefan Wagner, and Andreas Beham, CRC Press
3	Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson
<u>Assessment:</u>	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and the second class test when an additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise a total of six questions.
2	All question carries equal marks

3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four questions need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Useful Digital Links	
1	http://www.digimat.in/nptel/courses/video/106105173/L01.html
2	http://www.digimat.in/nptel/courses/video/127105006/L37.html
3	https://www.digimat.in/nptel/courses/video/106105173/L38.html
4	https://www.youtube.com/watch?v=Z_8MpZeMdD4
5	https://www.youtube.com/watch?v=Fs5ZIjp1hUk

Suggested List of Experiments	
Sr. No.	Title of Experiment
1	Implement different fuzzy operations
2	Implement different fuzzy membership functions
3	Implement different fuzzy relations
4	Implement fuzzy controller
5	Implement any supervised learning algorithm
6	Implement an unsupervised Learning algorithm
7	Implement any application using genetic algorithm
8	Case Study on Fuzzy Logic challenges
9	Case Study on Neural Network
10	Mini Project on Fuzzy Logic and Neural Network for Engineering Application

Course Code	Course Name	Credit
BV-BDCCG 403	Information Storage Concept	4

Prerequisite: Database Management Systems, Computer Networks.

Course Objectives:

1	To understands key elements of a data center environment
2	To introduce to Disk Performance
3	To introduce to RAID and intelligence of storage system
4	To understand storage connectivity technologies

Course Outcomes:

1	Explain the key elements of a data center environment.
2	Determine storage design based on application requirements and disk performance.
3	Apply RAID and intelligent storage systems for flexible information-centric strategy.
4	Apply storage connectivity technologies.
5	Analyze network-attached storage and object-based storage. (L4)

I	Introduction to Information Storage Technology:	Review data creation and the amount of data being created and understand the value of data to a business, Challenges in Data Storage and Management, Data Storage Infrastructure. Storage Systems Environment: Components of a Storage System Environment: Disk drive components, Disk Drive Performance, Logical Components	8
II	Data protection	Concept of RAID and its Components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Comparison of Levels. Intelligent Storage Systems: Components, Intelligent Storage Array, High-level architecture and working of an intelligent storage system.	8
III	Introduction to Networked Storage	Evolution of networked storage, Architecture, Overview of FC-SAN, NAS, and IP-SAN. Network-Attached Storage (NAS): Benefits of NAS, Components, Implementations, File Sharing, I/O operations, Performance and Availability.	5

IV	Content Addressed Storage (CAS)	features and Benefits of a CAS. CAS Architecture, Storage and Retrieval, Examples. Storage Virtualization: Forms, Taxonomy, Configuration, Challenges, Types of Storage Virtualizations.	10
V	Information Availability & Monitoring & Managing Datacenter	Information Availability, Business continuity, Failure Analysis, Business impact Analysis, Differentiate between business continuity (BC) and disaster recovery (DR). Disaster Recovery: Backup, Methods, And Technologies, Replication technologies: Local replicas, Technologies, Restore and Restart, Multiple Replicas. Remote Replication. DR in practice	6
VI	Storage Security and Management	Security Framework, Storage security domains, List and analyzes the common threats in each domain, Security Implementations. Managing The Storage Infrastructure: Monitoring the Storage Infrastructure, Storage Management Activities, Challenges and solutions.	8
Total			45

Textbooks:

- | | |
|---|---|
| 1 | G.Somasundaram, A.Shrivastava, —Information Storage and Management: Storing, Managing and Protecting Digital Information in Classic, Virtualized and Cloud Environment, 2 nd Edition, Wiley publication, 2012, Reprint 2016 |
|---|---|

References:

- | | |
|---|---|
| 1 | Nigel Poulton, —Data Storage Networkingll, 1st Edition, Wiley publication, 2014. |
| 2 | Tom Clark, —Storage Virtualization: Technologies for Simplifying Data Storage and Management, 1st Edition, Pearson Education, 2018. |

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and the second class test when an additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

- | | |
|---|---|
| 1 | Question paper will comprise a total of six questions. |
| 2 | All question carries equal marks |
| 3 | Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3) |

4	Only Four questions need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Useful Digital Links	
1	http://www.ictacademy.in/Pages/Information-Storage-and-Management.aspx
2	https://nptel.ac.in/courses/106/108/106108058

Suggested List of Experiments	
Sr. No.	Title of Experiment
1	Case study on development storage drives
2	Case study on HDD, SDD
3	Practical on File sharing and security.
4	Case study on data centers infrastructure
5	Study of RAID technology and their implementation

Course Code	Course Name	Credit
BV-BDCCS 401	Data Mining and Data ware Housing	4

Course Objective: The course aims:	
1	Students will be able to describe and explain the principles, architectures, applications, design, and implementation of data warehousing and data mining.
2	Students will be able to utilize the mathematical foundations of data mining tools in various scenarios.
3	Students will be able to examine and interpret classical models and algorithms in data warehouses and data mining.
4	Students will be able to assess and judge the kinds of patterns that can be discovered by association rule mining, classification, and clustering.
Course Outcome: On successful completion, of course, learner/student will be able to:	
1	Students will be able to articulate the principles, architectures, applications, design, and implementation of data warehousing and data mining.
2	Students will be able to apply the mathematical foundations of data mining tools to solve complex problems.
3	Students will be able to implement and optimize classical models and algorithms in data warehouses and data mining.
4	Students will be able to identify and interpret patterns discovered by association rule mining, classification, and clustering.

Module	Detailed Content	Hours
I	Data Mining Introduction	
	1.1 Data Mining definitions, KDD vs Data Mining, DBMS vs DM, DM Techniques, Issues and Challenges in DM, DM Applications	8
	1.2 Association Rules: What is an Association Rule?, Methods to Discover Association Rules, A Priori Algorithm, Partition Algorithm, FP-Tree Growth Algorithm, Discussion on Different Algorithms, Generalized Association Rule, Association Rules with Item Constraint	
II	Clustering Techniques	8
	2.1 Clustering Paradigms, Partitioning Algorithms, k-Medoid Algorithms, CLARA, CLARANS	
	2.2 Hierarchical Clustering, DBSCAN, CURE, Categorical Clustering Algorithms, STIRR, ROCK,	
III	Decision Trees:	8
	3.1 What is a Decision Tree?, Tree Construction Principle, Best Split, Splitting Indices, Splitting Criteria	

	3.2	Decision Tree Construction Algorithms, CART, ID3, C4.5, Decision Tree Construction with Presorting	
IV		Data Warehouse Fundamentals	10
	4.1	Introduction to Data Warehousing, OLTP Systems vs Data Warehouses, Data Warehouse Development, Planning and Requirements	
	4.2		
V		Data Warehouse Architecture	6
	5.1	Introduction to Data Warehouse Components,	
	5.2	Dimensional Modelling, Data Warehouse Schemas, Extract, Transform and Load (ETL)	
VI		Data Warehouse & OLAP	5
	6.1	Introduction to OLAP, Multidimensional Data	
	6.2	OLAP Architectures, Metadata Management in Data Warehouse	
Total			45

Textbooks:	
1	Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata cGraw – Hill Edition, Tenth Reprint 2007.
2	K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
3	Data Mining Techniques, Arun K Pujari, University Press
4	Data Mining: Concepts and Techniques, 3rd Edition, Jiawei Han, Micheline Kamber, Jian Pe
5	Database Systems: Introduction to Databases and Data Warehouses 1st Edition by NenadJukic ,Susan Vrbsky , SvetlozarNestorov
References:	
1	G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.
2	Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2007.
3	The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, 3rd Edition by Ralph Kimball

Assessment:
Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1	Question paper will comprise of 6 questions, each carrying 20 marks.
2	The students need to solve total 4 questions.
3	Question No.1 will be compulsory and based on entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful Links

1	https://www.tutorialspoint.com/data_mining/index.htm
2	https://www.tutorialspoint.com/market/index.asp
3	https://www.geeksforgeeks.org/data-warehousing/

Suggested List of Experiments

1	Star Schema Design: Construct a star schema for a retail business, incorporating dimensions such as time, product, location, and customer.
2	K-Means Clustering: Utilize a dataset of your choice and implement the k-means clustering algorithm. Analyze and interpret the resulting clusters.
3	ETL Process Design: Given a raw dataset, devise an ETL process to clean, transform, and load the data into a data warehouse.
4	OLAP Operations: Execute various OLAP operations like roll-up, drill-down, slice, and dice on a multi-dimensional dataset.
5	Apriori Algorithm: Implement the Apriori algorithm on a transaction dataset to discover frequent itemsets and generate association rules.
6	Snowflake Schema Design: Develop a snowflake schema for a healthcare system, including dimensions such as time, patient, doctor, and hospital.
7	Naive Bayes Classifier: Apply the Naive Bayes classifier on a dataset of your choice to predict a specific outcome. Evaluate the model's performance.
8	Data Reduction Techniques: Implement data reduction techniques such as aggregation, histogram analysis, and dimensionality reduction on a given dataset.
9	Decision Tree Algorithm: Use the decision tree algorithm on a dataset to classify instances. Interpret the resulting decision tree.
10	OLAP Operations on Data Cube: Perform various OLAP operations on a data cube and interpret the results

Course Code	Course Name	Credit
BV-BDCCS 402	Introduction to Big Data	4

Course Objective: The course aims:	
1	Students will be able to explain the concept of Big Data and the 4 V's of Big Data Applications.
2	Students will be able to identify and describe the trends of computing for Big Data including high-performance computing, grid computing, cloud computing, and mobile computing.
3	Students will be able to understand and use various Big Data tools, techniques, and systems such as HDFS, HBase, NoSQL, MapReduce, Spark, Hive, etc.
4	Students will be able to apply advanced analytical theory and methods such as recommendation, clustering, classification, and regression using Hadoop/Mahout.
Course Outcome: On successful completion, of course, learner/student will be able to:	
1	Students will be able to articulate the principles and applications of Big Data, demonstrating a clear understanding of its attributes and structures.
2	Students will be able to utilize high-performance computing, grid computing, cloud computing, and mobile computing for Big Data processing.
3	Students will be able to effectively use various Big Data tools and systems to analyze and interpret data.
4	Students will be able to apply advanced analytical theory and methods to solve complex problems using Big Data

Module	Detailed Content	Hours
I	Introduction	8
	1.1 Introduction to Big data, benefits, infrastructure requirement	
	1.2 4 V's of Big Data Applications	
II	Trends of Computing for Big Data	8
	2.1 Trends of computing for big data and developments	
	2.2 High-performance Computing (Supercomputers and Clusters), Grid Computing Cloud Computing, Mobile Computing	
III	Big Data for analytics	8
	3.1 Drivers of Big Data, Big Data Attributes,	
	3.2 Data Structures, Big Data Ecosystem, Examples of Data Analytics	
IV	Big Data Tools, Techniques, and Systems	10
	4.1 Exascale Computing, HDFS, HBase, and NoSQL (Document Store, Graph DB, etc.)	

	4.2	MapReduce, Spark, Oozie, Tez, Hive, Pig, etc., Hadoop 1 and Hadoop 2 (YARN)	
V		Advanced Analytical Theory and Methods	6
	5.1	Hadoop/Mahout	
	5.2	Recommendation, Clustering	
	5.3	Classification, Regression	
VI		Advanced Topics	5
	6.1	Big Data Visualization, High-performance Networking for Big Data Movement	
	6.2	Big Data Scientific Workflow Management and Optimization	
Total			45

Textbooks:	
1	Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph. By David Loshin, Elsevier, August 23, 2013
2	Anand Rajaraman and Jeff Ullman “Mining of Massive Datasets”, Cambridge University Press,
3	Alex Holmes “Hadoop in Practice”, Manning Press, Dreamtech Press.
4	Dan McCreary and Ann Kelly “Making Sense of NoSQL” – A guide for managers and the rest of us, Manning Press.
5	Bill Franks , “Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics”, Wiley
References:	
1	Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, “Big Data for Dummies”, Wiley India
2	Michael Minelli, Michele Chambers, Ambiga Dhiraj, “Big Data Big Analytics: Emerging Business Intelligence And Analytic Trends For Today's Businesses”, Wiley India
3	Phil Simon, “Too Big To Ignore: The Business Case For Big Data”, Wiley India
4	Paul Zikopoulos, Chris Eaton, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data’, McGraw Hill Education.
5	Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley India.

Assessment:	
Internal Assessment:	
Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed. Duration of each test shall be one hour.	
End Semester Theory Examination:	
1	Question paper will comprise of 6 questions, each carrying 20 marks.

2	The students need to solve total 4 questions.
3	Question No.1 will be compulsory and based on entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful Links

1	https://www.analyticsvidhya.com/blog/2014/05/hadoop-simplified/
2	https://www.analyticsvidhya.com/blog/2014/05/introduction-mapreduce/
3	https://www.tutorialspoint.com/big_data_analytics/index.htm

Suggested List of Experiments

1	Study of Hadoop ecosystem
2	Two programming exercises on Hadoop
3	Two programming exercises in No SQL
4	Implementing simple algorithms in Map- Reduce (3) - Matrix multiplication,
5	Aggregates, joins, sorting, searching etc.
6	Implementing any one Frequent Itemset algorithm using Map-Reduce
7	Implementing any one Clustering algorithm using Map-Reduce
8	Implementing any one data streaming algorithm using Map-Reduce
9	Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web) a) Twitter data analysis b) Fraud Detection c) Text Mining etc.

Course Code	Course Name	Credit
BV-BDCCS 403	Network Security & Cryptography	4

Prerequisite: Computer Network	
Course Objectives:	
1	To understand Security Trends And Cryptography Concepts.
2	To know the Symmetric Key Cryptography and Asymmetric Key Cryptography
3	To understand Authentication And system security.
Course Outcomes:	
1	Understand Security Trends And Concepts.
2	Explore Classical And Modern Cryptography.
3	Master the Mathematics Of Symmetric Key Cryptography.
4	Understand Asymmetric Key Cryptography.
5	Understand Authentication And Network Access Control.

I	Introduction	Security trends – Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies – Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.	10
II	Symmetric Key Cryptography	MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures – Modular arithmetic-Euclid's algorithm- Congruence and matrices -Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard – RC4 –Key distribution.	08
III	Public Key Cryptography	MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing –Factorization – Euler's totient function, Fermat's and Euler's Theorem – Chinese Remainder Theorem – Exponentiation and logarithm – ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman	12

		key exchange -ElGamal cryptosystem – Elliptic curve arithmetic- Elliptic curve cryptography.	
IV	Message Authentication And Integrity	Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications – Kerberos, X.509	8
V	Network Security	Network Access Control: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control Electronic Mail security – PGP, S/MIME – IP security – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.	10
VI	Advance Topics	Blockchains, Cloud Security and IoT security.	2
Total			45

Textbooks:

- | | |
|---|---|
| 1 | Cryptography and Network Security Principles And Practice William Stallings, Pearson Education, Eighth Edition. |
|---|---|

References:

- | | |
|---|--|
| 1 | Cryptography and Network Security ,Behrouz A Forouzan, Debdeep Mukhopadhyay ,McGrawHill ,3rd Edition, 2015 |
| 2 | Bruce Schneier, “Applied Cryptography”, John Wiley & Sons Inc, 2001 |
| 3 | Maiwald, “Fundamentals of Network Security”, Wiley Student Edition, 2006 |
| 4 | Charles B. Pfleeger and Shari Lawrence Pfleeger, “Security in Computing”, 3rd Edition, Pearson Education, 2003 |
| 5 | |

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and the second class test when an additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1	Question paper will comprise a total of six questions.
2	All question carries equal marks
3	Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4	Only Four questions need to be solved.
5	In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Useful Digital Links	
1	https://www.youtube.com/watch?v=rA_ZmWPormM
2	https://youtu.be/C7vmouDOJYM

Suggested List of Experiments	
Sr. No.	Title of Experiment
1	Simulate Buffer overflow attack using Splint
2	To implement a program in java for password cracking using Brute Force.
3	Implementation of Caesar cipher
4	Implementation of Playfair cipher
5	Implement RSA algorithm.
6	Implement Diffie Hellman Algorithm
7	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, ns lookup to gather information about networks and domain registrars.
8	Study of packet sniffer tools : wireshark, :
	1. Download and install wireshark and capture icmp, tcp, and http packets in promiscuous mode.
	2. Explore how the packets can be traced based on different filters..

Offg. Associate Dean
Dr. Deven Shah
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