

University of Mumbai



AAMS_UGS /ICC/2024-25/170

CIRCULAR:-

Sub :- B.Voc (Big Database Cloud Computing).

All the Principals of the Affiliated Colleges, the Heads of the University Departments and Directors of the recognized Institutions in Faculty of **Science & Technology** are hereby informed that the recommendations passed by the Board of Deans at its meeting held on **27th October, 2023** vide item No. **6.13 (N)** have been accepted by the Academic Council at its meeting held on **1st November, 2023**, vide item No. **6.13 (N)** and subsequently approved by the Management Council at its meeting held on **20th November, 2023** vide item No. **7** and that in accordance therewith, in exercise of the powers conferred upon the Management Council under Section 74(4) of the Maharashtra Public Universities Act, 2016 (Mah. Act No. VI of 2017) the Ordinance **6882 & 6883** Regulations **9713 & 9714** and the syllabus of **B.Voc (Big Database Cloud Computing) (Sem I to II) (CBCS)** has been introduced and the same have been brought into force with effect from the academic year **2023-24**, accordingly.

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

MUMBAI – 400 032
30th September, 2024


(Dr. Prasad Karande)
REGISTRAR

A.C/6.13 (N)/1/11/2023.
M.C/7/20/11/2023.

Copy forwarded with Compliments for information to:-

- 1) The Chairman, Board of Deans
- 2) The Dean, Faculty of Science & Technology,
- 3) The Chairman, Board of Studies,
- 4) The Director, Board of Examinations and Evaluation,
- 5) The Director, Board of Students Development,
- 6) The Director, Department of Information & Communication Technology,
- 7) The Co-ordinator, MKCL.

Copy forwarded for information and necessary action :-	
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
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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
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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 :-	
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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
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6	The Director, Department of Information & Communication Technology, director.dict@mu.ac.in

University of Mumbai



Syllabus for B. Voc. (Big Database and Cloud Computing)

Semester – I & II

Choice Based Credit System

(With effect from the academic year 2023–2024)

Progresively

University of Mumbai



Syllabus for Approval

Sr. No.	Heading	Particulars
1	O: <u>6882</u> Title of Course	B.Voc. (Big Database and Cloud Computing)
2	O: <u>6883</u> Eligibility	HSC or equivalent from any recognized board (Science, Commerce and Arts Stream) There is no age bar for admission in B.Voc. under NSQF
3	R: <u>9713</u> Standards of Passing	40%
4	Ordinance / Regulations (if any)	
5	No. of years/Semesters R : <u>9714</u>	3 years / 6 semesters
6	Level	Under Graduation
7	Pattern	Semester
8	Status	New
9	To be implemented from Academic Year	With effect from Academic Year: 2023-2024


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


Dr. Shivram Garje
Offg. Dean
Faculty of Science and Technology

Preamble

As per AICTE, Vocational Education can be defined as the education based on occupation and employment. It involves various practical trainings. It may be referred as technical education because the trainee directly develops expertise in a particular group of skills and techniques. Vocational Education prepares individuals for job, makes them perform better by honouring their skills, thus specializing them at their own Level. Vocational education provides an intensive training and certification Programme and support the youth in gaining appropriate employment, becoming entrepreneurs and creating appropriate knowledge.

The National Skills Qualifications Framework (NSQF) is a competency-based framework that organizes all qualifications according to a series of Levels of knowledge, skills and aptitude. These Levels, graded from one to ten, are defined in terms of learning outcomes which the learners must possess regardless of whether they are obtained through formal, Non-Formal or informal learning.

The curriculum in each of the years of the Program would be a suitable mix of general education and skill development components. The General Education Component shall have 40% of the total credits and balance 60% credits will be of Skill Component or as amended by the MoE/ Ministry from time to time.

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

Dean
Faculty of Science and Technology
University of Mumbai

Program Structure for First Year B.Voc. 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	12	2	2	12	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	12	18	--	9	9	--	18	
Grand Total		24	20	2	21	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 B.Voc. Big Database and Cloud Computing
UNIVERSITY OF MUMBAI (With Effect from 2023-2024)
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	12	2	2	12	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	12	18	--	9	9	--	18	
Grand Total		24	20	2	21	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 B.Voc. 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	12	2	2	12	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	12	18	--	9	9	--	18	
Grand Total		24	20	2	21	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 B.Voc. 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	12	2	2	12	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	12	18	--	9	9	--	18	
Grand Total		24	20	2	21	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 B.Voc. 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	12	2	2	12	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	12	18	--	9	9	--	18	
Grand Total		24	20	2	21	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

*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 B.Voc. 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	12	2	2	12	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	12	18	--	9	9	--	18	
Grand Total		24	20	2	21	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

*Should be conducted batch wise and

indicates practical and oral marks includes report and presentation

Course Code	Course Name	Credits
BV-BDCCG 101	Communication Skills	4

Course Objectives: The course aims :

1	To demonstrate the fundamental concepts of communication.
2	To encourage active listening with focus.
3	To develop fluent speaking skills in social, academic and professional situations.
4	To train in reading strategies for comprehending academic and business correspondence.
5	To promote effective writing skills in business, technology and academic areas
6	To inculcate confident personality traits along with grooming and social etiquettes in technological society.

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

1	Learn & understand basics of communication
2	Develop four skills: listening , reading writing and speaking of language
3	Improve verbal ability in English both in terms of fluency and clarity.
4	Use effective reading skills for fast understanding of context
5	Develop academic , professional and technical writing Skills
6	Create an impressive content using ICT Tools

Module No.	Detailed Contents	Hrs.
1	Basics of Communication	10
	Definition, Meaning & Concept, objectives of communication, Elements of communication, Process of communication, Barriers to communication Methods of communication (Verbal & Non- verbal) , Body language & gestures, Types of Listening	
2	Spoken English & English language	4
	i) Basic Grammar (ii) Noun, Pronoun, Adjective, Verb Tenses (iii) Preposition, Articles, Conjunction, Punctuation (iv) Vocabulary, (v) Spellings, (vi) Grammar, (vii) Sentence Structure, (viii) Synonyms, Antonyms, (ix) Sentence Construction (x) Introduction to everyday communication	
3	Reading Skills	

	Summarization and Comprehension: Passages to test the analytical skills and expression MCQ, Summary and introduction to graphic organizers.	4
4	Writing Skills (Part-I)	6
	● Picture Composition ● Notice Writing ● Memos ● Letter writing ● Technical Writing (Definition , Instruction . Process/ Procedure)	
5	Digital Content Creation	4
	Information Communication Technology (ICT) enabled Communication media: E-mail, Blog and Website.	

<u>References:</u>	
1	Communication Skills Sanjay Kumar & Pushp Lata Oxford University Press.
2	Technical Communication: Principles and practice. Raman, M., & Sharma, S. Oxford University Press.
3	Communication Skills for Engineers Laxminarayanan K.R & Murugavel .T. Sitech Publication
4	Business Communication Raymond V Lesikar, Flatley Marie E, Rentz Kathryn, Pande Neeraja McGraw- hill

Useful Links:

Sr. No.	URL
1	https://www.researchgate.net/publication/323794732_Barriers_to_Effective_Communication
2	https://nptel.ac.in/courses/109/104/109104031
4	https://www.academia.edu/42203605/Letter_Writing_PDF
5	https://intensiveintervention.org/sites/default/files/GraphicOrganizersPart4-508.pdf

Course Code	Course Name	Credits
BV-BDCCG 102	Applied Mathematics	4

Course Objectives: The course aims:

1	To learn the concepts of Set theory and counting principles.
2	To understand the concept of Functions and define the recursive functions.
3	To understand the concept of vector spaces used in the field of engineering problems.
4	To understand the concept of linear independence of vectors over a field, and the dimension of a vector space.
5	To understand the concept of Singular value decomposition.
6	To understand the Matrix algebra engineering problems.

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

1	Apply the Set theory and counting principles.
2	Apply the Relation concepts and functions.
3	Apply the concept of vector spaces and orthogonalization process in Engineering Problems.
4	Use the concept of dimension in finding the rank of a matrix.
5	Using the concept of Singular value decomposition is a very useful tool in various Engineering applications.
6	Apply the concepts of eigenvalues and eigenvectors in engineering problems

Module	Detailed Contents	Hours
1	Set theory	8
	1.1 Definition of Sets, universal sets, subsets, Venn-Euler Diagrams, Operation on sets, complement of sets, De. Morgan's law.	
	1.2 Power set, Product of two or more sets, Equivalence relations, Partitions of sets with examples	

	1.3	Countable and Uncountable sets.	
	1.4	Counting principles: Pigeonhole principle, Principle of inclusion and exclusion, derangements.	
2	Relation and Functions		7
	2.1	Relation: Definition, types of relation, composition of relations, pictorial representation of relation (Digraphs), properties of relation, partial ordering relation. Operations on relations, and Closures.	
	2.2	Function: Definition and types of function, composition of functions, invertible functions. Recursive and recursively defined functions, Generating Functions.	
3	Vectors		8
	3.1	Vectors in n-dimensional vector space, norm, dot product, The Cauchy Schwarz inequality (without proof) and Unit vector.	
	3.2	Linear span of a set, linear combination, linear independent and dependent subsets.	
	3.3	Orthogonal projection, Orthonormal basis, Gram-Schmidt orthogonalization process for vectors.	
	3.4	Vector spaces over real field, and subspaces	
4	Linear algebra-I		8
	4.1	Basis: Coordinate systems, Basis, Unique representation, Change of basis and standard properties.	
	4.2	Dimension: Dimension and rank, column rank, and row rank	
	4.3	Linear transformations, properties, matrix of a linear transformation, change of basis, range and kernel.	
5	Linear algebra-II		7
	5.1	Singular Value Decomposition (SVD).	
	5.2	The adjoint of a linear operator.	
	5.3	Normal and Self adjoint operators.	
	5.4	Orthogonal projections and Spectral theorem.	
6	Eigenvalues and Eigenvectors		7
	6.1	Eigenvalues and Eigenvectors: Characteristic Polynomials of degree 2 and 3	
	6.2	Eigenvalues and eigenvectors, Properties of eigenvalues and eigenvectors,	
	6.3	Cayley–Hamilton Theorem (without proof), verification and reduction of higher degree polynomials.	
	6.4	Similarity of matrices, diagonalizable and non-diagonalizable matrices.	

References:	
1	Elements of Discrete Mathematics. L. Liu and D. P. Mohapatra, McGraw Hill
2	Linear algebra ,K. Hoffmann and R. A. Kunze, PHI Learning
3	Linear Algebra, Stephen H Friedberg, Eastern Economic Edition
4	Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers
5	Elements of discrete Mathematics. L. Liu and D. P. Mohapatra, Tata McGraw-Hill.

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/problem solving of 10-15 minutes. This will be considered as a mini project in Engineering Mathematics. This project will be graded out of 10 marks depending on the performance of the students.
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 2 nd 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	Question 1, based on the entire syllabus, will have 4 sub-questions of 5 marks each and is compulsory.
4	Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
5	Each sub-question in (4) will be from different modules of the syllabus.
6	Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.

Useful Links	
1	https://nptel.ac.in/courses/111105123/
2	https://www.analyticsvidhya.com/blog/2017/02/introductory-guide-on-linear-programming-explained-in-simple-english/
3	https://u-aizu.ac.jp/~qf-zhao/AI/AI.html
4	Math for Machine Learning & AI (Artificial Intelligence) Udemy
5	Vector Space - II - Vector Space Coursera

Suggested List of Tutorials:

Sr. No.	Topic

1	Tutorial on Set theory
2	Tutorial on Principle of Inclusion and Exclusion
3	Tutorial on Pigeonhole Principle
4	Tutorial on Relation
5	Tutorial on Functions
6	Tutorial on system of linear algebraic equations
7	Tutorial on Caley Hamilton theorem
8	Tutorial on diagonalization of matrix
9	Tutorial on Gram-Schmidt orthogonalization
10	Tutorial on vector space and subspace
11	Tutorial on linear dependence and independence of vectors
12	Tutorial on basis and dimensions of vector space
13	Tutorial on linear transformation and its matrix
14	Tutorial on Singular Value Decomposition
15	Tutorial on normal, adjoint and self-adjoint operators

Course Code	Course Name	Credits
BV-BDCCG 103	Object Oriented Programming – C++	4

Pre-requisite: Basic Mathematics

Course Objectives: The course aims:

- | | |
|---|---|
| 1 | To understand the principles of Object Oriented Programming (OOP) language. |
| 2 | To understand object-oriented concepts such as data abstraction, encapsulation, inheritance and polymorphism. |
| 3 | To learn the object-oriented paradigm in program design. |
| 4 | To develop programming using OOP constructs |

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

- | | |
|---|--|
| 1 | Describe the basic principles of OOP. |
| 2 | Apply OOP principles for classes and objects. |
| 3 | Develop programming applications using Inheritance. |
| 4 | Implement different programming applications using Polymorphism. |
| 5 | Analyze the strength of OOP using Exception handling. |
| 6 | Implement file handling operations of OOP. |

Module	Detailed Contents	Hours
1	Introduction to Object Oriented Language	6
	1.1 Object Oriented Methodology: Introduction, Advantages and Disadvantages of Procedure Oriented Languages, what is Object Oriented? What is Object Oriented Development? Object Oriented Themes, Benefits and Application of OOPS. Principles of OOPS: OOPS Paradigm, Basic Concepts of OOPS: Objects, Classes, Data Abstraction and Data Encapsulation, Inheritance, Polymorphism, Dynamic Binding, Message Passing	
2	Classes and Objects	6
	2.1 Classes and Objects: Simple classes (Class specification, class members accessing), Defining member functions, passing object as an argument, Returning object from functions, friend classes, Pointer to object, Array of pointer to object	
	2.2 Constructors and Destructors: Introduction, Default Constructor, Parameterized Constructor and examples, Destructors	
3	Inheritance	5
	3.1 Program development using Inheritance: Introduction, understanding inheritance, Advantages provided by inheritance, choosing the access specifier, Derived class declaration, derived class constructors, class hierarchies, multiple inheritance, multilevel inheritance, containership, hybrid inheritance.	
4	Polymorphism	6

	4.1	Polymorphism: Concept of function overloading, overloaded operators, overloading unary and binary operators, overloading comparison operator, overloading arithmetic assignment operator, Data Conversion between objects and basic types,	
	4.2	Virtual Functions: Introduction and need, Pure Virtual Functions, static Functions, this Pointer, abstract classes, virtual destructors	
5	Exception Handling		8
	5.1	Exception Handling: Introduction, Exception Handling Mechanism, Concept of throw & catch with example	
6	File Handling		8
		Templates: Introduction, Function Template and examples, Class Template and examples. Working with Files: Introduction, File Operations, Various File Modes, File Pointer and their Manipulation,	

Textbooks:

1	Let Us C++ , Yashavant Kanetkar, BPB publications
2	Object Oriented Programming with C++, E. Balagurusamy, Tata McGraw Hill
3	The C++ Programming language, Bjarne Stroustrup, Pearson Education

References:

1	Effective Modern C++, Scott Meyers, SPD
2	Mastering C++, K R Venugopal, Rajkumar Buyya, T Ravishankar, Tata McGraw Hill
3	

Assessment:

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 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	Question 1, based on the entire syllabus, will have 4 sub-questions of 5 marks each and is compulsory.
4	Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
5	Each sub-question in (4) will be from different modules of the syllabus.
6	Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.

Useful Links	
1	www.tutorialspoint.org, https://www.tutorialspoint.com/cplusplus/index.htm
2	www.javatpoint.com, https://www.javatpoint.com/cpp-tutorial ,
3	www.w3schools.in, https://www.w3schools.com/cpp

Course Code	Course Name	Credit
BV-BDCCS 101	Data Structures and Algorithm	4

Course Objective: The course aims:	
1	To understand the need and significance of Data structures as a computer Professional.
2	To teach concept and implementation of linear and Nonlinear data structures.
3	To analyze various data structures and select the appropriate one to solve a specific real-world problem.
4	To introduce various techniques for representation of the data in the real world.
5	To teach various searching techniques.
Course Outcome: On successful completion, of course, learner/student will be able to:	
1	Implement Linear and Non-Linear data structures.
2	Handle various operations like searching, insertion, deletion and traversals on various data structures.
3	Explain various data structures, related terminologies and its types.
4	Choose appropriate data structure and apply it to solve problems in various domains.
5	Analyze and Implement appropriate searching techniques for a given problem.
6	Demonstrate the ability to analyze, design, apply and use data structures to solve engineering problems and evaluate their solutions

Module	Detailed Content	Hours
1	Introduction to Data Structures	5
	1.1 Introduction to Data Structures, Concept of ADT, Types of Data Structures- Linear and Nonlinear, Operations on Data Structures.	
2	Stack and Queues	8
	2.1 Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack-Well form-ness of Parenthesis, Infix to Postfix	
	2.2 Conversion and Postfix Evaluation, Recursion.	
	2.3 Introduction, ADT of Queue, Operations on Queue, Array Implementation of	
3	Linked List	6
	3.1 Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on Singly Linked List and Doubly Linked List, Stack and Queue using Singly Linked List, Singly Linked List Application-Polynomial Representation and Addition.	
4	Trees	6
	4.1 Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree, Applications of Binary Tree-Expression Tree, Huffman Encoding,	

		Search Trees-AVL, rotations in AVL Tree, operations on AVL Tree, Introduction of B Tree, B+ Tree.	
5		Graphs	6
	5.1	Introduction, Graph Terminologies, Representation of Graph, Graph Traversals-	
	5.2	Depth First Search (DFS) and Breadth First Search (BFS), Graph Application-	
		Topological Sorting's	
6		Searching Techniques	
	6.1	Linear Search, Binary Search, Hashing-Concept, Hash Functions, Collision resolution Techniques	

Textbooks:

1	Data Structures Using C , “Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein,” Pearson Publication.
2	Data Structures using C, “Reema Thareja” Oxford Press
3	Introduction to Data Structure and Its Applications, “Jean Paul Tremblay, P. G. Sorenson” McGraw-Hill Higher Education
4	Data Structure Using C, “E. Balagurusamy”, Tata McGraw Hill

References:

1	Andrew S. Tanenbaum, “Structured Computer Organization”, Pearson Publication.
2	B. Govindarajalu, “Computer Architecture and Organization”, McGraw-Hill Publication.
3	Malvino, “Digital computer Electronics”, McGraw-Hill Publication, 3 rd Edition.
4	Smruti Ranjan Sarangi, “Computer Organization and Architecture”, McGraw-Hill Publication.

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.classcentral.com/course/swayam-computer-organization-and-architecture-a-pedagogical-aspect-9824
2	https://nptel.ac.in/courses/106/103/106103068/
3	https://www.coursera.org/learn/comparch
4	https://www.edx.org/learn/computer-architecture

Course Code	Course Name	Credits
BV-BDCCS 102	Computer Network	4

Course Objectives: The course aimed:

- | | |
|---|--|
| 1 | To introduce concepts and fundamentals of data communication and computer networks. |
| 2 | To explore the inter-working of various layers of OSI. |
| 3 | To explore the issues and challenges of protocols design while delving into TCP/IP protocol suite. |
| 4 | To assess the strengths and weaknesses of various routing algorithms. |
| 5 | To understand various transport layer and application layer protocols. |

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

- | | |
|---|---|
| 1 | Demonstrate the concepts of data communication at physical layer and compare ISO - OSI model with TCP/IP model. |
| 2 | Explore different design issues at data link layer. |
| 3 | Design the network using IP addressing and sub netting / super netting schemes. |
| 4 | Analyze transport layer protocols and congestion control algorithms. |
| 5 | Explore protocols at application layer |

Module	Detailed Contents	Hours
1	The Intel Microprocessors 8086 Architecture	8
	1.1 8086CPU Architecture,	
	1.2 Programmer's Model	
	1.3 Functional Pin Diagram	
	1.4 Memory Segmentation	
	1.5 Banking in 8086	
	1.6 Demultiplexing of Address/Data bus	
	1.7 Functioning of 8086 in Minimum mode and Maximum mode	
	1.8 Timing diagrams for Read and Write operations in minimum and maximum mode	
	1.9 Interrupt structure and its servicing	
2	Instruction Set and Programming	6
	2.1 Addressing Modes	
	2.2 Instruction set-Data Transfer Instructions, String Instructions, Logical Instructions, Arithmetic Instructions, Transfer of Control Instructions, Processor Control Instructions	
	2.3 Assembler Directives and Assembly Language Programming, Macros, Procedures	
3	Memory and Peripherals interfacing	8
	3.1 Memory Interfacing - RAM and ROM Decoding Techniques – Partial and Absolute	
	3.2 8255-PPI-Block diagram, CWR, operating modes, interfacing with 8086.	
	3.3 8257-DMAC-Block diagram, DMA operations and transfer modes.	
	3.4 Programmable Interrupt Controller 8259-Block Diagram, Interfacing the 8259 in single and cascaded mode.	

4	Intel 80386DX Processor		7
	4.1	Architecture of 80386 microprocessor	
	4.2	80386 registers—General purpose Registers, EFLAGS and Control	

		registers	
	4.3	Real mode, Protected mode, virtual 8086 mode	
	4.4	80386 memory management in Protected Mode – Descriptors and selectors, descriptor tables, the memory paging mechanism	
5	Pentium Processor		6
	5.1	Pentium Architecture	
	5.2	Superscalar Operation,	
	5.3	Integer & Floating-Point Pipeline Stages,	
	5.4	Branch Prediction Logic,	
	5.5	Cache Organization and	
	5.6	MESI protocol	
6	Pentium 4		4
	6.1	Comparative study of 8086, 80386, Pentium I, Pentium II and Pentium III	
	6.2	Pentium 4: Net burst micro architecture.	
	6.3	Instruction translation look aside buffer and branch prediction	
	6.4	Hyper threading technology and its use in Pentium 4	

Textbooks:

1	John Uffenbeck, “8086/8088 family: Design Programming and Interfacing”, PHI.
2	Yu-Cheng Liu, Glenn A. Gibson, “Microcomputer System: The 8086/8088 Family, Architecture, Programming and Design”, Prentice Hall
3	Walter A. Triebel, “The 80386DX Microprocessor: hardware, Software and Interfacing”, Prentice Hall
4	Tom Shanley and Don Anderson, “Pentium Processor System Architecture”, Addison-Wesley.
5	K. M. Bhurchandani and A. K. Ray, “Advanced Microprocessors and Peripherals”, McGraw Hill

References:

1	Barry B. Brey, “Intel Microprocessors”, 8 th Edition, Pearson Education India
2	Douglas Hall, “Microprocessor and Interfacing”, Tata McGraw Hill.
3	Intel Manual
4	Peter Abel, “IBM PC Assembly language and Programming”, 5 th Edition, PHI
5	James Antonakons, “The Pentium Microprocessor”, Pearson Education

Assessment:	
Internal Assessment Test:	
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://swayam.gov.in/nd1_noc20_ee11/preview
2	https://nptel.ac.in/courses/108/105/108105102/
3	https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894
4	https://www.mooc-list.com/tags/microprocessors

Course Code	Course Name	Credit
BV-BDCCS 103	Operating System	04

Course Objectives: The Course aimed:

- | | |
|---|--|
| 1 | 1. To introduce basic concepts and functions of operating systems. |
| 2 | 2. To understand the concept of process, thread and resource management. |
| 3 | 3. To understand the concepts of process synchronization and deadlock. |
| 4 | 4. To understand various Memory, I/O and File management techniques. |

Course Outcome:

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

- | | |
|---|--|
| 1 | Understand the objectives, functions and structure of OS |
| 2 | Analyze the concept of process management and evaluate performance of process scheduling Algorithms. |
| 3 | Understand and apply the concepts of synchronization and deadlocks |
| 4 | Evaluate performance of Memory allocation and replacement policies |
| 5 | Understand the concepts of file management. |
| | Apply concepts of I/O management and analyze techniques of disk scheduling. |

Module	Detailed Content		Hours
1	Operating system Overview		4
	1.1	Introduction, Objectives, Functions and Evolution of Operating System	
	1.2	Operating system structures: Layered, Monolithic and Microkernel	
	1.3	Linux Kernel, Shell and System Calls	
2	Process and Process Scheduling		9
	2.1	Concept of a Process, Process States, Process Description, Process Control Block.	
	2.2	Uniprocessor Scheduling-Types: Preemptive and Non-preemptive scheduling algorithms (FCFS, SJF, SRTN, Priority, RR)	
	2.3	Threads: Definition and Types, Concept of Multithreading	
3	Process Synchronization and Deadlocks		9
	3.1	Concurrency: Principles of Concurrency, Inter-Process Communication, Process Synchronization.	
	3.2	Mutual Exclusion: Requirements, Hardware Support (TSL), Operating System Support (Semaphores), Producer and Consumer problem.	

	3.3	Principles of Deadlock: Conditions and Resource, Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm, Deadlock Detection and Recovery, Dining Philosophers Problem.	
4	Memory Management		9
	4.1	Memory Management Requirements, Memory Partitioning: Fixed, Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Paging and Segmentation, TLB	
	4.2	Virtual Memory: Demand Paging, Page Replacement Strategies: FIFO, Optimal, LRU, Thrashing	
5	File Management		4
	5.1	Overview, File Organization and Access, File Directories, File Sharing	
6	I/O management		4
	6.1	I/O devices, Organization of the I/O Function, Disk Organization, I/O Management and Disk Scheduling: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK.	

Textbooks:

1	William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8 th Edition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918.
2	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons, Inc., 9 th Edition, 2016, ISBN 978-81-265-5427-0

References:

1	Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3 rd Edition
2	Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3 rd Edition.
3	Maurice J. Bach, "Design of UNIX Operating System", PHI
4	Sumitabha Das, "UNIX: Concepts and Applications", McGraw Hill, 4 th Edition

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://swayam.gov.in/nd1_noc19_cs50/preview
2	https://nptel.ac.in/courses/117/106/117106113/
3	https://www.classcentral.com/course/swayam-introduction-to-operating-systems-6559

Course Code	Lab Name	Credits
BV-BDCCG 103	Object oriented programming-C++ Lab	1

Suggested List of Practical/ Experiments:

Practical Number	Practical/ Experiment on C++ program:
1	Write a Program to design a class having a static member function named <i>showcount ()</i> which has the property of displaying the number of objects created of the class.
2	Write a Program using class to process Shopping List for a Departmental Store. The list includes details such as the Code No and Price of each item and performs the operations like Adding, Deleting Items to the list and Printing the Total value of an Order.
3	Write a Program which creates & uses <i>array of object of a class</i> . (For eg. implementing the list of Managers of a Company having details such as Name, Age, etc...).
4	Write a Program to find Maximum out of Two Numbers using <i>Friend function</i> . <i>Note: Here one number is a member of one class and the other number is a member of some other class.</i>
5	Write a Program to swap private data members of classes named as <i>class_1, class_2</i> using friend function.
6	Write a Program to design a class complex to represent complex numbers. The complex class should use an external function (use it as a friend function) to add two complex numbers. The function should return an object of type complex representing the sum of two complex numbers.
7	Write a Program using a copy <i>constructor</i> to copy data of an object to another object.
8	Write a Program to allocate memory dynamically for an object of a given class using the class's constructor.
9	Write a Program to design a class to represent a matrix. The class should have the functionality to insert and retrieve the elements of the matrix.
10	Write a program to design a class representing complex numbers and having the functionality of performing addition & multiplication of two complex numbers using operator overloading.
11	Write a program for developing a matrix class which can handle integer matrices of different dimensions. Also overload the operator for addition, multiplication & comparison of matrices.
12	Write a C++ program to use pointers for both base and derived classes and call the member function. Use Virtual keyword

Course Code	Lab Name	Credits
BV-BDCCSL 101	Data Structure and Algorithms Lab	1

Suggested List of Practical/ Experiments:

Practical Number	Practical/ Experiment
1	Implement Stack ADT using an array.
2	Convert an Infix expression to Postfix expression using stack ADT.
3	Evaluate Postfix Expression using Stack ADT.
4	Applications of Stack ADT.
5	Implement Linear Queue ADT using an array.
6	Implement Circular Queue ADT using an array.
7	Implement Priority Queue ADT using array.
8	Implement Stack / Linear Queue ADT using Linked List.
9	Implement Binary Search Tree ADT using Linked List.
10	Implement Graph Traversal techniques :) Depth First Search b) Breadth First Search

Lab Code	Lab Name	Credits
BVBDCCL 102	Computer Network Lab	1

Suggested List of Practical/ Experiments:

Sr. No.	Title of Experiment
1.	Study of RJ45 and CAT6 Cabling and connection using crimping tool.
2.	Use basic networking commands in Linux (ping, tracert, nslookup, netstat, ARP, RARP, ip, ifconfig, dig, route)
3.	Build a simple network topology and configure it for static routing protocol using packet tracer. Setup a network and configure IP addressing, subnetting, masking.
4.	Perform network discovery using discovery tools (eg. Nmap, mrtg)
5.	Use Wire shark to understand the operation of TCP/IP layers: • Ethernet Layer: Frame header, Frame size etc. • Data Link Layer: MAC address, ARP (IP and MAC address binding) • - Network Layer: IP Packet (header, fragmentation), ICMP (Query and Echo) • - Transport Layer: TCP Ports, TCP handshake segments etc. • Application Layer: DHCP, FTP, HTTP header formats

6.	Use simulator (Eg. NS2) to understand functioning of ALOHA, CSMA/CD.
7.	Study and Installation of Network Simulator (NS3)
8.	a. Set up multiple IP addresses on a single LAN. b. Using nestat and route commands of Linux, do the following: • View current routing table • Add and delete routes • Change default gateway c. Perform packet filtering by enabling IP forwarding using IPtables in Linux.
9	Design VPN and Configure RIP/OSPF using Packet tracer.
10.	Socket programming using TCP or UDP
11.	Perform File Transfer and Access using FTP
12.	Perform Remote login using Telnet server

Course Code	Course Name	Credit
BVBDCCSL 103	Operating System Lab	01

Suggested List of Practical/ Experiments:

Sr. No.		Content
1		Explore Linux Commands
	1.1	Explore usage of basic Linux Commands and system calls for file, directory and process management. For eg: (mkdir, chdir, cat, ls, chown, chmod, chgrp, ps etc. System calls: open, read, write, close, getpid, setpid, getuid, getgid, getegid, geteuid. Sort, grep, awk, etc.)
2		Linux shell script
	2.1	Write shell scripts to do the following: a. Display OS version, release number, kernel version b. Display top 10 processes in descending order c. Display processes with highest memory usage. d. Display current logged in user and log name. Display current shell, home directory, operating system type, current path setting, current working directory.
3		Linux- API
	3.1	Implement any one basic commands of linux like ls, cp, mv and others using kernel APIs.
4		Linux- Process
	4.1	a. Create a child process in Linux using the fork system call. From the child process obtain the process ID of both child and parent by using getpid and getppid system call. b. Explore wait and waitpid before termination of process.
5		Process Management: Scheduling

	5.1	a. Write a program to demonstrate the concept of non-preemptive scheduling algorithms. b. Write a program to demonstrate the concept of preemptive scheduling algorithms
6		Process Management: Synchronization
	6.1	a. Write a C program to implement solution of Producer consumer problem through Semaphore
7		Process Management: Deadlock
	7.1	a. Write a program to demonstrate the concept of deadlock avoidance through Banker's Algorithm b. Write a program demonstrate the concept of Dining Philosopher's Problem
8		Memory Management
	8.1	a. Write a program to demonstrate the concept of MVT and MFT memory management techniques b. Write a program to demonstrate the concept of dynamic partitioning placement algorithms i.e. Best Fit, First Fit, Worst-Fit etc.
9		Memory Management: Virtual Memory
	9.1	a. Write a program to demonstrate the concept of demand paging for simulation of Virtual Memory implementation b. Write a program in C demonstrate the concept of page replacement policies for handling page faults eg: FIFO, LRU etc.
10		File Management & I/O Management
	10.1	a. Write a C program to simulate File allocation strategies typically sequential, indexed and linked files b. Write a C program to simulate file organization of multi-level directory structure. c. Write a program in C to do disk scheduling - FCFS, SCAN, C-SCAN

Course Code	Course Name	Credits
BV-BDCCG 201	Business communication Ethics	4

Course Objectives: The course aimed:

- | | |
|---|--|
| 1 | To enhance effective communication and interpersonal skills |
| 2 | To explain / defend his/her ideas to a single person or panel. |
| 3 | To develop creative and impactful presentation skills. |
| 4 | To understand the dynamics of business communication through group communication. required for career enhancement. |
| 5 | To develop analytical and logical skills for problem-solving. |

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

- | | |
|---|---|
| 1 | Prepare effective business/ technical documents apt for managerial roles in social and professional situations. |
| 2 | Deliver effective business and technical presentations. |
| 3 | Develop life skills/interpersonal skills to build a confident personality. |
| 4 | Develop creative thinking and problem solving attitude through group communication |
| 5 | Organize personal and professional skills to build an impressive professional image for internal or external communication. |
| 6 | Apply the trait of a successful professional with a charismatic personality. |

Module	Detailed Contents	Hours
1	Writing Skills (Part -II) A Report & Proposal Writing	7
	1.1 Report Writing : Objectives of Report Writing (on General Topics) Language and Style in a report	
	1.2 Types: Informative and Interpretative (Analytical, Survey and Feasibility) and Formats of reports(Short Report)	
	1.3 Proposal Writing :Short Proposal Writing : Objectives, formats, language style	
2	Writing Skills (Part -II) B Business/ Trade Letters	7
	2.1 Order credit and status Enquiry Letters of inquiry, letter of complaints, Claim & adjustment letter Sales Letter, promotional leaflets and fliers	
3	Presentation Skills	5
	3.1 Technical Presentation Business Presentation n	
4	Introduction to Interpersonal Skills	7
	4.1 Emotional Intelligence,Leadership and Motivation,Team Building,Assertiveness	

		Conflict Resolution and Negotiation Skills, Time Management, Decision Making	
5	Meetings and Documentation		6
	5.1	Need & Importance of meeting, Conduct of meeting, Strategies for conducting effective meetings, Notice, Agenda and Minutes of a meeting, Business meeting etiquettes	
6	Introduction to Business Ethics		7
	6.1	Concept & meaning, Importance of Business Ethics, Business Ethics & Media Computer Ethics, personal integrity at public place	

Books and References:

Sr. No	Publisher
1	Business communication today. Bovée, C. L., & Thill, J. V. NJ: Pearson.
2	Place Mentor, Tests of Aptitude for Placement Readiness. RamArchana Oxford University Press
3	Technical Communication, Principles and Practice. Raman Meenakshi, Sharma Sangeeta Oxford University Press
4	Personal development for life and work. Masters, L. A., Wallace, H. R., & Harwood, L. Mason: South-Western Cengage Learning.

Term Work:

General Instructions:

1	Batch wise tutorial shave 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/problem solving of 10-15 minutes. This will be considered as a mini project in Engineering Mathematics. This project will be graded out of 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows:

1	Attendance (Theory and Tutorial)	05 marks
2	Class Tutorials on entire syllabus	10 marks
3	Mini project	10 marks

Assessment:

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	Question 1, based on the entire syllabus, will have 4 sub-questions of 5 marks each and is compulsory.
4	Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
5	Each sub-question in (4) will be from different modules of the syllabus.
6	Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.

Suggested List of Tutorials:

Sr. No	Topic
1	Report writing Or Proposal Writing (Brief reports on general topics)
2	Letter writing
3	Business Or Technical presentation
4	Public Speaking Activity
5	Role Play & Model Building
6	Meetings Documentation (Notice agenda & minutes writing
7	Case study on business/ corporate ethics
8	Group discussion & Debate

Course Code	Course Name	Credit
BV-BDCCG 202	Probability And Statistics	3

Course Objectives: The Course aimed:

1. To understand some advanced topics of probability, random variables with their expectations and variances.
2. To make the learner able to use different measures of central tendency and dispersion wherever relevant and check the Skewness and Kurtosis of data.
3. To make the learner able to apply the concepts of probability distributions.
4. To make the learner able to apply the concepts of sampling theory for large samples.
5. To make the learner able to apply the concepts of sampling theory for small samples
6. To make learners able to find the correlation between different variables and further apply the regression analysis to find the exact relation between them.

Learning Outcomes:

After successful completion of this course, learners would be able to

1. Understand the concepts of probability and expectation for getting the spread of the data.
2. Analyze Statistical data using measures of central tendency and dispersion.
3. Understand the concepts of distribution of probabilities.
4. Use the concept of sampling theory on large samples.
5. Use the concept of sampling theory on small samples.
6. Apply the concept of Correlation and Regression to the problems in data science, machine learning, and AI.

Module No	Topics	No of Lectures
1	1.1 Definition and basics of probability, Space and Events, conditional probability. 1.2 Total Probability theorem and Bayes' theorem. 1.3 Discrete and continuous random variable with probability distribution and probability density function. 1.4 Expectation and Variance.	9
2	2.1 Measures dispersion: Concept of dispersion, Absolute and Relative, Quartile deviation, Standard deviation, Combined standard deviation. Coefficient of range, Coefficient of quartile deviation and Coefficient of variation (C.V.) 2.2 Moments: Concept of Moments, Raw moments, Central moments, Relation between raw and central moments. 2.3 Measures of Skewness and Kurtosis: Concept of Skewness and Kurtosis, measures based on moments, quartiles.	8

3	3.1 Binomial Distribution, Poisson Distribution and Normal Distribution 3.2 Evaluation of statistical parameters for these three distributions (Distribution functions, Mean and Variance).	8
4	4.1 Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom. Standard Normal Variate, Central Limit Theorem, standard error, Type-I and Type-II errors, estimation, confidence intervals 4.2 Large sample test for single mean, difference of means, and difference of standard deviations.	9
5	5.1 Students' -distribution (Small sample) - Test the significance of mean and difference between the means of two samples. 5.2 Chi-Square Test: Test of goodness of fit and independence of attributes, Contingency table and Yates's correction. 5.3 Analysis of variance: F-test (significant difference between variances of two samples)	9
6	6.1 Measure of Correlation: Scatter diagram and interpretation, Karl Pearson's coefficient of correlation (r) 6.2 Spearman's Rank correlation coefficient (R) (with repeated and Non-repeated ranks). Relation between correlation and regression. 6.3 Lines of regression and multivariable regression. 6.4 Fitting of first- and second-degree curves.	9

Books and References:

1	Fundamentals of Mathematical Statistics, S.C. Gupta & V.K. Kapoor Sultan Chand & CO.
2	Introduction to Probability Theory, G. Hoel, S. C. Port and C. J. Stone Universal BookStall
3	An Introduction to Statistical Learning: with Applications in R by Gareth James, Daniela Witten, Trevor Hastie Springer
4	A textbook of Engineering Mathematics, N.P. Bali and Manish Goyal Laxmi Publications
5	Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Education

Useful Links

<https://nptel.ac.in/courses/111/106/111106112/>

<https://nptel.ac.in/courses/111/105/111105124/>

<https://www.youtube.com/watch?v=L-pQtGm3VS8>

<https://www.youtube.com/watch?v=vN5cNN2-HWE>

List of Tutorials:

Sr. No.	Topic
1	Tutorial on Conditional Probability and Bayes theorem
2	Tutorial on discrete and continuous random variables
3	Tutorial on Central Tendency: Mean, Median, Mode
4	Tutorial on Correlation
5	Tutorial on Regression
6	Tutorial on Curve fitting
7	Tutorial on Sampling theory
8	Tutorial on large sample test for single mean and difference of means
9	Tutorial on large sample test for difference of standard deviations
10	Tutorial on small sample test for single mean and difference of means
11	Tutorial on large sample test for difference of standard deviations
12	Tutorial on Chi-Square Test
13	Tutorial on F-test

Course Code:	Course Title	Credit
BV-BDCCG 203	Introduction to Data Science	4

Course Objectives: The course aimed:

1. To build the fundamentals of data science.
2. To build a classification model and interpret results
3. To learn the intricacies of logistic regression, evaluate its outputs, and comprehend how a link function works
4. To handle a data set to produce a specified set of results

Course Outcome:

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

1. To be able to calculate probabilities for continuous and discrete random variables.
2. To understand the basics of statistics.
3. To understand Bivariate statistics
4. To understand theory of sampling
5. To understand Test of significance
6. To understand Paired test, chi-square test for goodness of fit.

Module No.	<u>Detailed Contents</u>	Hrs
1	Basic Probability Probability spaces, conditional probability, independence, Bayes theorem, Discrete random variables, Independent random variables, sums of independent random variables; Expectation of Discrete and Continuous Random Variables, Moments, Variance of a sum	8
2	Basic Statistics	8

	Measures of Central tendency, Moments, skewness and Kurtosis, Binomial, Poisson and Normal distribution and evaluation of statistical parameters for these three distributions (Distribution functions, Mean and Variance).	
3	Bivariate Statistics Correlation and Regression – Concepts of Correlation, Coefficient of Correlation, Rank correlation, Regression Analysis - linear & multivariable regression, Curve fitting by the method of least squares-fitting of straight lines, second degree polynomials	10
4	Sampling Theory Introduction to sampling distributions, Standard Normal Variate, Central Limit Theorem, standard error, Type-I and Type-II errors, estimation, confidence intervals	7
5	Applied Statistics -I Test of significance: Large sample test for single mean, difference of means, and difference of standard deviations, Small samples test for single mean, difference of means	8
6	Applied Statistics – II Paired t-test, Chi-square test for goodness of fit and independence of attributes, Test for ratio of variances	5

Books and References:

1	Fundamentals of Mathematical Statistics, S.C. Gupta & V.K. Kapoor, Sultan Chand & Co
2	Introduction to Probability Theory, P. G. Hoel, S. C. Port and C. J. Stone, Universal BookStall
3	An Introduction to Statistical Learning: with Applications in R, Gareth, James, Daniela Witten, Trevor Hastie, Springer
4	A First Course in Probability, S. Ross, Pearson Education India

Useful Links:

Sr.No.	URL
1	https://www.statisticssolutions.com/continuous-probability-distribution/
2	https://nptel.ac.in/courses/111106112
3	https://nptel.ac.in/courses/111105124

4	https://www.youtube.com/watch?v=L-pQtGm3VS8 https://www.youtube.com/watch?v=vN5cNN2-HWE
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Course Code:	Course Title	Credit
BV-BDCCS 201	ADVANCED OPERATING SYSTEMS	04
Course Objectives: The course aimed: 1. To understand the Operating System & their functions. 2. To understand the working of a distributed Operating System. 3. To study various Operating System as Microprocessor , RTOS , database , Mobile. Course Outcome: On successful completion, of course, learner/student will be able to: 1. Learn functions of operating system. 2. Understand distributed operating systems and their architecture. 3. Student will implement scheduling algorithm of microprocessor operating systems. 4. Understand Real time operating systems and various algorithm. 5. Understand Database operating systems and various algorithm. 6. Understand the implementation of mobile operating system on android platform.		

Module	Detailed content	Hours
1	Introduction Functions of operating systems, Design approaches: layered ,kernel based and virtual machine approach, why advanced operating systems, types of advanced operating systems	4
2	Distributed Operating Systems Architecture of distributed operating systems, system architecture types, issues in distributed operating systems, inherent limitation of distribute	8

	systems, distributed mutual exclusion: classification of mutual exclusion algorithms, Lamport's token based algorithm, Suzuki-Kasami's Broadcast algorithm, Raymond's Tree based algorithm, Distributed deadlock detection, Distributed file systems, Distributed shared memory, Distributed scheduling	
3	Multiprocessor Operating Systems Introduction, structure of multiprocessor operating system, operating system design issues, threads, the test and set instruction, the swap instruction, implementation of the process wait, processor scheduling, reliability and fault tolerance.	6
4	Real Time Operating System Introduction to Real time systems and Real Time Operating Systems, Characteristics of Real Time operating Systems, Classification of Real Time Operating Systems, Services, structure, goal and feature of RTOS, architecture of RTOS, micro kernels and monolithic kernels, tasks in RTOS, Performance measures, estimating program runtimes, task assignment, scheduling in RTOS, rate monotonic scheduling, priority inversion, task management, inter task communication, applications of various RTOS.	10
5	Database operating Systems Introduction to database operating systems, concurrency control: theoretical aspect, distributed database system, concurrency control algorithms	6
6	Mobile Operating System Symbian O.S.: introduction, kernel design in Symbian OS, scheduling in Symbian OS, File systems on mobile phones, I/O in Symbian OS, Application development using Android. Introduction to cloud OS.	6

Books and References:

1	M Singhal and NG Sivaratri, Advanced Concepts in Operating Systems, Tata McGraw Hill Inc., 2001
2	A.S. Tanenbaum, Distributed Operating system, Pearson Education Asia, 2001.
3	A.S. Tanenbaum, Modern Operating system, Prentice Hall, 3 rd edition.
4	Real Time Operating System, Barr M.
5	Real-Time Systems, Jane Liu, Pearson Ed. Asia
6	Real -Time Systems, Krishna and Shin, McGraw Hill International.
7	Smart phone operating system concepts with Symbian O.S. A tutorial guide by Michael J.Jipping. Symbian Press, Wiley.
8	Application development using Android, Hello, Android, mobile development platform 3 rd Edition by Ed Burnette

9	SILBERSCHATZ and P. GALVIN, Operating System Concepts, VI edition , Addison Wesley 2004.

SUGGESTED LABORATORY EXERCISES:

Case studies on Open source software, LINUX, Open SOLARIS, PalmOS, Symbian OS, Mach OS, Android OS, Linux For Mobile Devices, various RTOS.

Course Code	Course Name	Credit
BV-BDCCS 202	Introduction to Cloud Computing	4

Course Objectives: The course aimed:	
1	To Understand the fundamentals of cloud computing
2	To Understand the concept of Cloud models
3	To introduce various types of cloud services
4	To Appreciate the importance of virtualization of cloud
5	To understand security aspects of cloud
6	To understand advances of cloud computing
Course Outcomes: On successful completion, of course, learner/student will be able to:	
1	Explain fundamentals of cloud computing
2	Explain the concept of various cloud models
3	Interpret various cloud computing services
4	Interpret the significance of virtualization in the context of cloud
5	Interpret security aspects of cloud
6	Explain advances in cloud computing in terms of multimedia, Fog and Edge computing and their applications in the real world

Module No.	<u>Detailed Contents</u>	

1	Introduction to Cloud Computing	6
	Evolution of cloud, Essentials, Cloud Computing definition, Benefits and Challenges, Limitations, Usage and Applications, Business Models around Cloud Computing, Characteristics, Cloud Adoption	
2	Cloud models	10
	Introduction, Collaboration to cloud, Cloud Models, Cloud Applications and Architecture, Cloud Computing Architecture, Cloud Infrastructure Models, Cloud Infrastructure Self Service, Scaling a cloud infrastructure	
3	Cloud services	10
	Introduction to Services, Storage as a Service, Database as a Service, Information as Service, Process as a Service, Application as a Service, Management/Governance as Service, Platform as a Service, Security as a Service, Testing as Service, Integration as Service, Infrastructure as Service	
4	Virtualization for cloud	7
	Introduction, Pros and Cons of Virtualization, Virtualization Architecture, Virtualization Machine, Virtualization in Clusters/Grid Context, Virtual Network, Types of Virtualization, Virtual Machine Monitor, Virtual Desktop Infrastructure	
5	Cloud security	6
	Host security for SaaS, IaaS and PaaS, Data Security, Data confidentiality and Encryption – Data Availability- Data integrity, Cloud storage gateway, Cloud Firewall. AAA model, SSO model for cloud, Authentication, Authorization and Accounting for cloud.	
6	Cloud Application	6
	Cloud computing application: Cloud computing for healthcare, Education, transportation, Manufacturing. Multimedia Cloud- Streaming protocols Case studies- Fog computing, Edge computing, Video streaming app and video Transcoding app.	

Books & References:

1	Cloud Computing - A Hands-on Approach Arshdeep Bahga and Vijay K. Madisetti Universities Press
2	Mastering Cloud Computing: Foundations and Applications Programming, Rajkumar Buyya, Christian, Vecchiola. S.Thamarai Selvi, Morgan Kaufmann
3	Amazon Web Services For Dummies, Bernard Golden, John Wiley & Sons
4	The Cloud Computing Book: The Future of Computing Explained, Douglas E. Comer, Taylor and Francis group
5	Cloud Computing Black Book, Kailash Jayaswal, Jagannath Kallakurchi. Donald J. Houde. Dr. Deven Shah, Dreamtech Press

Useful Links

1	https://aws.amazon.com/whitepapers/
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2	https://azuremicrosoft.com/en-in/resources/whitepapers
3	https://cloud.google.com/whitepaper

Course Code:	Course Title	Credit
BV-BDCCS 203	Software Engineering	4

Course Objectives: The course aimed:	
1	To provide the knowledge of software engineering discipline.
2	To apply analysis, design and testing principles to software project development.
3	To demonstrate and evaluate real world software projects.
Course Outcomes: On successful completion, of course, learner/student will be able to:	
1	Identify requirements & assess the process models.
2	Plan, schedule and track the progress of the projects.
3	Design the software projects.
4	Do testing of software project.
5	Identify risks, manage the change to assure quality in software projects.

Module		Detailed Content	Hrs
1		Introduction To Software Engineering and Process Models	7
	1.1	Software Engineering-process framework, the Capability Maturity Model(CMM), Advanced Trends in Software Engineering	

	1.2	Prescriptive Process Models: The Waterfall, Incremental Process Models, Evolutionary Process Models: RAD & Spiral	
	1.3	Agile process model: Extreme Programming (XP), Scrum, Kanban	
2		Software Requirements Analysis and Modeling	4
	2.1	Requirement Engineering, Requirement Modeling, Data flow diagram, Scenario based model	
	2.2	Software Requirement Specification document format(IEEE)	
3		Software Estimation Metrics	7
	3.1	Software Metrics, Software Project Estimation (LOC, FP, COCOMO II)	
	3.2	Project Scheduling & Tracking	
4		Software Design	7
	4.1	Design Principles & Concepts	
	4.2	Effective Modular Design, Cohesion and Coupling, Architectural design	
5		Software Testing	7
	5.1	Unit testing, Integration testing, Validation testing, System testing	
	5.2	Testing Techniques, white-box testing: Basis path, Control structure testing black-box testing: Graph based, Equivalence, Boundary Value	
	5.3	Types of Software Maintenance, Re-Engineering, Reverse Engineering	
6		Software Configuration Management, Quality Assurance and Maintenance	7
	6.1	Risk Analysis & Management: Risk Mitigation, Monitoring and Management Plan (RMMM).	
	6.2	Quality Concepts and Software Quality assurance Metrics, Formal Technical Reviews, Software Reliability	
	6.3	The Software Configuration Management (SCM) , Version Control and Change Control	
<u>Books & References</u>			
1	Roger Pressman, “ Software Engineering: A Practitioner’s Approach ”, 9 th edition , McGraw-Hill Publications, 2019		
2	Ian Sommerville, “ Software Engineering ”, 9 th edition, Pearson Education, 2011		
3	Ali Behfroz and Fredeick J. Hudson, “ Software Engineering Fundamentals ”, Oxford University Press, 1997		
4	Grady Booch, James Rumbaugh, Ivar Jacobson, “ The unified modeling language user guide ”, 2 nd edition, Pearson Education, 2005		
5	Pankaj Jalote, “ An integrated approach to Software Engineering ”, 3 rd edition, Springer, 2005		
6	Rajib Mall, “ Fundamentals of Software Engineering ”, 5 th edition, Prentice Hall India, 2014		
7	Jibitesh Mishra and Ashok Mohanty, “ Software Engineering ”, Pearson , 2011		
8	Ugrasen Suman, “ Software Engineering – Concepts and Practices ”, Cengage Learning, 2013		
9	Waman S Jawadekar, “ Software Engineering principles and practice ”, McGraw Hill Education, 2004		

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 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	Only Four questions need to be solved.
4	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://nptel.ac.in/courses/106/105/106105182/
2	https://onlinecourses.nptel.ac.in/noc19_cs69/preview
3	https://www.mooc-list.com/course/software-engineering-introduction-edx

Lab Code	Lab Name	Credit
BV-BDCCG 203	Introduction to Data Science Lab	1

Suggested List of Practical/ Experiments:

Practical Number	Practical/ Experiment Topic
1	Implement conditional probability and Bayes theorem
2	Perform experiment to plot probabilities for continuous and discrete random variable
3	Perform experiment to measure central tendency of a dataset
4	Perform experiment to measure dispersion of a dataset
5	Perform experiment to calculate correlation between variables
6	Implement Regression
7	Implement curve fitting optimization using SciPy package
8	Implement Sampling distributions
9	Implement Statistical Significance tests
10	1. Statistical analysis of Criminal offenses 1999- 2007 2. Regression analysis on National income 1998- 2003 3. Statistical analysis of student expenditure 4. Infant Mortality rate analysis 1995-2004 5. Cash deposit pattern analysis in commercial banks 6. Analysis of coal 7. Financial statement analysis to aid meaningful investment decision making 8. Cluster analysis on effect of dollar increment on economy 9. Regression analysis on hours spent on internet and time spent to study on academic performance of students

Course Code	Course Name	Credit
BVBDCCS 201	Advanced Operating System Lab	01

Suggested List of Practical/ Experiments:

Sr. No.	Content
1	Atleast one Experiment using Unix commands
2	Experiment using linux shell script
3	Experiment based on Distributed scheduling algorithm
4	Experiment based on Distributed operating system
5	Experiment based on Mobile operating system

Lab Code	Lab Name	Credit
BV-BDCCS 202	Introduction to Cloud Computing Lab	1

Suggested List of Practical/ Experiments:-

Practical Number	Practical/ Experiment
1	Study and implementation of infrastructure as a service
2	Installation and Configuration of virtual machine
3	Study and implementation of Storage as a Service
4	Study and implementation of identity management
5	Study Cloud Security management
6	Write a program for web feed
7	Study and implementation of Single-Sign-On
8	Case study on Amazon EC2/Microsoft Azure/Google Cloud Platform

Lab Code	Lab Name	Credit
BV-BDCCS 203	Software Engineering Lab	1

Suggested List of Experiments - Assign the case study/project as detail statement of problem to a group of two/three students. Laboratory work will be based on course syllabus with minimum 10 experiments. Open source computer-aided software engineering (CASE) tools can be used for performing the experiment.

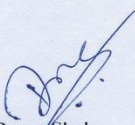
Sr. No.	Title of Experiment
1	Application of at least two traditional process models.
2	Application of the Agile process models.
3	Preparation of software requirement specification (SRS) document in IEEE format.
4	Structured data flow analysis.
5	Use of metrics to estimate the cost.
6	Scheduling & tracking of the project.
7	Write test cases for black box testing.
8	Write test cases for white box testing.
9	Preparation of Risk Mitigation, Monitoring and Management Plan (RMMM).
10	Version controlling of the project.

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 of CSC502 and CSL501 syllabus
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6-13/19

Appendix B

Justification for
B.Voc. (Big Database and Cloud Computing)

1.	Necessity for starting the course:	As per government mandate skill based course need to be promoted.
2.	Whether the UGC has recommended the course:	AICTE has recommended skill based course to be promoted on higher and technical institute to support vikshit bharat 2047,
3.	Whether all the courses have commenced from the academic year 2023-24	yes
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?:	Course start by Affiliated college.
5.	To give details regarding the duration of the Course and is it possible to compress the course?:	3 years no compress is not possible.
6.	The intake capacity of each course and no. of admissions given in the current academic year:	0
7.	Opportunities of Employability / Employment available after undertaking these courses:	The skill based course on ICT infrastructure and hence opportunity of employability is very high.


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